# ICCAT ATLANTIC-WIDE RESEARCH PROGRAMME FOR BLUEFIN TUNA (GBYP). ACTIVITY REPORT FOR THE FIRST PART OF PHASE 4 (2013-2014)

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*SUMMARY*

*The Atlantic-wide research programme on bluefin tuna (GBYP) officially begun on October 2009. The fourth phase of GBYP activities began in March 2013 and was extended up to 9 December 2014, including (a) continuation of data mining, recovery and elaboration, (b) biological and genetic sampling and analyses, (c) tagging, including awareness and rewarding campaign, (d) aerial survey on bluefin spawning aggregations and (e) further steps of the modelling approaches. The extension period was used for improving few activities, due to the budget restrictions. A very impressive amount of data was recovered in the first four phases, covering a period from 1509 to 2009, all available for the normal ICCAT procedure and officially presented to ICCAT meeting on BFT data and then to SCRS in 2013. The conventional tag seeding in these first trials was quite successful and the recovery is improving. The miniPATs implanted since 2011 provided very interesting result, which open new perspectives in our understanding of bluefin tuna behaviour, but now tagging should be extended to the eastern Mediterranean. The large participations of scientific institutions to the biological and genetic studies are also providing some interesting preliminary results, but more effort is needed for having all the analyses pursued; anyway, it seems that the eastern Mediterranean population is quite detectable. In terms of modelling, the GBYP initially focused on risk analysis to identify the main perceived sources of uncertainty related to assessment and advice, then other preliminary studies were carried out and now, after the meeting in Gloucester in 2013, the work for developing new approaches for a more focused management finally started.*

*RÉSUMÉ*

*Le Programme de recherche de l'ICCAT sur le thon rouge englobant tout l'Atlantique (GBYP) a commencé officiellement ses activités en octobre 2009. La quatrième phase des activités du GBYP a démarré au mois de mai 2013 et a été prolongée jusqu'au 9 décembre 2014, comprenant (a) la poursuite de l'exploration, récupération et élaboration des données ; (b) l'échantillonnage et les analyses biologiques et génétiques ; (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. La période d'extension a servi à améliorer quelques activités, en raison des restrictions budgétaires. Un volume très impressionnant de données a été récupéré dans les quatre premières phases, couvrant une période s'étirant de 1509 à 2009 et ces données sont désormais disponibles pour la procédure normale de l'ICCAT et ont été officiellement présentées à la réunion de l'ICCAT sur les données relatives au thon rouge et ensuite au SCRS en 2013. L'implantation des marques conventionnelles au cours de ces premiers essais a été assez fructueuse et la récupération est en voie d'amélioration. Les mini PAT, implantées depuis 2011, ont fourni des résultats très intéressants, qui ouvrent de nouvelles perspectives dans notre compréhension du comportement du thon rouge ; mais, le marquage devrait maintenant s'étendre à la Méditerranée orientale. La forte participation des institutions scientifiques aux études biologiques et génétiques fournit également des résultats préliminaires intéressants, mais des efforts restent à faire pour que toutes les analyses soient réalisées ; il semblerait toutefois que la population de la Méditerranée orientale puisse être clairement détectée. En ce qui concerne la modélisation, le GBYP s'est concentré dans un premier temps sur l'analyse des risques visant à identifier les principales sources d'incertitude perçues se rapportant à l'évaluation et à l'avis. D'autres études préliminaires ont été menées et, à l'issue de la réunion tenue à Gloucester en 2013, les travaux d'élaboration de nouvelles approches en vue d'une gestion plus ciblée ont finalement démarré.*

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*RESUMEN*

*El Programa de investigación sobre atún rojo para todo el Atlántico (GBYP) comenzó oficialmente en octubre de 2009. La cuarta fase de las actividades del GBYP comenzó en marzo de 2013 y duró hasta el 9 de diciembre de 2014. Esta fase incluyó a) una continuación de la minería, recuperación y elaboración de datos; b) el muestreo biológico y genético y análisis; c) la continuación del marcado convencional 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. El periodo de ampliación se utilizó para mejorar varias actividades debido a las restricciones presupuestarias. En las cuatro primeras fases se recuperó una cantidad impresionante de datos, que cubrían un periodo desde 1509 hasta 2009, y estos datos están ahora disponibles para el procedimiento normal de ICCAT y se presentaron oficialmente a la reunión de ICCAT sobre datos de atún rojo y posteriormente al SCRS en 2013. Los experimentos de detección y comunicación de marcas convencionales en estos primeros ensayos tuvieron bastante éxito y la recuperación está mejorando. Las miniPAT implantadas desde 2011 proporcionaron resultados muy interesantes, que abren nuevas perspectivas en nuestra comprensión del comportamiento del atún rojo, pero ahora el marcado debería ampliarse al Mediterráneo oriental. La amplia participación de instituciones científicas en los estudios genéticos y biológicos está produciendo también algunos resultados preliminares interesantes, pero son necesarios más esfuerzos para finalizar todos los análisis. De cualquier forma, parece que la población del Mediterráneo oriental es bastante detectable. En términos de modelacion, el GBYP se centró inicialmente en los análisis de riesgo para identificar las principales fuentes percibidas de incertidumbre relacionadas con la evaluación y el asesoramiento, posteriormente se llevaron a cabo otros estudios preliminares y ahora, tras la reunión de Gloucester de 2013, ha empezado finalmente el trabajo para desarrollar nuevos enfoques para una ordenación más dirigida.*

*KEYWORDS*

*Bluefin tuna, ICCAT, Historical data, Market data, Biological analyses, Tagging, Genetics, Maturity, Microchemistry, Aerial survey, Modelling, Mediterranean Sea, Atlantic Ocean*

## 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 Phases. 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 has a total budget of 2,875,000 Euros (against the original approved figure of 5,195,000 Euros). The overall GBYP operating budget for the first three phases (a total of 4,742,086 Euro) is about 46.84% of what was supposed to be (10,125,000 Euro). If we include the fourth Phase (estimating the full budget as used), then the total of the first four Phases reaches 7,491,086 (against the original figure of 15,320,000 euro), equal to about 48.9% of what was decided by the Commission. These budget reductions had an impact on all activities carried out so far.

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 joined the funders in Phase 3 and 4, but some of them did not paid their contribution, even limiting the use of available funds, because the EU has a maximum percentage of contribution of 80%. Several private or public entities[2] provided funds or in kind support.

[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), IEO–Fuengirola (SP); INRH –Tangier (MO), Maromadraba SARL and Es Sahel

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.

The fourth phase (about 18 months) 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 23 months.

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.

A first report of the GBYP activities in Phase 4 up to September 2013 was provided by Di Natale *et al*. (2015).

## 1. Coordination activities

In the first part of the Programme, the staff was composed by the GBYP Coordinator, the Coordinator assistant and one contracted technician for data management. In the second part of Phase 4, because of budget constraints, the staff was reduced to the Coordinator only. The ICCAT Secretariat provided the necessary support for the GBYP activities.

A total of 33 reports were produced in the framework of ICCAT GBYP in Phase 4 so far, without considering all interim reports produced before the final one was provided. Several additional documents and reports have been also provided by GBYP for the needs of the Steering Committee for its meetings. A total of 45 scientific papers have been produced so far in Phase 4 (**Annex I**).

A total of 9 Calls for Tenders were issued so far in Phase 4, providing 23 contracts up to September 2014 (**Annex II**). In total, the number of contracts provided by GBYP in the first 4 Phases is 69, including 82 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 17 meetings in various countries in Phase 4, up to September 2014 (**Annex III**).

The administrative and desk work behind these duties was quite important 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.

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 CPC 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. The GBYP assisted the ICCAT Secretariat and the SCRS in organising three outside meetings: two in Tenerife (SP) in May and one in Gloucester (US) in July. All these efforts and the heavy workload behind have been compensated by the results of the various activities.

In the first part of Phase 4, the GBYP Coordination was also in charge of assisting the scientists carrying out the mid-term review of the ICCAT-GBYP, providing all necessary support and all documents.

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 and 2014.

In conformity with the Atlantic-Wide Bluefin Research Programme (GBYP) adopted by the SCRS and the Commission for Phase 3, the following research initiatives have been conducted or initiated (see also Annex II).

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(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.

## 2. Data mining and data recovery (Phase 4)

### *2.1 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 currently 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 a better understanding and for improving our knowledge about Atlantic bluefin tuna.

So far, the GBYP objectives set for data recovery and data mining in these four Phases have been largely accomplished.

### *2.2 Data recovery in Phase 4*

The objective which was set for data recovery and data mining in Phase 4 has been accomplished, even if formally the report will be provided in September, after the SCRS meeting. Partial reports, up to September 2013, were provided by Justel-Rubio *et al.* (2014), Di Natale *et al*. (2014a), Justel-Rubio *et al*. (2014), Örenc (2014) and Di Natale and Idrissi (2014). Following the recommendations of the Steering Committee, the objective for Phase 4 was set again focused on the Ottoman data, because additional data from the Eastern Mediterranean Sea, the Marmara Sea and the Black Sea are considered of basic importance for understanding the evolution of both the bluefin tuna population and fisheries. Due to the very peculiar difficulties included in this data mining activity, it was decided to have a meeting with the team of scientists who conducted the first part of the exploratory work in Phase 3 before issuing a Call for Tenders. The meeting took place in Istanbul in April 2013, also attended by Dr. Saadet Karakulak, and all problems and possibilities were deeply analysed. As a result of this important operational meeting, it was decided to suspend the data mining activities in Turkey, until real possibilities of finding historical data will be detected. The frank and very professional cooperation of the Turkish team was very useful for adopting the right decision.

Then, after taking into account the initial data mining and data recovery objectives set by the Commission when the GBYP was established and the additional and new information provided to GBYP by some scientists, concerning the opportunities for recovering or mining various data sets, it was issued the ICCAT-GBYP Call for Tenders 06/2013, targeting detailed fishery and size frequency data from NW Atlantic and historical genetic data from the Eastern Mediterranean. Two bids were received but then one offer was not finalised for local difficulties of the tender. As a matter of fact, the objectives were re-conducted to the original one and a contract was issued for recovering ancient genetic data from samples collected at the beginning of the XX century in the central-eastern Mediterranean and in the Marmara Sea. The samples were recovered and the genetic analyses will be presented at the SCRS in September 2014.

Furthermore, following the recommendation of the GBYP Steering Committee and the SCRS BFT Species Group, GBYP carried out a difficult work for setting a team able to analyse the many trade and auctions data provided as a gift in kind to GBYP in Phase 3. Finally, after many discussions and negotiations, a contract was provided to an external expert who analysed in details all the many data sets, following very carefully all the instructions provided by the TORs and the result of this huge work was presented at the SCRS BFT Data Preparatory Meeting in May (Mielgo-Bregazzi, 2015). Two important sets of data were selected as “reliable”, while a third set would need additional efforts, particularly for cross-checking the data with the BCD. The SCRS BFTDPM had acknowledged the quantity and quality of the work carried out on the trade, auction and market data, setting further provision for their official incorporation in the SCRS data base.

In addition to the activities already planned, many historical data on tuna traps were donated to Ph.D. Jean-Marc Fromentin (IFREMER) to ICCAT GBYP. These data were provided on an excel file, having 10 spreadsheets. The data cover the period 1525-2000; they include 25 traps from several countries, concerning 1,569,939 bluefin and an undefined amount of tons. Several of these data, obtained during the ICCAT GBYP data mining activities, have been already included in the ICCAT BFT data base and, for this reason, the “new” data need to be carefully checked against the official data base. This work, which was not planned in Phase 4, will be carried out in Phase 5 if a data analyst support will be made available for GBYP.

### *2.3 Bluefin tuna fishery data analyses*

All fishery and size data recovered by ICCAT-GBYP in the first Phases have been deeply quality checked, cross-controlled against the ICCAT BFT data base and analysed, as requested by the GBYP Steering Committee.

The result of this intense and complex work were provided to the ICCAT Bluefin tuna Meeting on Biological Parameters Review (Tenerife, May 2013), specifically charged by SCRS to provide recommendations for the use of data recovered by GBYP. The analyses and the overview of the data have been included in the document Di Natale *et al.* 2014a. The summary results showing the total number of data recovered are on **Tables 1 and 2**. The numbers on the two tables do not include the data recently donated to ICCAT GBYP, mentioned in the last paragraph of the previous point 3.2.

Many GBYP data sets were directly used by the various small WG established during this Meeting. The final recommendations by the Tenerife Meeting (see the final Report on http://www.iccat.int/Documents/Meetings/Docs/2013-BFT_BIO_ENG.pdf ) are the followings:

a) For the Task II size data the Group considered that the methods used to validate those data have been appropriate and agreed to incorporate these data to the ICCAT data bases.

b) As regards Task II catch and effort series that fill gaps in ICCAT current data base, once the quality checking is passed, be incorporated in the ICCAT data base.

c) Regarding Task II catch and effort series recovered under the GBYP that overlap, scientists from the involved CPCs will work in collaboration with the Secretariat in order to solve the problem. Those corrections will be submitted to the next BFT Species Group for approval by the SCRS.

d) Regarding Task II catch and effort series that overlap with those already in ICCAT database, scientists from the involved CPCs will work in collaboration with the Secretariat in order to solve the problem. Those corrections will be submitted to the next BFT Species Group for approval by the SCRS.

The action recommended in point a) has been already successfully completed and then the data will be finally officially incorporated in the ICCAT BFT Data Base. For action recommended in point b), overlapping and conflicts were fully identified and finally resolved, all other catch and effort data will be directly incorporated in the ICCAT BFT Data Base. For the actions recommended in points c) and d), the GBYP and the Secretariat worked with the Statistical Correspondents and the national scientists of each CPC concerned; overlapping and conflicts were fully identified and finally resolved (as communicated to the SCRS Data Preparatory Meeting on May 2014). Catch/effort data for the period prior to 1950 were added to the ICCAT BFT data base.

The analysis work carried out by GBYP concerned also Task I data recovered by the Programme. These data were cross-checked against the data already existing in the ICCAT Task I BFT data base and the results are in Justel-Rubio *et al*. (2014). A few conflicts were noticed and these were further discussed according to the procedures in place. All other GBYP catch data including those for the period prior to 1950 were added to the ICCAT BFT Task I data base.

### *2.4 Trade, auction and marked data validation*

One of the objective set for Phase 4 was the validation of the several data sets including millions of trade, auction and market data, which were provide as in-kind donation to GBYP in previous Phases. These data were deeply discussed by the SCRS BFT Species Group and a strategy was recommended. The GBYP Steering Committee elaborated very detailed terms of reference that were largely discussed with the interested parties. Besides all many efforts and commitments, the contradictory validation was not possible and, in agreement with the Steering Committee, the validation was carried out by an external expert. The first overview of the analyses was presented to ICCAT on 27 April 2014, some comments were provided to the expert and then the draft report was reviewed, taking all comments into account. The final report about this validation work was presented to the SCRS Data Preparatory meeting in May 2014 (the data recovered are included in **Table 1** and **Table 2**). Many data were considered fully reliable and then fully validated, while other were selected and identified for additional validation against statistical documents and BCDs, a work which needs much additional time and efforts, with the strict cooperation of the CPCs concerned, national experts and the ICCAT Secretariat. The SCRS Data Preparatory meeting "recommended the creation of a group of experts (to be established by the Group rapporteurs, the Secretariat and the GBYP coordinator during the September species group meeting) to review and fully validate the trade data compiled and presented in Mielgo-Bregazzi (2015) for use in the 2015 stock assessment. The Group acknowledged the important work of preliminary validation carried out by the external expert contracted by GBYP".

## 3. Aerial Survey on Bluefin Tuna Spawning Aggregations

### *3.1 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 the ICCAT-GBYP, in order to provide fishery-independent trends on the minimum SSB. The original GBYP programme included a total of three surveys over a maximum of three areas, but this was later modified by the Steering Committee and the statistical study revealed that under the best possible conditions a minimum of six surveys will be necessary for detecting a trend. So far, the GBYP objectives initially set for the aerial survey on spawning aggregations in these four Phases have been largely accomplished.

Two surveys on four selected areas have been carried out in GBYP Phase 1 and Phase 2. The aerial survey activity was suspended in Phase 3, 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, and because sufficient funds were not made available.

Piccinetti *et al*. (2013) 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 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 for obtaining useful data for operating model purposes, following the views of the SC (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 new aerial survey in Phase 4.

The GBYP Steering Committee, following the request by various CPCs during the 2013 Commission Meeting, included the extended aerial survey in the recommended research plans of Phase 4, under the condition to have the necessary permits by the various CPCs concerned for operating in their air spaces (FIR) (**Figure 1**). A budget was made available for conducting this survey.

The immediate and detailed information for the SCRS was provided by document Di Natale *et al*. (2014).

### *3.2 The ICCAT-GBYP Revision of the Aerial Survey Design for Phase 4*

Following the recommendation of the GBYP Steering Committee and taking into account the results of the preliminary survey carried out by the ICCAT Executive Secretary for exploring the opportunities of getting the aerial survey permits by the various CPCs and coastal States concerned, it was possible to have the map of the areas on which the 2013 aerial survey was planned (**Figure 2**). This map included only the areas for which ICCAT had received a preliminary declaration of cooperation by the CPC or coastal State concerned. Of course, areas where problems of various types were noticed in spring 2013 were not included in the survey for security reasons.

The design was revised by the same team which made the aerial survey designs in Phase 1 and 2, in order to follow a similar methodology, but 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 areas already surveyed in previous years, having a more dense number of transects, and a new design for the areas never surveyed in previous years, having a less dense number of transects (see: http://www.iccat.int/GBYP/en/asurvey.htm). The design was made with additional tracks, in order to provide opportunities when necessary. At the same time, the team in charge of the design was ready to provide modified tracks in case of any problem or need, and this was very useful during the operative survey.

### *3.3 The ICCAT-GBYP Aerial Survey for Bluefin Tuna Spawning Aggregations in Phase 4*

Four contracts were awarded after the Call for Tenders GBYP 03/2013. A training course for pilots, professional spotters and scientific observers was organised at the ICCAT Secretariat in Madrid, attended by 24 fellows, trained by two external experts (Dr. A. Cañadas and Dr. J.A. Vasquez) and by the GBYP Coordinator.

Once awarded the contracts, the ICCAT Secretariat immediately informed all concerned CPCs and assisted all contractors in all procedures for getting the necessary permits. This work needed a continuous assistance by the GBYP Coordination, because of the many delicate aspects concerned. The permits were not easy to get in many areas, besides of the good will expressed in advance by the CPCs concerned. Libya provided a letter of availability which arrived too late and well after awarding the contracts.

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 F and G, in order to bring all transects concerning the Turkish FIR to a single Company, for allowing the Turkish national observer to carry out his duties; it was also necessary to partly modify some transects in area D, for avoiding some permit problems. Another problem was noticed in area E, due to the impossibility of releasing a flight permit by the Italian authorities to an aircraft registered in US; thanks to the good will and the availability of two Companies, the Italian FIR was then covered by an aircraft belonging to a different Company, for which a sub-contract was specifically authorised by ICCAT-GBYP. The survey was carried out using a total of 7 aircrafts.

Furthermore, the flight permit was never provided by the Algerian authorities, besides of the many interventions of the ICCAT Executive Secretary, the GBYP staff and the efforts made by the Companies. As a consequence, the transects in areas A and B were reduced in length and then it was possible improving the number of surveys in the remaining part of these areas, thanks to additional tracks provided in real time. Strong winds, scarce visibility and military activities have been operative problems that caused the delay for completing the survey within the schedule in some areas. The final survey area is showed on **Figure 3**.

It is important to note that this very extended aerial survey, never tried or made so far by any entity in the Mediterranean Sea, 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 four Companies contracted by ICCAT-GBYP and the team in charge of the survey design.

### *3.4 Elaboration of Aerial Survey Data*

At the end of the survey, each Company provided a report for each area, including the excel forms with the detailed data. A contract for elaborating the 2013 aerial survey data was provided to the same team which carried out the same analysis in previous years. 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. The results of this study are now available on http://www.iccat.int/GBYP/en/asurvey.htm.

The survey revealed that most of the sightings were concentrated very close to the areas initially selected by GBYP for conducting the surveys in 2010 and 2011 (**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. Only very few sightings were made in other areas where spawners usually travel not so close to the surface. The delayed time schedule had consequences in some areas, because the spawning aggregations were found already split in smaller schools. The objectives set for this survey were largely attained.

The logistic of such an extended survey was really 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 415 h, which implied a total length of about 69928 km, but only 28947 km were on transects, Anyway, the survey allowed for the exploring a total surface of 1,558,224 $km^2$.

The main results for the areas surveyed in 2010, 2011 and 2013, with comparative data, are showed on **Table 3**. It is quite evident that the problems for conduting the survey in areas E and G, related to meteorological, permits and logistical problems strongly and negatively affected the results, because spawners had major concentration at the beginning of the season, while the survey was conducted later in the season. The higest increase in presence was in area C (Tyrrhenian Sea) and fishery anecdotical information is confirming this situation. The presence of some extremely large schools was noticed both in the Balearic Sea and in the Tyrrhenian Sea.

Additional quantities of bluefin tuna were detected in the areas where the extended survey was carried out in 2013 (called “outside” areas) and these are showed on **Table 4**, along with the quantities reported for the “inside” areas. It is very clear that the increase in number of detected schools noticed in 2013 is not corresponding to an increase in quantities (both tons and animals): this is the clear effect of the late survey in some areas, where large schools of spawners disaggregated in smaller schools, somebody leaving the upper strata of the sea for starting their post-spawning movements and migrations. It is extremely important to bear in mind these facts, caused by various logistic constraints, for better understanding the results of the 2013 aerial survey. Clearly, these are the “normal” risks when carrying out an extended survey with limited resources and with a short preliminary advice.

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

a) The methodology for the survey design applied in 2010, 2011 and 2013 (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) as the effort outside only serves to spread out effort and resources over areas with basically very small or no density of spawning bluefin tuna. The 2013 survey has been useful to prove that the previously surveyed spawning areas remain the important areas to be surveyed in the future.
c) It would be interesting, though, to repeat a whole basin wide survey from time to time (i.e.: every decade) 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.
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.
e) Extend the G-inside sub-area slightly to the west on the north of Cyprus to cover the small area detected with high concentration of bluefin tuna for future surveys; extend the northern border of the C-inside subarea slightly as there was a concentration of off-effort sightings right outside this sub-area; possibly slightly extend the E-inside east boundary.
f) Allocate more effort to future surveys, allowing for more passages and for the CV reduction.
g) Possibly carry out the annual surveys continuously, 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 allows for and increasing quality of the results and for getting more reliable trends.

## 4. 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*. (2015).

### *4.1 Objectives*

The specific objectives of the GBYP tagging activity on the medium term are:

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[3].
b) Estimate the natural mortality rates (M) of bluefin tuna populations by age or age-groups and/or total mortality (Z).
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.
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, internal archival tags and PIT 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, with a total budget of 9,765,000 euro; the mandatory tag awareness and rewarding campaigns were not included. So far, with only 33.14% of the funds, GBYP deployed 80.26% of the conventional tags and 51.67% of the electronic tags; furthermore, the awareness and rewarding campaigns were included in the activity. It is very clear that the general objectives sets for the tagging activities in these first four Phases were largely accomplished so far.

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

For Phase 4, the GBYP Steering Committee recommended to extend conventional tagging to BFT adults in some areas, particularly in north-west African coast (Moroccan traps), in west Mediterranean (Italian traps, Sardinia) and in the Tyrrhenian Sea (Italian Purse seiner), while tagging for bluefin tuna juveniles be limited to Bay of Biscay and Strait of Gibraltar (Spanish bait boats). The first set of reports concerning the tagging activities in Phase 4 (up to 15 September 2013) is available in the Phase 4 folder on http://www.iccat.int/GBYP/en/tagging.htm.

### *4.2 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. In detail, ICCAT-GBYP acquired the followings:

- No. 30000 single barb conventional spaghetti tags
- No. 18000 double-barb small billfish conventional spaghetti tag
- No. 12000 double-barb large billfish conventional spaghetti tag
- No. 2400 applicators for single barb tags
- No. 5273 applicators for double-barb small billfish tag
- No. 5072 applicators for double-barb large billfish tag
- No. 85 mini-PATs pop-up electronic tags
- No. 10 applicators for mini-PATs
- No. 50 internal archival tags

Furthermore, additional tags were made available by other institutions:

a) 35 mini-PATs by WWF-MedPO (implanted in Morocco and in the Mediterranean Sea)
b) 8 mini-PATs by the Stanford University (US) (implanted in Morocco)
c) 8 acoustic tags provided by Stanford University (US) (implanted in Morocco)
d) 5 mini-PATs by the St. Andrews Biological Station (implanted in Canada)
d) 1 mini-PAT by Aquastudio Research Institute (IT).

### *4.3 Tagging activities*

The Steering Committee, in December 2012, adopted a different tagging strategy for Phase 4, keeping the baitboat tagging only in the Bay of Biscay and in the Strait of Gibraltar, while pilot activities were planned in traps for tagging adults (both in Morocco and Sardinia), by purse seine for adults in the Tyrrhenian Sea and by purse-seine and cages in the Adriatic Sea. The contracts were provided to a Spanish Consortium headed by AZTI for the baitboat-based tagging, to an international consortium headed by INRH with the participation of WWF MedPO for the Moroccan traps, to an Italian consortium headed by COMBIOMA for the Sardinian traps, to an Italian consortium headed by UNIMAR for the purse-seine based tagging in the Tyrrhenian Sea and to a Croatian Company, Kali Tuna, for the purse-seine based tagging in the Adriatic Sea. Further tagging activities were carried out on a complimentary base in 2014 by COMBIOMA (Sardinian tuna traps) and in 2013 and 2014 by Oceanis (Malta cages and one Sardinian tuna trap). The updated situation of the tagging activities is showed on **Table 5**.

In total, at the moment, the total number of bluefin tunas tagged so far in all Phases of GBYP are 16631, and a total of 24237 tags of various types have been implanted (**Table 6**).

**Figure 5a** shows the progression of the ICCAT GBYP tagging activities in the various years, clearly showing the yearly improvements. **Figure 5b** shows the percentage distribution of tags implanted in the various geographical areas, up to September 2014.

The ICCAT GBYP electronic tagging with mini-PATs in Phase 4 was carried out on juveniles in the Bay of Biscay and in the Strait of Gibraltar, on juveniles in the Adriatic Sea and on adults in the Moroccan Atlantic. GBYP internal archival tags have been implanted so far in the Bay of Biscay, in the Strait of Gibraltar and in the Adriatic Sea. Most of the results for Phases 2, 3 and for the initial part of Phase 4 have been already provided to SCRS and the Commission in 2012 and 2013. Further results were provided to the Tenerife SCRS Meeting in May 2013 and at the SCRS BFT Data Preparatory Meeting in May 2014.

It is important to note that several premature detachments[4] were noticed for mini-PATs since the beginning; 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 is improving. The full analyses of the detachments will be possibly provided at the end of Phase 4.

The preliminary maps of the mini-PATs deployed by GBYP in the various areas and popped-off in the first part of Phase 4 are on **Figures 6** to **9**. The data from tags which transmitted corrupted data or those staying for less than 10 days at sea are not included in those figures. The most recent data concerning tag pop-off in Phase 4 which have been not processed up to May 2014 will be included in the final report of Phase 4.

Some of the juvenile tunas electronically tagged in the Bay of Biscay are confirming that their movements in the short period are usually much extended, while one specimen showed extensive movements over a longer period of time; other remained in the same area. The juveniles electronically tagged in the Gulf of Lion shows a permanence in the Western Mediterranean Sea; only one specimen moved towards the Southern Mediterranean area, possibly for its first spawning.

Those juveniles and young bluefin tuna electronically tagged in the Strait of Gibraltar had many varieties of movements: some of them remained closer to the Strait of Gibraltar, while others had more extensive movements and some of these latter reached well-known spawning areas.

The adult pre-spawners which were tagged in the Moroccan traps showed a general behaviour very similar to the one noticed in Phase 2 and Phase 3: a considerable percentage of individuals did not entered into the Mediterranean Sea for spawning during the spawning season and remained in Atlantic areas, independently from the tagging technique; this confirms the high interest of getting more data from this area. The preliminary data analyses of some selected tags presented during the Tenerife meeting showed the relevance of this tagging activity either for confirming spawning behaviour evidences or for calculating the time at the surface. This last point is very useful for better calibrating the aerial survey data in future analyses, as it was originally planned.
In 2013, for the first time within the GBYP activities, a first tentative trial of implanting pop-up tags in juveniles in the Adriatic Sea was enforced and the results shows that all fish except one remained in the Adriatic Sea, while one went SE of Malta in January 2014 (**Figure 10**).

It will be particularly important to investigate the behaviour and the origin of the fish going to Moroccan traps before getting there and particularly in the last part of winter and the first part of spring. Anecdotic information collected by GBYP confirms that bluefin tuna is distributed in several parts of the southern Atlantic Ocean, but scientific data are missing for various reasons. The analyses of all mini-PATs released up to the date will be available at the end of Phase 4.

No bluefin tuna, tagged with electronic tags, went to the eastern Mediterranean and this fact, which possibly supports the genetic evidence of a separate subpopulation, needs to be further investigated, possibly carrying out an electronic tagging activity in Turkey in next GBYP Phases.

### *4.4 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 map clearly shows the distribution effort (**Figure 11**). The ICCAT-GBYP web page has the full list of contacts http://www.iccat.int/GBYP/images/mapamunditicks.jpg.

The GBYP staff actively participated every year to the formation of ICCAT ROPs, with a specific focus on tag awareness and tag recovery, but also for having reports of any natural tag in bluefin tuna harvested in farms.

[4] The full analyses will be carried out in next months, because in some cases it is not clear if the premature detachment was a real one or a catch.

Following the Steering Committee recommendation, a Call for tenders was launched and awarded in 2014. The Consortium in charge has the objective to further promote the tag awareness to all stakeholders in the main fishing areas in the eastern Atlantic and the Mediterranean, with a major attention to farms and traps, through direct contacts, promoting also the dissemination of press releases and videos. The field activities will be completed within Phase 4. The basic material was provided to the contractor by GBYP.

Posters are now present in most of the ports where bluefin tuna are usually or potentially 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. The SCRS and the ICCAT Commission were informed about the campaign, while direct information was also provided to the World Congress of Sport Fishing Federations in 2012. Some articles were also promoted and they have been published on newspapers and magazines. According to the first data, this activity is a starting to provide better tag reporting results.

### *4.5 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 first data, this policy (along with the strong tag awareness activity) was very useful for considerably improving the tag reporting.

### *4.6 Tag recovery and tag reporting*

This activity is the final result of the activities listed in points 5.3 and 5.4. For further improving the results, meetings with ICCAT ROPs were organised, 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 ROPs.

The first report of ICCAT-GBYP tag recovery activities was provided by Di Natale *et al*. (2014), while updated data are provided by Di Natale *et al.* 2015. While examining the results of the ICCAT-GBYP tag recovery/reporting activities, it is very important to consider that about 92% 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. Up to the 15th of September 2014, there have been 209 tags recovered as follow:

- 133 Conventional Spaghetti tags
- 50 Conventional Double/Single barb spaghetti (billfish) tags
- 17 External Electronic “mini-PATs” tags
- 5 Internal Electronic “Archival” tags
- 4 Commercial (“trade”) Japanese bluefin tuna tag.

The distribution of tag recovered by area and fishery[5] is showed on **Table 8**, while the first set of data is showed on the maps in **Figures 12** to **15**.

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 41.8 tags per year[6], with 5,429% increase. The year 2013, when tagging activities were carried out in many areas and tag awareness activities were already settled, GBYP recovered a total of 95 tags, about 45.5% of the total over the whole period. It is possible that 2014 recoveries will be at 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 any other area. 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

[5] 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).

[6] Without considering that GBYP initiated its activities in March 2010 and the tag recovery considers only Tags reported before 15 September 2014. The first and the last year were considered as full years.

GBYP tags deployed, the provisional recovery rate is only 0.89%, but this rate is clearly negatively biased by the juvenile ages of more than 92.4% of the tagged fish, and positively biased by the presence of non-GBYP implanted tags. 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 activities in the Eastern Atlantic and in the Mediterranean Sea (purse-seiners/cages and tuna traps) are 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 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 22 tags, of various types (18 spaghetti, 3 billfish, 1 archival). Even considering that most of the recent tagging activities were targeting juveniles, the recovery and reporting rate is unrealistically too low (10.4% of the total). The same considerations can be done for the traps, because only one Spanish tuna trap (Tarifa) and 1 Italian trap (Carloforte) had reported 5 tags to ICCAT within the period taken into account (2 spaghetti, 1 billfish, 2 internal archival). Even in this case, the recovery and reporting rate (2.4% of the total) 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 (25 tags in total, 14 spaghetti, 9 billfish and 2 archival, equal to 11.6% of the total). The possible reasons for the low report rates from these fisheries are detailed by Di Natale *et al.* 2014.

Interesting information is slowly coming from the tunas double tagged (**Table 8**): so far a total of 52 fish were recovered and 44 of them had still both tags on; 5 fish had only the billfish (double-barb) tag on, while 3 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 (96.9%) of the double barb against the single barb ones (94.8%).

During the first part of the ICCAT-GBYP it was also noticed 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. 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. 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)”.

## 5. Biological and Genetic Sampling and Analyses

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_Sampling_Plan_GBYP_2011.pdf.

Some of the activities concerning the biological sampling and analyses have been already preliminary presented to SCRS and the Commission in 2012, while the activities for Phase 3 were presented by Die *et al.* (2014) and SCRS/2013/089. This report includes the preliminary results of Phase 4 activities.

### *5.1 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 the probable sub-populations identification.

### *5.2 Activities*

The activities in previous GBYP Phases have been clearly able to accomplish their objectives (**Table 9**). 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 the sub-population hypothesis, which may require several years of data and many analyses, depending on the available budget.

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[7] and will be officially reported to SCRS in September-October 2014.

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 in Di Natale *et al.* (2014b), Rodriguez-Marin (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 so far (contractual Deliverable no. 3) 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. The late beginning of the activity made impossible the collection of gonad samples in 2013 and this fat was duly taken into account on the planning. Additional technical and logistic problems were noticed by the Consortium, particularly for sampling juveniles in Malta in 2013 and for exporting the samples from Turkey.

Among the most relevant results, the genetic analyses carried out in 2013 and the first part of 2014 are clearly showing and preliminary confirm 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, seem able to better identify at least two sub-populations inside the Mediterranean: one temporarily called “western Mediterranean” (which includes tunas from the western Mediterranean, but the previous results which included also the central Mediterranean and the Adriatic Sea were not confirmed by the last analyses) and the other temporarily called “eastern Mediterranean” (which is possibly generated by the ancient sub-population of bluefin tuna which inhabited the Black Sea and the Marmara Sea up to the ‘70s and which possibly displaced in the Eastern Mediterranean after the ecological crisis of the Black Sea) (as discussed by Di Natale (2015). The more recent provisional results coming from the genetic studies carried out in Phase 4 and using different markers, show a difference between the western Mediterranean samples and the remaining part of the Mediterranean ones, and these last findings shall be further investigated.

Even if further analyses are necessary for confirming and more precisely define the various sub-populations, it is clear that the availability of information from many different sources (aerial survey, environmental data, genetics, microchemistry, etc.) may sometimes contribute in increasing our understanding of the results of other sophisticated analyses.

After the preliminary discrimination between WBFT and EBFT carried out in Phase 2 and 3, and after defining a new baseline, the **microchemical analyses** in Phase 4 were concentrated mostly on Atlantic areas, trying to better define the mixing between the two main stocks. The analyses, carried out on 324 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 latest information, if compared with the analyses concerning the Moroccan samples in the previous Phase, shows an interannual variability of the components, and then a variable mixing rate that should be further followed and investigated. Even if the previous GBYP report discusses in a deeper way this part, in general the microchemical 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 interannual variability of the components (**Figure 16**).

[7] 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.

In Phase 4 the biological activities 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. The first preliminary results are showing that at least one of the parameters (the circularity) varies significantly between regions, but all 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 much broader overview; then, it should be very useful top compare the results of the otolith shape analysis with the genetic and the microchemical ones, thring to find all necessary correlations.

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. Rodriguez Marin (IEO). Finally, 13 institutions from 9 countries were able to provide their reading on time for the elaboration and the results are quite promising. According to this first and important experience, it seems very important to further develop and apply it in future years. The results will be available for SCRS 2014.

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. The idea is to move all samples to the same sample bank used for GBYP samples and then made them available to all SCRS scientists, but other alternative solutions are currently studied, taking into account the logistic and maintenance requirements. According to the latest information, the many samples stored in Charleston will be moved to the NOAA Laboratory in Panama and ICCAT GBYP, together with NOAA will develop a simple procedure for using them.

## 6. Modelling approaches

The ICCAT-GBYP Modelling activities in the first part of 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 of the first two contracts are already available on the ICCAT GBYP web pages (http://www.iccat.int/GBYP/Documents/MODELLING/PHASE%204/Identification%20and%20prioritization%20of%20uncertainties%20for%20management%20of%20Eastern%20Atlantic.pdf and www.iccat.int/GBYP/Documents/MODELLING/PHASE 4/2013_Report for ICCAT-GBYP 04.pdf).

### *6.1 Objectives*

Under the GBYP the modelling programme addresses objective 3:

- Improve assessment models and provision of scientific advice on stock status through improved modelling of key biological processes (including growth and stock-recruitment), further developing stock assessment models including mixing between various areas, and developing and use of biologically realistic operating models for more rigorous management option testing.

In addition, in 2012 the Commission requested the SCRS to conduct a stock assessment in 2015 and to:

a) Develop a new assessment model allowing the inclusion of the last updated knowledge on the biology and ecology of bluefin tuna, in particular life-history parameters, migration patterns, and aiming at identifying and quantifying uncertainties and their consequences on the assessment results and projections.

b) Release a stock status advice and management recommendations, supported by a full stock assessment exercise, based on the new model, additional information and statistical protocols mentioned in points above and on which basis all actions may be adopted and updated by the Commission through the management plan to further support the recovery.

In further addition, the GBYP Steering Committee requested an external report in order to analyse the power to detect population trends that consider additional variance, to obtain data that could be used as fishery independent indices for operating models.

The GBYP activities in the first Phases were consistent with the objectives.
In Phase 4, two meetings were held on modelling approaches: a first one in May 2013 in Tenerife (Spain) for preparing a discussion draft document (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 in July in Gloucester (USA), where a detailed planning of bluefin tuna modeling activities have been agreed for the submission to SCRS (see the report on http://www.iccat.int/Documents/Meetings/Docs/2013_BFT_METHODS_REP_ENG.pdf .

### *6.2 Phases 4 activities for modelling in support of BFT stock assessment*

The first two final reports concerning Modelling approaches in Phase 4 are already available on http://www.iccat.int/GBYP/en/modelling.htm.

#### *6.2.1 Risk analysis*

The objectives of this work package are to identify the main sources of uncertainty related to stock assessment and management. The risk analysis conducted under Phase 2 identified the main sources of uncertainties of concern to members of the SCRS; under Phase 3 this work was extended to managers. In Phase 4 the risk analysis was quantitatively modelled using the initial qualitative work carried out during Phase 3. The development of such a quantitative risk analysis was to evaluate the relative importance of the different sources of uncertainty, in particular in helping to design scenarios used in the management strategy evaluation of the alternative management procedures with respect to meeting management objectives.

The GBYP Bluefin tuna rebuilding plan uses stochastic projections that do not capture all the uncertainty associated with stock assessment/ management variables. This could mean that the outcomes predicted by the projections are more optimistic or pessimistic than those that will be achieved in practice. A methodology was sought to capture stakeholder perceptions of particular uncertainties that should be included in stock assessments of Bluefin tuna and then to provide preliminary quantification of their relative importance impact on achieving management objectives. Ultimately, this will allow risk-based scenarios to be specified for the Operating Models (OM) used as part of a Management Strategy Evaluation and enable the SCRS and the GBYP Steering Committee to prioritise research. Given that the combinations of scenarios for inclusion in an MSE can grow exponentially with each extra variable, it may not be possible to evaluate the quantitative impact of all sources of uncertainties identified, or even prioritised. Therefore discussions with assessment scientists were conducted to reduce the initial list to those variables most amenable for further evaluation using simpler quantitative modelling approaches such as elasticity or scenario-based sensitivity analysis. In elasticity analysis the proportional change of derived values relative to changes in the input parameters allows the relative impact of the different inputs to be evaluated.

Having determined which of the uncertainties have greater impact on derived values, measured using a utility function, discussions can be initiated with the stakeholders to elicit which of the shortlisted uncertainties should have priority for further quantitative investigations. Finally, a representative ‘reference’ set of Operating Models can be selected based on analysis of interactions among uncertainties. The plausibility weights for this reference set of OMs provide another opportunity to engage stakeholders, and to elicit their views as to how robustness trials with the MSE should be ‘tuned’. Having thus established an MSE framework, other sources of uncertainty from the qualitative analysis stage can be quantitatively addressed but it is still unlikely that every single one can be given a quantitative treatment. Therefore, elicitation process will also serve to document what is missing from the quantitative risk assessment, giving a more transparent and comprehensive view of uncertainties in the scientific advice to managers and other stakeholders (see Levontin *et al.*, 2015).

*6.2.2 Statistically based stock assessment methods*

The work carried out under this item was the following:

a) examining the opportunity of using a statistical catch at age for Bluefin tuna stock evaluation,
b) highlighting the structure and the assumptions of the chosen statistical model (iSCAM developed by S. Martell [Martell, 2012]),
c) running a simulation study for evaluating the quality of the estimation procedure,
d) producing operational codes for running a stock evaluation on Bluefin Tuna east stock with a statistical catch at age model,
e) comparing the results with the results presented in previous stock assessment. Three non-parametric stochastic imputation approaches that provide a means of imputing Atlantic bluefin tuna length frequency data are described and tested by cross-validation.

The results obtained with iSCAM are consistent with the results described in [SCRSGroup, 2012] and obtained using a virtual population analysis. Furthermore, as iSCAM used the stock recruitment relationship in the last phase of estimation, the recruitment may be almost freely estimated as in a VPA approach.

Some of the parameters have to be fixed and can't be estimated with the data available for this study. iSCAM may be more finely tuned using more expertise on the studied stock; this expertise may be included as a prior for example but also uses to propose more adequate choices. By instance, the catch at age data show strong pattern, this may correspond to a known change in the selectivity and should be included in the model.

On the other hand, the mortality rate is a key parameter and has been chosen constant throughout ages, but recent development of iSCAM should allow to use a mortality rate varying with age and produce results closer from the previous stock assessment. iSCAM also proposes some prediction of the evolution of the stock according to fixed TAC policy. The code using this possibility of iSCAM is also available.

Running iSCAM on BFTE will require more precise tuning of the parameters. The improvement obtained with a fine tuning will not circumvent the issue of the amount of noise (estimated by iSCAM) in the data. This high level of noise in the data may produce biased estimates on the key parameters and in any case this variability in the recruitment process and in the observed abundance indices makes the stock assessment difficult. However this variability cannot be omitted and has to be considered.

Therefore, using a Bayesian framework, would allow to include prior information and to produce predictive interval which account for both uncertainty described by the model and its variances parameters and uncertainty on those parameters itself. Taking all sources of uncertainty into consideration would help to develop decision analysis process under uncertainty and should be strongly recommended.

*6.2.3 Assistance to bluefin tuna stock assessment: Modelling coordinator*

After the Call for tenders, this contract was provided to CSIRO (Australia), which made available Ph.D. Campbell Davies for coordinating the GBYP modelling work, following the Modelling Plan. The initial delay for releasing the Call, due to the procedures for extending and revising the GBYP Grant Agreement, had a further delay caused by the complex contractual procedures in CSIRO and the consequent negotiations. These delays, along with an heavy workload of the Modelling Coordinator in spring 2014, prevented the duly provision of the Modelling work plan to the SCRS BFT Data Preparatory Meeting and then the full schedule was revised in emergency, in order to go on with the work and the related recruitment of the MSE Technical Assistant. The Modelling Coordinator provided detailed TORs for the MSE Technical Assistant and participated to the selection.

The revised Modelling Work Plan for the period 2014-2018 was provided at the beginning of June 2014, while the revised table was provided on 31 July 2014. Both documents will be presented to SCRS. Various telephone conferences were held with the ICCAT staff for discussing the details.

According to the TORs, the GBYP Modelling Coordinator proposed a Core Modelling Group and the names were discussed at approved by ICCAT Secretariat. The Core Modelling Group will be chaired by Campbell Davies, while the members will be Laurie Kell, Polina Levontin, Richard Hillary, Toshihide Kitakado, Clay Porch, Sylvain Bonhommeau and, ex-officio, Josu Santiago, Doug Butterworth, Paul De Bruyn and Antonio Di Natale. The role of the Core Modelling Group is defined as follows:

a) Provide technical oversight and advice on the MSE process to the SCRS
b) Provide annual review of progress against work plan and report to SCRS and Commission

c) Review technical contributions and outputs to the work program and advise the Secretariat on satisfactory completion of tendered contracts
d) Advise the Secretariat and GBYP Steering Committee on out-of-session revisions to work program, where necessary and appropriate.

The GBYP Modelling Coordinator, together with the GBYP Coordinator and the ICCAT Secretariat are working for organizing the Modelling meeting included in Phase 4 planning; the date will be after the ICCAT Commission meeting and anyway before the end of Phase 4.

*6.2.4 Assistance to bluefin tuna stock assessment: MSE Technical Assistant*

After the Call for tenders, released with an initial delay as reported above, this contract was provided to an expert from Canada, who will be in charge to develop the Operating Model and MSE framework and related code, working directly with the Modelling Coordinator and in consultation with the ICCAT Secretariat, the core Modelling Group and MP modellers. The first operative meeting between the expert and the Modelling Coordinator was held in Seattle on 28 June 2014, with the objective to discuss the work plan and details of the Operating Model.

A second meeting was held at the ICCAT Secretariat on July 14-17, 2014, discussing in details the first steps of the modelling work and for agreeing about the working procedures. The Modelling Coordinator participated by telephone conference.

At the moment, the work is going on as scheduled, but the plan is to continue this part of the modelling work also in future GBYP Phases.

## 7. 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 ).

## 8. 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 60 ICCAT GBYP RMA certificates have been issued in 2013, using 4,392.8 kg of bluefin tuna, while only 3 RMA certificates have been issues so far in 2014, using a total of 762.7 kg (provisional data). RMA used quantities in 2013 were officially communicated to ICCAT Statistical Department for the inclusion in the official ICCAT BFT catch table (see Di Natale, 2015).

## 9. 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. Specific forms were provided to ROP. 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.

## 10. Steering Committee Meetings

The GBYP Steering Committee is currently composed by the Chair of SCRS, Ph.D. Josu Santiago, the BFT-W Rapporteur, Ph.D. Clay Porch, 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 one meeting on 28-29 September 2013 and will have another meeting during the SCRS BFT Species Group on September 2014. All reports of all GBYP Steering Committee meetings are available on http://www.iccat.int/GBYP/en/scommittee.htm. The next meeting is planned during the SCRS Bluefin Tuna Species Group (22-26 September 2014) with the objective, among others, to revise the planning for Phase 5.

## 11. 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 46.84% of the funds originally approved for the same time period (4,742,086.02 euro against 10,125,000 euro). Including Phase 4 (provisional data), the available funds will be equal to 48.9% (7,491,086.02 euro against 15,320,000 euro) of the budget originally approved for the first 4 Phases (but with the difference that they were always considered as 4 years, while now the duration is 5 years).

In Phase 4, the budget is supposed to have the following donors (in order of contribution):

| | | |
|---|---|---|
| European Union (grant agreement) | Euro | 2,300,000.00 |
| United States of America (donation, 2013) | Euro | 193,693.34 |
| Kingdom of Morocco (donation) | Euro | 125,234.37 |
| Japan (donation) | Euro | 111,259.96 |
| Turkey (donation according to quota) | Euro | 54,349.50 |
| Tunisia (donation according to quota, 2014)* | Euro | 44,717.34 |
| Canada (grant agreement) | Euro | 41,812.70 |
| Norway (donation) | Euro | 39,614.86 |

| | | |
|---|---|---|
| Croatia (donation, 2013) | Euro | 18,077.61 |
| Chinese Taipei (donation) | Euro | 6,000.00 |
| Egypt (donation according to quota)* | Euro | 4,267.25 |
| Korea (donation according to quota, 2013) * | Euro | 3,727.16 |
| Iceland (donation according to quota) | Euro | 3,023.76 |
| Popular Republic of China (donation according to quota, 2013) * | Euro | 1,767.54 |

*the donation was lower than the amount requested by the ICCAT Secretariat according to the quota.

Further contributions for Phase 4 according to quota were requested to Algeria, Albania Libya and Syria, but they were never provided to ICCAT GBYP so far. Other CPCs contributed only for one of the two years included in Phase 4. Contributions for previous GBYP Phases are still pending for Korea, Libya and Tunisia.

The ICCAT Secretariat is covering the missing part of the co-funding agreed within the EC Grant for the residual amount, in order to reach the reduced budget established for each Phase 4.

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 never approved so far.

The Atlantic-wide Research Programme for Bluefin Tuna is a very complex programme and its activities concern all stakeholders. 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.
- ✓ Grupo 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 bluefin tuna samples from the central Atlantic fishery: estimated value not defined (for GBYP biological and genetic analyses in Phase 2, 3 and 4).
- ✓ 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).
- ✓ 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).

**12. 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.

**13. 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 4, 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 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 shall be fully validated according to the recommendation provided by the SCRS Data Preparatory Meeting in 2014 and made available to scientists as soon as possible. Now it seems finally possible to recover genetic data from ancient samples coming from the Marmara Sea, possibly representing the ancient bluefin tuna population which was usually migrating from/to the Black Sea and the analyses of these samples is recommended for finally solving the uncertainties about this sub-population. If reliable additional data about LL BFT fisheries in the Mediterranean in the last decade, not already included in official Task II data, will be detected, then these data should be recovered and used for improving our understanding of this fishery.

c) Aerial survey: it is considered 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; data should be tested for standardisation; the prediction model using the SST data should be further developed and improved.

d) Tagging: electronic tagging should be strongly improved, while conventional tagging should be carried out taking advantage of the experiences in the first part of Phase 4. In particular, electronic tagging should be carried out in the eastern Mediterranean. The tag awareness activity shall be firmly continued, improving media communication.

e) 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. The recovery of old ICCAT BYP samples should be defined.

f) 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.

Additional recommendations were provided by the GBYP Steering Committee in 2013, and they will be revised during the next meeting in 2014.

**Annex 1**

## 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 are not included when the final report is available; interim reports cannot be published):**

1. 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. Steering Committee – ICCAT GBYP Steering Committee Report, Madrid, 28-29 September 2013, 17 p.
3. Meetings – Report of the 2013 Bluefin tuna meeting on biological parameters. Tenerife, Spain, May 7 to 13, 2013, 75 p.
4. Meetings - Report of the Bluefin tuna stock assessment methods meeting. Gloucester, MA, USA, July 20 to 22, 2013, 11p.
5. 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.
6. 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.
7. Data recovery, data mining and data analyses - Report, 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.
8. 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.
9. 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+20 p.
10. 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). Grupo Air Med (Spain), 34 p. + various annexes.
11. 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.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. Biological and genetic activities – 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.
18. Biological and genetic activities – 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.
19. Biological and genetic activities – 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.
20. 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.
21. 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.
22. 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.

23. 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.
24. 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.
25. 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.
26. 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.
27. Tag awareness programme – Final report, 15 September 2014: ICCAT GBYP 01/2014, Field tag awareness activities. COFREPECHE on behalf of the Consortium: 124 p.
28. Modelling approaches – Final report, 15 January 2014: Report for ICCAT GBYP 04/2013. Etienne M.P., Carruthers T., McAllister M. (France, Canada), 36 p.
29. 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.
30. Modelling approaches – Interim report, 6 June 2014: BFT MSE Program Review. Davies C. (Australia), 3 p.
31. Modelling approaches – Interim report, 1 July 2014: Notes from ABT MSE Initial Planning Meeting. Davies C. (Australia), 2 p.
32. Modelling approaches – Interim report, 22 July 2014: BFT MSE Core Modelling Group. Davies C. (Australia), 2 p.
33. Modelling approaches – Interim report, 31 July 2014: Summary Work Programme. Davies C. (Australia), 2 p.

**List of Scientific Papers – Phase 4**


1. Anonymous, 2014, Report of the 2013 Bluefin tuna meeting on biological parameters. Tenerife, Spain, May 7 to 13, 2013, Collect. Vol. Sci. Pap ICCAT: 70(1): 1-159.
2. Anonymous, 2014, Report of the Bluefin tuna stock assessment methods meeting. Gloucester, USA, July 20 to 22, 2013, Collect. 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). Collect. 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. Collect. 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. Collect. 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. Collect. Vol. Sci. Pap. ICCAT, 70(2): 299-320.
7. 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). Collect. Vol. Sci. Pap. ICCAT, 70(2): 221-231.
8. 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*). Collect. Vol. Sci. Pap. ICCAT, 70(2): 338-356.
9. Mariani A., Dell'Aquila M., Scardi M., Costa C., 201, Feasibility study to assess the utilization of stereo-video systems during transfer of Atlantic bluefin tunas (*Thunnus thynnus*) to evaluate their number and size. Collect. Vol. Sci. Pap. ICCAT, 70(2): 401-421.
10. Di Natale A., 2014, Iconography of tuna traps: the discovery of the possible oldest printed image of a tuna trap, Collect. Vol. Sci. Pap. ICCAT, 70(6): 2820-2827.
11. Di Natale A., 2014, The ancient distribution of tuna fishery: how coins can improve our knowledge. Collect. Vol. Sci. Pap. ICCAT, 70(6): 2828-2844.
12. 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. Collect. Vol. Sci. Pap. ICCAT, 70(2): 447-458.
13. Di Natale A., Idrissi M., 2014, ICCAT GBYP Atlantic-wide Research Programme for Bluefin Tuna 2013. GBYP Coordination detailed activity report for Phase 3 (last part) and Phase 4 (first part). Collect. Vol. Sci. Pap. ICCAT, 70(2): 459-498.
14. 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. Collect. Vol. Sci. Pap. ICCAT, 70(2): 518-536.
15. 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. Collect. Vol. Sci. Pap. ICCAT, 70(2): 537-542.
16. Di Natale A., Idrissi M., Justel Rubio A., 2014, ICCAT-GBYP Tag Recovery Activities (up to September 2013). Collect. Vol. Sci. Pap. ICCAT, 70(2): 299-320.
17. Fonteneau A., Suzuki Z., Payne A.I.L., 2014, Mid-term review of the ICCAT Atlantic-wide research Programme on Bluefin Tuna. Collect. Vol. Sci. Pap. ICCAT, 70(2): 565-584.
18. 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. Collect. Vol. Sci. Pap. ICCAT, 70(2): 585-591.
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21. Kell L.T., Jean-Marc Fromentin J.M., Szuwalski C.S. 2015. Which Came First? The Chicken, The Egg or The Tortilla? Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
22. Kell L.T., Hillary R., Fromentin J.M., Bonhommeau S. 2015. Evaluation Of Model Free Harvest Control Rules. An Example North Atlantic Bluefin Tuna Management Strategy. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
23. 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. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
24. 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*). Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
25. Mielgo-Bregazzi R. 2015. 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. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*

26. 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. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume*.
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28. Di Natale A. 2015. An update of the ICCAT GBYP data mining and data recovery activities. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
29. 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. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
30. Di Natale A. 2015. ICCAT Atlantic-wide Research Programme for Bluefin Tuna (GBYP), Activity Report for the first part of Phase 4 (2013-2014). Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
31. Cort J.L., Artetxe I., 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. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume*.
32. Enrique 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., Miguel N. Nieves dos Santos M., Walter J., Zarrad R., 2015. Length and weight relationships for Atlantic Bluefin tuna (*Thunnus thynnus*). Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
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34. Kell L.T., Bonhommeau S. 2015. Simple Catch-At-Age and Size Analyses For Atlantic Bluefin. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
35. Levontin P., Leach A.W., Holt J., Mumford J.D. and Kell, L. T. 2015. Specifying and weighting scenarios for MSE robustness trials. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
36. Di Natale A. 2015. Report on the use of Research Mortality Allowance by ICCAT GBYP in 2012, 2013 and 2014. Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
37. Anonymous, 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.
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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. 2015. Report on the age calibration exchange within the Atlantic-wide Research Programme for Bluefin Tuna (ICCAT GBYP) Collect. Vol. Sci. Pap. ICCAT, 71. *In this Volume.*
43. Piccinetti C., Di Natale A., Arena P. 2013. Eastern bluefin tuna (*Thunnus thynnus*, L.): Reproduction and reproductive areas and seasons. Collect. Vol. Sci. Pap. ICCAT, 69(2): 891-912.
44. Die D., Johnson M. and Lauretta M. 2014. Simulating tagging of tropical tuna in the Equatorial Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 70(6): 2710-2724.
45. Quílez-Badia G., Ospina-Alvarez A., Sainz Trápaga S., Di Natale A., Abid N., Cermeño P., Tudela S., The WWF/GBYP multi-annual bluefin tuna electronic tagging programme (2008-2013): repercussions for management. 17 p.

**Annex 2**

# GBYP contracts issued in the first part of Phase 4

**ICCAT-GBYP CONTRACTS AND MEETINGS (PHASE 4 incomplete)**

**ICCAT GBYP COODINATION**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | 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 | | | X |

**ICCAT GBYP DATA RECOVERY**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | 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 | 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 | 1 | 1 | data on excel files |

**ICCAT GBYP AERIAL SURVEY**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | DELIVERABLES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | initial date | final date | REPORT | SCRS PAPERS | OTHERS |
| 4 | 2013 - 2014 | 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 | 1 | | |
| | | 19.000,00 | | *GBYP Aerial Survey Training Course* - ICCAT | Antonio Di Natale e-mail: antonio.dinatale@iccat.int | | 04/06/2013 | 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 | 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 | 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 | 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 | 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 | 1 | | data on excel files |

**ICCAT GBYP TAGGING PROGRAMME**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | 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 | 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 | 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 | 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 | 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 | 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 | | DELIVERABLES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | initial date | final date | REPORT | SCRS PAPERS | OTHERS |
| 4 | 2013 - 2014 | 300000,00 | 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 | 3 | 1 | data on excel files |

**ICCAT GBYP MODELLING APPROACHES**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | DELIVERABLES | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | initial date | final date | REPORT | SCRS PAPERS | OTHERS |
| 1 | 2010 | 0 | - | - | | | | | | |
| 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 | 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 | 1 | 1 | |
| | | | 04/2013 | Development of Biological Hypotheses for the Use within MSE (no bids have been submitted) | - | | | | | |
| | | 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 | 19/09/2014 | 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 | 19/09/2014 | 1 | 1 | |

**ICCAT GBYP MID-TERM REVIEW**

| PHASE | YEAR | BUDGET € | CALL FOR TENDERS or ACTIVITY | RETAINED PROPOSAL | main contact | working schedule | | 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 | 1 | 1 | |
| | | | | *Mid-term Review, Alain Fonteneau, PhD* | Alain Fonteneau, e-mail: alain.fonteneau@ird.fr | 06/08/2013 | 15/09/2013 | | | |
| | | | | *Mid-term Review, Ziro Suzuki, PhD* | Ziro Suzuki, e-mail: zsuzuki@affrc.go.jp | 06/08/2013 | 15/09/2013 | | | |

**Annex 3**

## List of meetings and activities attended by GBYP coordination staff or external invited experts

| No. | date | place | Meeting or activity | Motivation |
|---|---|---|---|---|
| 1 | 03-04/04/2013 | Istanbul (TK) | Meeting with the specialists at the University of Istanbul for analysing the further possibilities for exploring the ancient archives for data mining | Analysis of data already recovered and discussion about future activities |
| 2 | 7-13/05/2013 | Tenerife (SP) | SCRS - 2013 BFT Meeting on biological parameters review | Presentation of all the ICCAT-GBYP data sets (Phases 1 to 3 / 2010-2012) |
| 3 | 13-16/05/2013 | Tenerife (SP) | SCRS - Meeting on GBYP Modelling Approaches | Supervision of the meeting for preliminary draft of the GBYP modelling future plans |
| 4 | 17-20/05/2013 | Larache (MO) | 2013 BFT Conventional & electronic tagging (Phase 4) | Delivery of all tagging equipment and supervising of the electronic tagging |
| 5 | 04/06/2013 | Madrid (SP) | ICCAT-GBYP Training course on Aerial Survey | Training for pilots, professional spotters and scientific observers working for the GBYP aerial survey. |
| 6 | 10-22/07/2013 | Gloucester (USA) | SCRS - 2013 Meeting on Bluefin Tuna stocks assessment methods | Supervision of the work to be done for ICCAT-GBYP modelling (Phases 4 and on) |
| 7 | 13-15/09/2013 | Isla Cristina (SP) | 2013 Meeting of Tuna Trap Captains | Presentation of GBYP research activities. (nop) |
| 8 | 23-24/09/2013 | Madrid (SP) | SCRS Sub-Committee on Statistics | GBYP data recovery issues |
| 9 | 15-27/09/2013 | Madrid (SP) | SCRS BFT Species Group | Overview of the GBYP activities, historical data, tags and other BFT subjects |
| 10 | 28-29/09/2013 | Madrid (SP) | GBYP SC meeting | Presentation of the GBYP activities and plans in Phase 4 and plan for Phase 5 |
| 11 | 30/09-4/10/2013 | Madrid (SP) | SCRS Plenary | Presentation of the GBYP activities and plans |
| 12 | 5-7/10/2013 | Favignana (IT) | Settimana delle Egadi, Tonni e Tonnare | Presentation of the GBYP data recovery activity on tuna traps. (nop) |
| 13 | 18-25/11/2013 | Cape Town (SA) | 23rd Regular Meeting of the Commission | |
| 14 | 12/03/2014 | Sevilla (SP) | Las almadrabas y el atún rojo en un contexto de crisis. Universidad de Sevilla. | Seminar about the history of tuna traps. (nop) |
| 15 | 5-10/05/2014 | Madrid (SP) | SCRS – BFT Data Preparatory Meeting | Presentation of GBYP tagging activities and scientific papers |
| 16 | 12-13/09/2014 | Isla Cristina (SP) | 2014 (XIII) Meeting of Tuna Trap Captains | Review of literature about tuna traps (nop) |
| 17 | 22-26/09/2014 | Madrid (SP) | SCRS BFT Species Group | Overview of the GBYP activities, other BFT subjects |

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

**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.** Comparison of main aerial survey results on effort, encounter rates and density of schools, and mean and total weight and animal abundance in the inside subareas, between 2010, 2011 and 2013.

| Year | 2010 | | | | 2011 | | | 2013 | | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sub-area | A inside | C inside | E inside | G inside | A inside | C inside | E inside | A inside | C inside | E inside | G inside | 2010 | 2011 | 2013 |
| Date | 1-Jun / 2-Jul | 5-29-Jun | 3-Jun / 3-Aug | 5-30-Jun | 15-Jun / 11-Jul | 19-Jun / 8-Jul | 13-29-Jun | 6-Jun / 6-Jul | 18-28-Jun | 22-Jun /12-Jul | 20-Jun / 15-Jul | | | |
| Survey area (km$^2$) | 62,264 | 52,461 | 90,796 | 55,248 | 62,264 | 52,461 | 100,471 | 62,194 | 54,177 | 82,054 | 56,329 | 260,769 | 215,196 | 254,754 |
| Number of transects | 52 | 45 | 42 | 55 | 131 | 77 | 65 | 76 | 37 | 108 | 27 | 194 | 273 | 248 |
| Transect length (km) | 6,301 | 8,703 | 5,288 | 3,482 | 7,977 | 8,771 | 11,429 | 6,807 | 2,791 | 4,371 | 1,700 | 23,774 | 28,177 | 15,669 |
| Effective strip width x2 (km) | 9.66 | 2.92 | 9.66 | 2.92 | 7.03 | 7.03 | 0.66 | 4.6 | 4.6 | 4.6 | 4.6 | 2.9 / 9.7 | 0.7 / 7.0 | 4.6 |
| % Coverage | 97.8 | 48.4 | 56.3 | 18.4 | 90 | 118 | 7.5 | 50.3 | 23.7 | 24.5 | 13.9 | 57 | 58 | 28.3 |
| Number of schools | 7 | 6 | 19 | 31 | 11 | 10 | 35 | 13 | 11 | 20 | 12 | 63 | 56 | 56 |
| Encounter rate of schools | 0.0011 | 0.0007 | 0.0036 | 0.0089 | 0.0014 | 0.0011 | 0.0031 | 0.0018 | 0.0039 | 0.0046 | 0.0071 | 0.0027 | 0.0020 | 0.0036 |
| %CV encounter rate | 51 | 43 | 39 | 25 | 32 | 31 | 24 | 42 | 44 | 47 | 41 | 20 | 47 | 23 |
| Density of schools (1000 km$^{-2}$) | 0.157 | 0.237 | 0.508 | 3.05 | 0.196 | 0.162 | 3.98 | 0.447 | 0.742 | 3.164 | 2.343 | 0.909 | 1.956 | 1.804 |
| %CV density of schools | 55 | 53 | 44 | 40 | 37 | 36 | 26 | 51 | 49 | 54 | 48 | 30 | 25 | 34 |
| Mean weight (t) | 127.1 | 124.2 | 50.6 | 62.1 | 84.8 | 42.7 | 102.8 | 90.1 | 189.0 | 4.2 | 3.3 | 85.9 | 94.9 | 22.6 |
| %CV mean weight | 8 | 5.6 | 25 | 13 | 26 | 44 | 27 | 32 | 22 | 103 | 62 | 15 | 11 | 51 |
| Mean cluster size (animals) | | | | | 789 | 291 | 1,275 | 439 | 1,536 | 111 | 272 | | 1,211 | 302 |
| %CV mean cluster size | | | | | 26 | 31 | 32 | 35 | 19 | 108 | 57 | | 12 | 43 |
| Total weight (t) | 1,244 | 1,540 | 2,335 | 10,434 | 1,033 | 364 | 44,837 | 1,083 | 6,633 | 949 | 436 | 15,553 | 46,234 | 9,100 |
| %CV total weight | 56 | 53 | 51 | 42 | 43 | 54 | 41 | 40 | 59 | 96 | 68 | 30 | 40 | 45 |
| Total abundance (animals) | | | | | 9,616 | 2,477 | 549,276 | 12,194 | 61,725 | 28,819 | 35,911 | | 561,369 | 138,650 |
| %CV total abundance | | | | | 43 | 46 | 42 | 45 | 53 | 99 | 63 | | 41 | 35 |

**Table 4.** Results of ICCAT-GBYP extended aerial survey carried out in 2013, concerning both the "inside" (areas previously surveyed in 2010 and 2011) and "outside" areas (new extended areas surveyed for the first time in 2013).

| Sub-area | 2013 'inside' | 2013 'outside' | TOTAL |
|---|---|---|---|
| Survey area (km$^2$) | 254,754 | 1,303,470 | 1,558,224 |
| Number of transects | 248 | 130 | 378 |
| Transect length (km) | 15,669 | 13,278 | 28,947 |
| Effective strip width x2 (km) | 4.6 | 4.6 | 4.6 |
| % Coverage | 28.3 | 4,7 | 8.5 |
| Number of schools | 56 | 12 | 68 |
| Encounter rate of schools | 0.0036 | 0.0009 | 0.0024 |
| %CV encounter rate | 23 | 69 | 23 |
| Density of schools (1000 km$^{-2}$) | 1.804 | 0.323 | 0.565 |
| %CV density of schools | 34 | 76 | 41 |
| Mean weight (t) | 22.6 | 5.5 | 15.0 |
| %CV mean weight | 51 | 75 | 46 |
| Mean cluster size (animals) | 302 | 432 | 364 |
| %CV mean cluster size | 43 | 49 | 37 |
| **Total weight (t)** | **9,100** | **2,988** | **12,088** |
| %CV total weight | 45 | 65 | 38 |
| **Total abundance (animals)** | **138,650** | **181,980** | **320,629** |
| %CV total abundance | 35 | 86 | 53 |

**Table 5.** Details on the number of bluefin tuna tagged with various types of tags in Phase 4 and on the number of the various types of tags implanted in the various areas (updated on 15 September 2014).

| | 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 | 29 | 6 | 6 | 0 | 0 | 0 | 17 | 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 |
| | | **3534** | **491** | **7** | **0** | **0** | **3641** | **33** | **0** | **7** | **12** | **0** | **1** |
| GRAND TOTAL | **7726** | **SUBTOTAL = 4019** | | | | | **SUBTOTAL = 3694** | | | | | | |

| | 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 | 46 | 23 | 23 | 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 |
| | **11427** | **7190** | **4170** | **47** | **12** | **8** |

**Table 6.** Details on the number of bluefin tuna tagged with various types of tags in all Phases of GBYP and on the number of the various types of tags implanted in the various areas (updated on 15 September 2014).

| | 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 | **46,3%** |
| Morocco* | 283 | 129 | 0 | 12 | 0 | 0 | 121 | 13 | 0 | 7 | 0 | 0 | 1 | **1,7%** |
| Portugal | 29 | 6 | 6 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | **0,2%** |
| Strait of Gibraltar*** | 5561 | 2254 | 43 | 0 | 0 | 0 | 3212 | 22 | 5 | 0 | 23 | 2 | 0 | **33,4%** |
| West Med. ** | 1646 | 931 | 358 | 0 | 0 | 0 | 352 | 5 | 0 | 0 | 0 | 0 | 0 | **9,9%** |
| Central Med. | 1405 | 772 | 135 | 0 | 0 | 0 | 479 | 7 | 0 | 0 | 12 | 0 | 0 | **8,4%** |
| | | **8265** | **544** | **15** | **0** | **0** | **7674** | **70** | **5** | **7** | **48** | **2** | **1** | |
| GRAND TOTAL | **16631** | **SUBTOTAL = 8811** | | | | | **SUBTOTAL = 7807** | | | | | | | **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 | **46,3%** |
| Morocco* | 432 | 258 | 134 | 32 | 0 | 8 | **1,8%** |
| Portugal | 46 | 23 | 23 | 0 | 0 | 0 | **0,2%** |
| Strait of Gibraltar*** | 8618 | 5491 | 3075 | 27 | 25 | 0 | **35,6%** |
| West Med. ** | 2002 | 1284 | 713 | 5 | 0 | 0 | **8,3%** |
| Central Med. | 1903 | 1251 | 633 | 7 | 12 | 0 | **7,9%** |
| TOTAL | **24237** | **16004** | **8078** | **97** | **50** | **8** | **100,0%** |
| % | **100%** | **66,0%** | **33,3%** | **0,4%** | **0,2%** | **0,0%** | |

**no tagging in Eastern Mediterranean!**

(*)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 7**. Details of tag recovery by area (first table), fishery, in numbers and percent (updated on 15 September 2014).

| Fishing Area / Tags | Spaghetti Tags | Single/Double BarbTags | External Elec. Tags | Internal Elec. Tags | Commercial Tags | Grand Total | % |
|---|---|---|---|---|---|---|---|
| East Atl | 49 | 27 | 9 | 2 | 1 | 88 | 40,74 |
| Med | 85 | 24 | 4 | 3 | | 116 | 53,70 |
| North Atl | 1 | | | 1 | 2 | 4 | 1,85 |
| West Atl | 2 | | | 1 | 1 | 4 | 1,85 |
| Unknown | | | 4 | | | 4 | 1,85 |
| Grand Total | 137 | 51 | 17 | 7 | 4 | 216 | 100 |
| %ge | 63,4% | 23,6% | 7,9% | 3,2% | 1,9% | 100,0% | |

**Table 3. Details of tag recovery by fishery, in numbers and percent**

| Fishery -Gear / Tags | Spaghetti Tags | Single/Double BarbTags | External Elec. Tags | Internal Elec. Tags | Commercial Tags | Grand Total | % |
|---|---|---|---|---|---|---|---|
| BB | 63 | 29 | | | | 92 | 42,59 |
| FARM | 18 | 3 | | 1 | | 22 | 10,19 |
| HAND | 3 | 3 | | | | 6 | 2,78 |
| LL | 14 | 8 | | 2 | | 24 | 11,11 |
| LLHB | | 1 | | | | 1 | 0,46 |
| NF | | | 12 | 1 | 4 | 17 | 7,87 |
| PS | 3 | 2 | 1 | | | 6 | 2,78 |
| RR | 3 | 1 | | | | 4 | 1,85 |
| SPOR | 5 | | | | | 5 | 2,31 |
| TN | 1 | 1 | | | | 2 | 0,93 |
| TP | 1 | | | 1 | | 2 | 0,93 |
| TRAP | 2 | 1 | | 2 | | 5 | 2,31 |
| TROL | 7 | 2 | | | | 9 | 4,17 |
| UNCL | 17 | | 4 | | | 21 | 9,72 |
| Grand Total | 137 | 51 | 17 | 7 | 4 | 216 | 100 |

**Table 8.** Detail of the recoveries from double tagged bluefin tunas (GBYP only) (updated on 15 September 2014).

| Release | Spaghetti tag only | Single/Double Barb Tag only | Both | TOTAL |
|---|---|---|---|---|
| 2011 | 0 | 2 | 5 | 7 |
| 2012 | 2 | 2 | 27 | 31 |
| 2013 | 1 | 1 | 12 | 14 |
| Total | 3 | 5 | 44 | 52 |
| % | 5,77 | 9,62 | 84,62 | 100 |

| RcCode: 2conv | both recovered | | | |
|---|---|---|---|---|
| | Year of Recovery | | | |
| Year of Release | 2012 | 2013 | 2014 | Grand Total |
| 2011 | 1 | 3 | 2 | 6 |
| 2012 | 5 | 15 | 6 | 26 |
| 2013 | | 6 | 6 | 12 |
| Grand Total | 6 | 24 | 14 | 44 |

**Table 9.** Samples collected and analyses carried out by the Consortium headed by AZTI in GBYP Phase 4, with the target and percentages of achievement (up to 12 September 2014).

| ***Item*** | ***Target no.*** | ***Achievement no.*** | ***% of achievement*** | ***No. considering 10% tolerance*** |
|---|---|---|---|---|
| **Bluefin tuna individuals sampled (1)** | 1210 | 1733 | 143.22 | n.a. |
| **Biological & Genetic Sampling (2)**: | | | | |
| Genetic samples (muscle/fin) | 1110 | 1712 | 154.23 | n.a. |
| Otoliths | 910 | 1052 | 115.60 | n.a. |
| Spines | 1160 | 959 | 82.67 | 954 |
| *Total biological and genetic samples* | *3180* | *3723* | *117.08* | *n.a.* |
| **Biological & Genetic Analyses (3):** | | | | |
| Genetic analyses (SNP validation) | 192 | 0 | 0 | 173 |
| Genetic analyses (new genotypes) | 576 | 165 | 28.65 | 518 |
| Genetic analyses (RAD-seq) | 60 | 0 | 0 | 54 |
| Microchemical analyses (stable hisotopes) | 190 | 174 | 91.58 | 171 |
| Microchemical analyses (trace elements) | 210 | 154 | 73.33 | 189 |
| Microchemical analyses (additional sets) | 100 | 0 | 0 | 90 |
| Otolith shape | 300 | 422 | 140.67 | n.a. |
| Age readings (intercalibration)(3 x each) | 100 | 100 | 100 | n.a. |
| *Total biological and genetic analyses* | *1728* | *1015* | *58.74* | *1555* |
| | | | | |
| **TOTAL (1+2+3)** | 6118 | 6471 | 105.77 | n.a. |

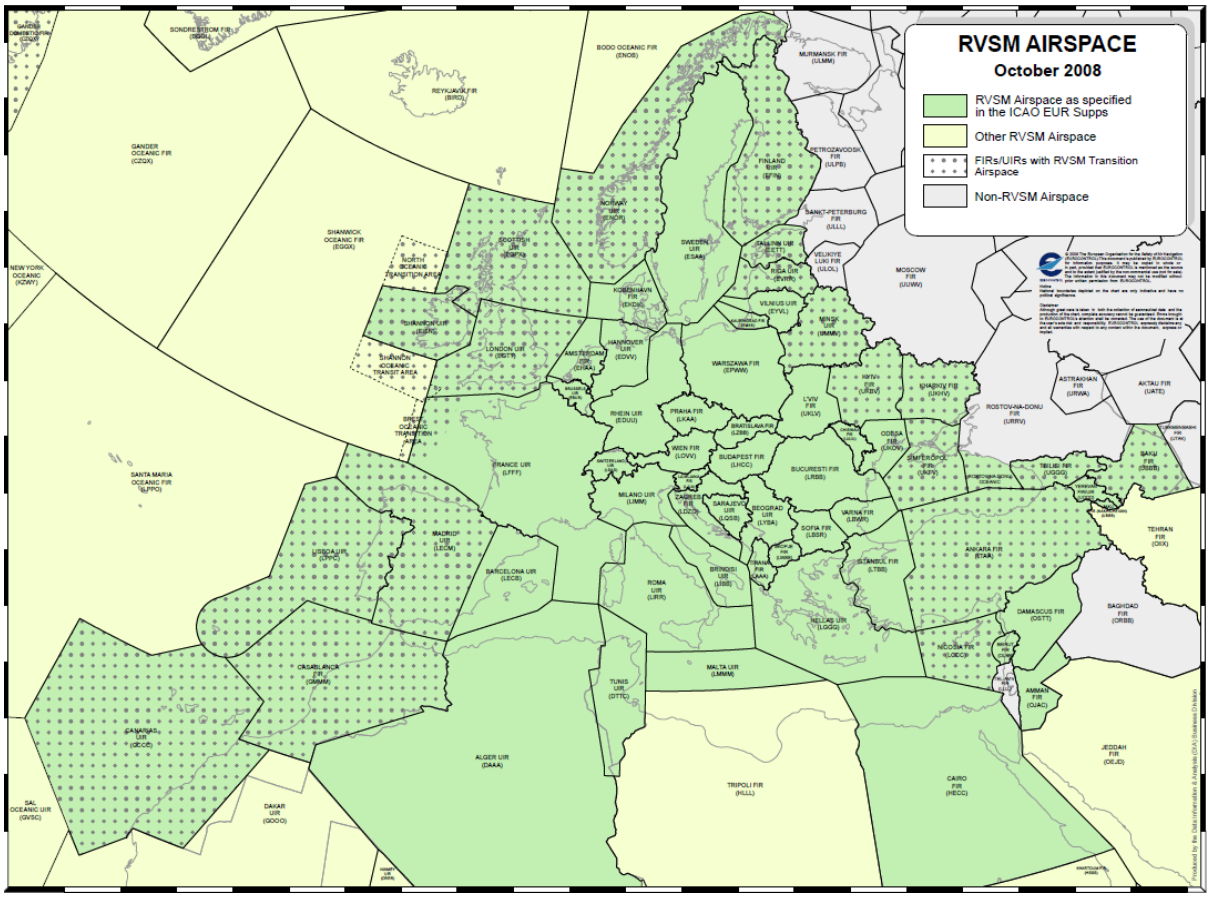



**Figure 1.** Boundaries of the national air-spaces in the Mediterranean Sea (the Black Sea is excluded), showing the complexity of operating in a geographical area with 24 Countries (16 are ICCAT CPCs), with various rules.

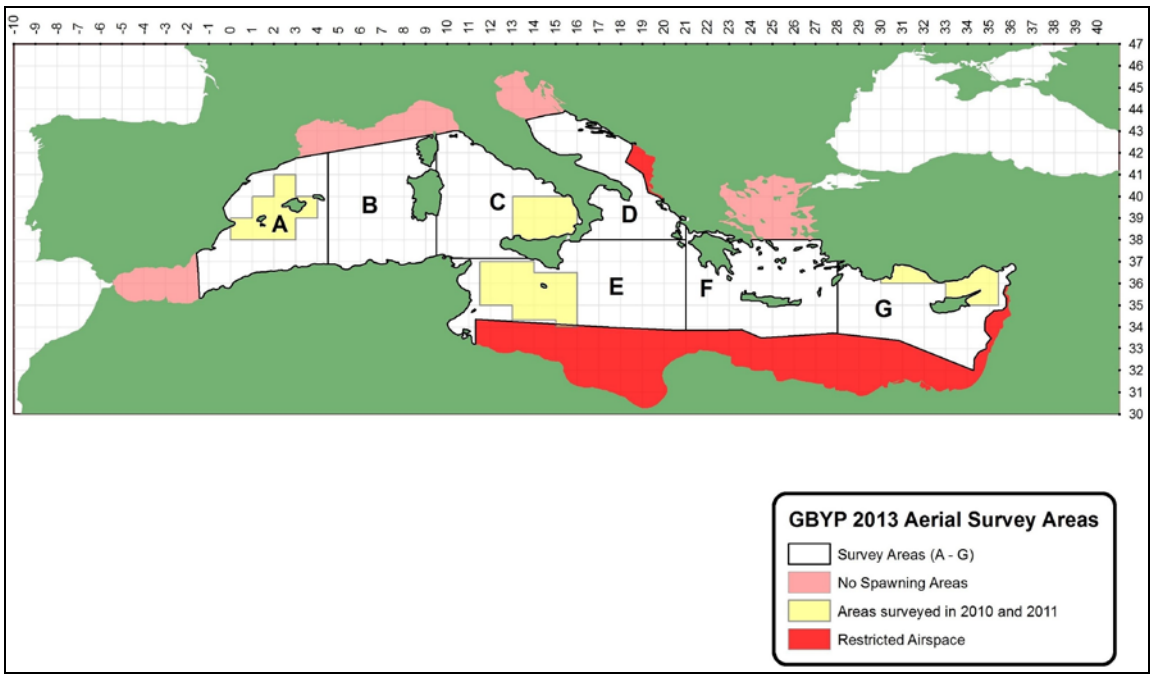



**Figure 2.** Map used for elaborating the aerial survey design in 2013, based on the potential opportunities of getting the flight permits by the various CPCs and coastal States concerned. The letters in bold identify the various areas used by GBYP.

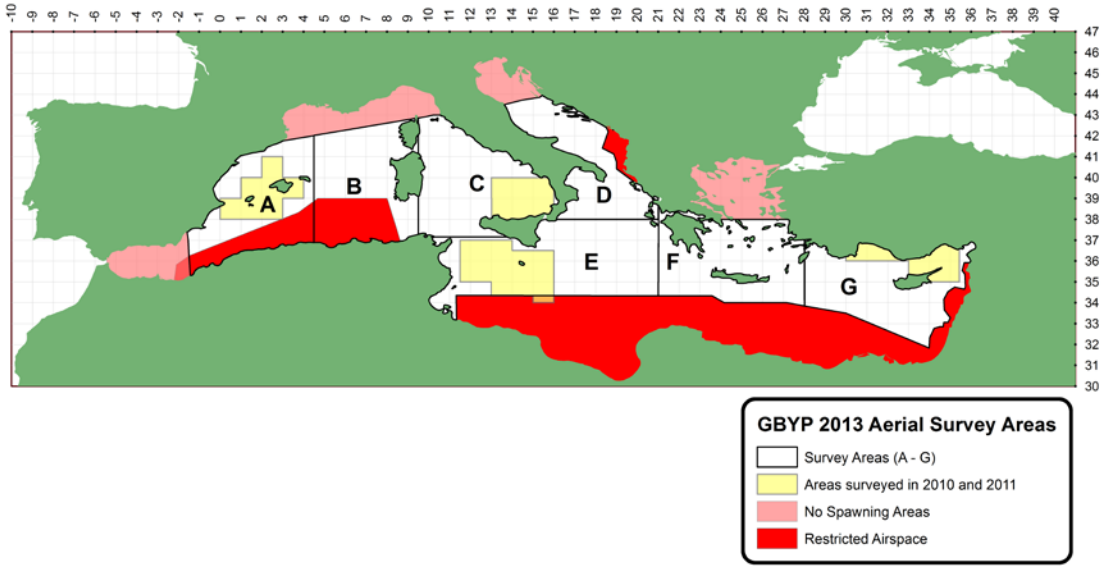



**Figure 3.** Map showing the areas on which it was possible to have permits for the aerial survey in 2013 (white and yellow zones). The letters in bold identify the various areas used by GBYP.

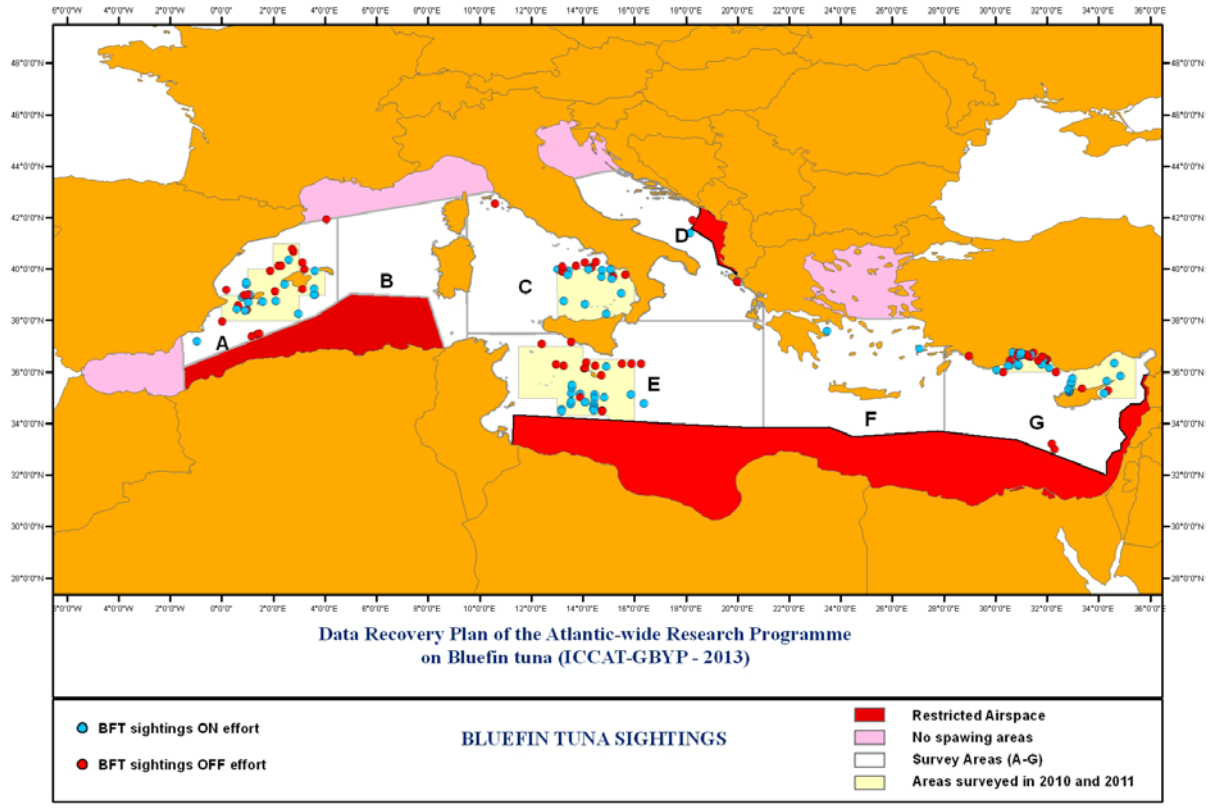
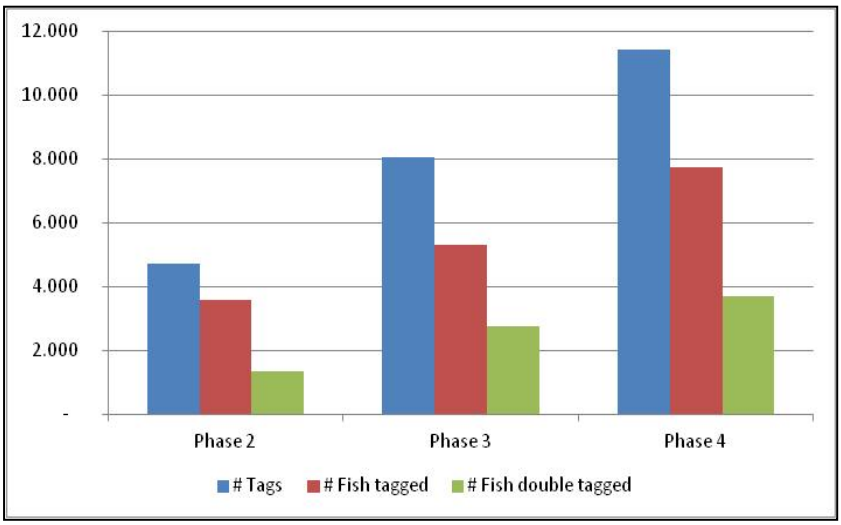



**Figure 4.** Sightings of bluefin tuna (on and off effort) during the 2013 GBYP aerial survey on spawning aggregations.



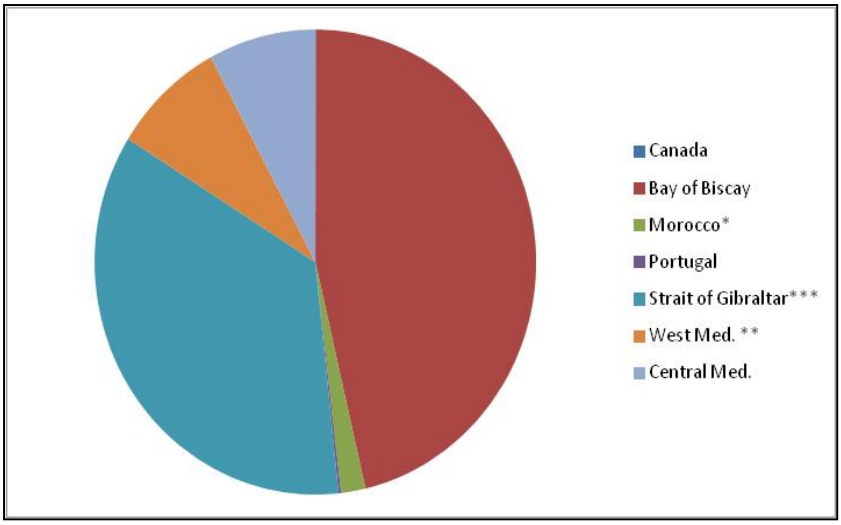




**Figure 5a**. Progression of the ICCAT GBYP tagging activities in the various Phases. **Figure 5b**. Percentage distribution of tags implanted in the various geographical areas by GBYP, up to 15 September 2014.

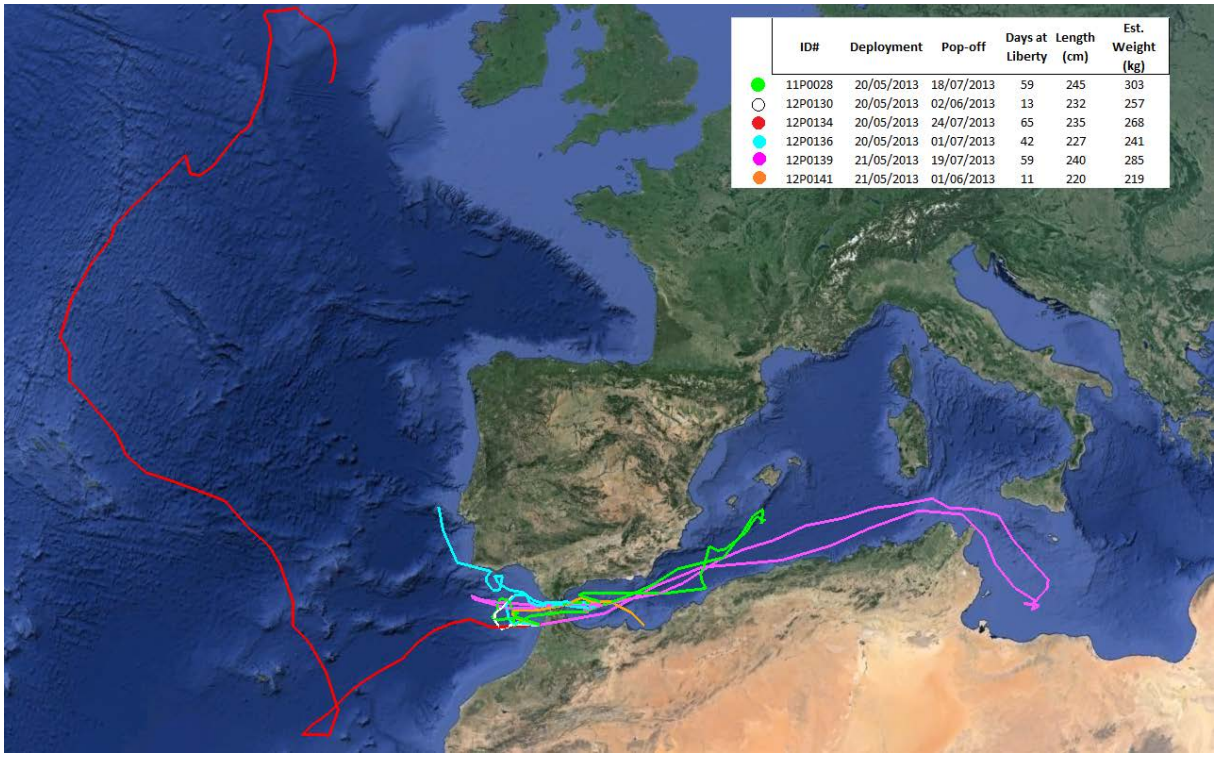



**Figure 6**. Tracks of adult bluefin tunas tagged with mini-PATs in the Moroccan traps in GBYP Phase 4 (2013).

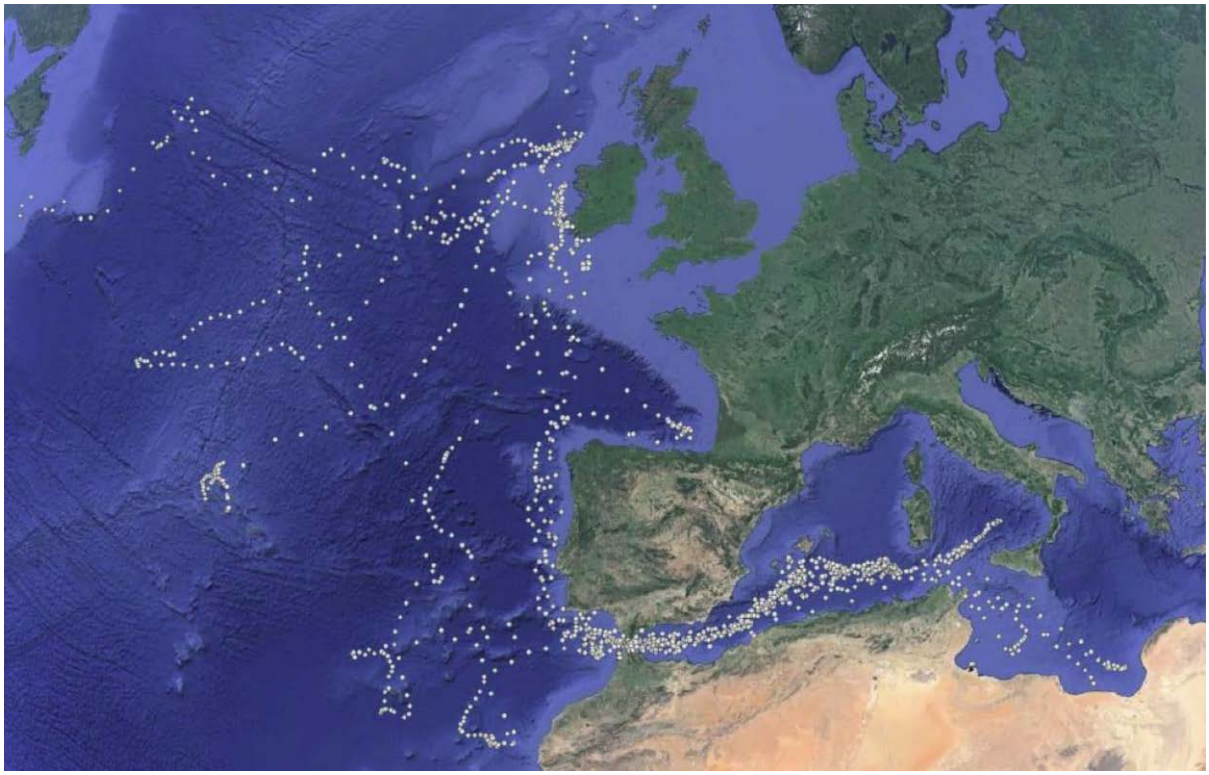


**Figure 7**. Tracks of 13 mini-PATs deployed by GBYP and WWF (SCRS/2014/184).

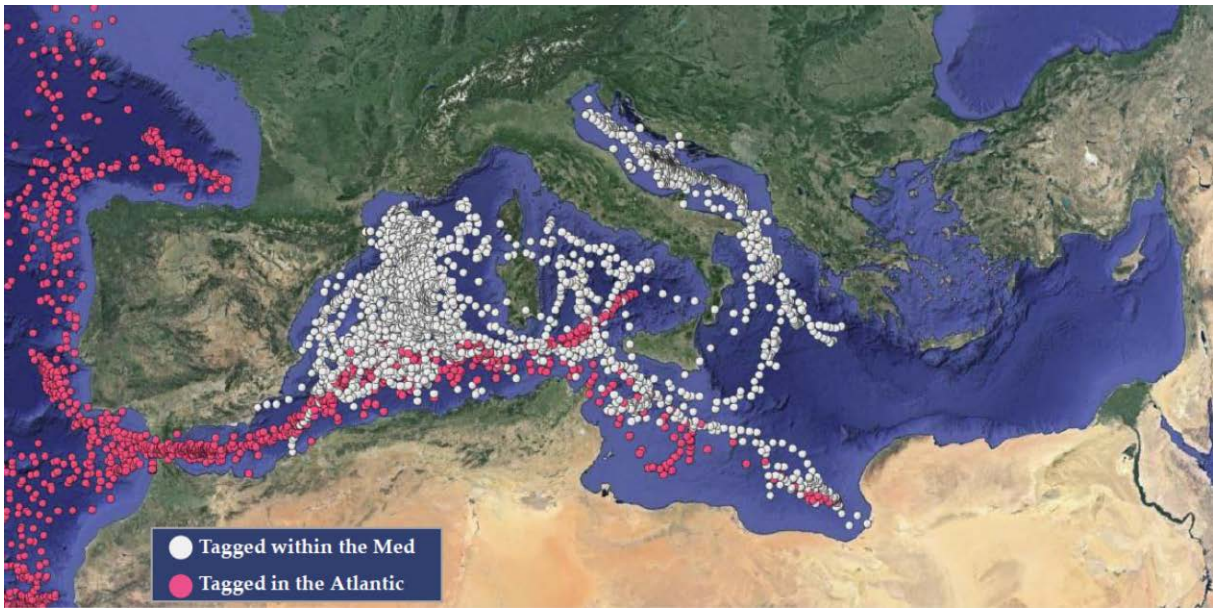



**Figure 8**. Tracks of mini-PATs deployed by both GBYP and WWF in various years (SCRS/2014/184). It seems clear that no bluefin tuna never went to the eastern Mediterranean Sea.

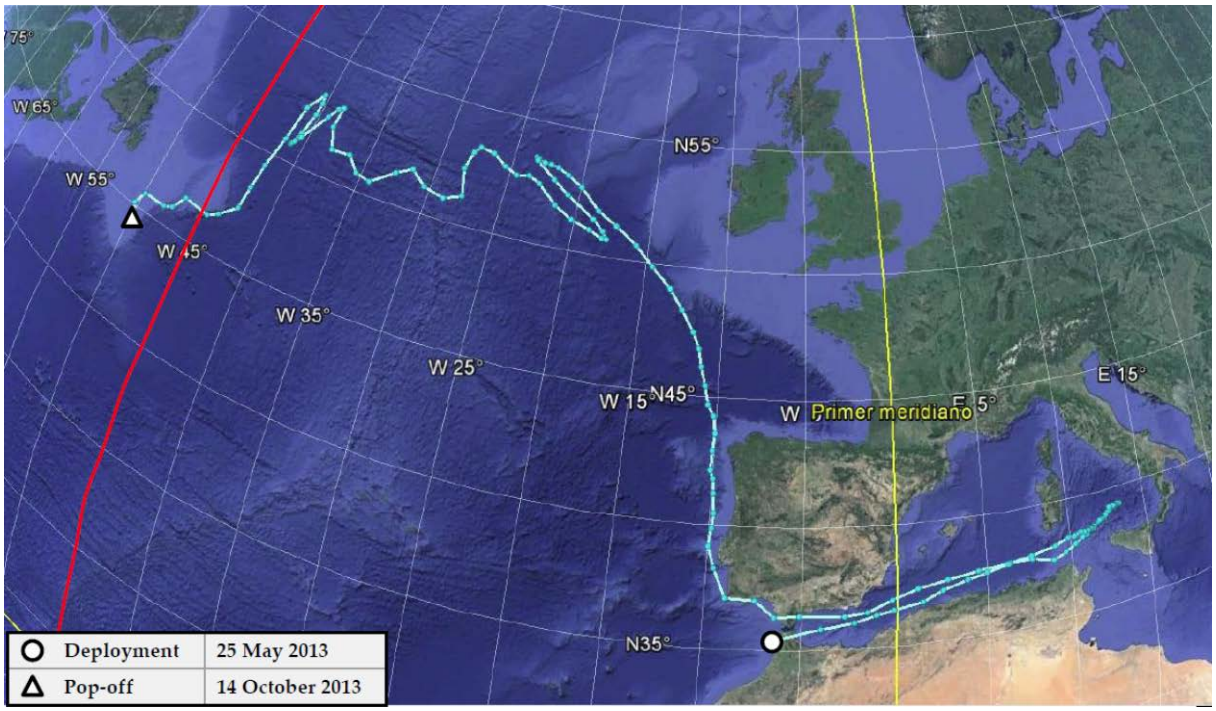



**Figure 9**. Track of one mini-PAT deployed by GBYP and WWF in the Moroccan trap of Larache in 2013 (SCRS/2014/184). This fish spawned in the Tyrrhenian Sea and then travelled up to Newfoundland.

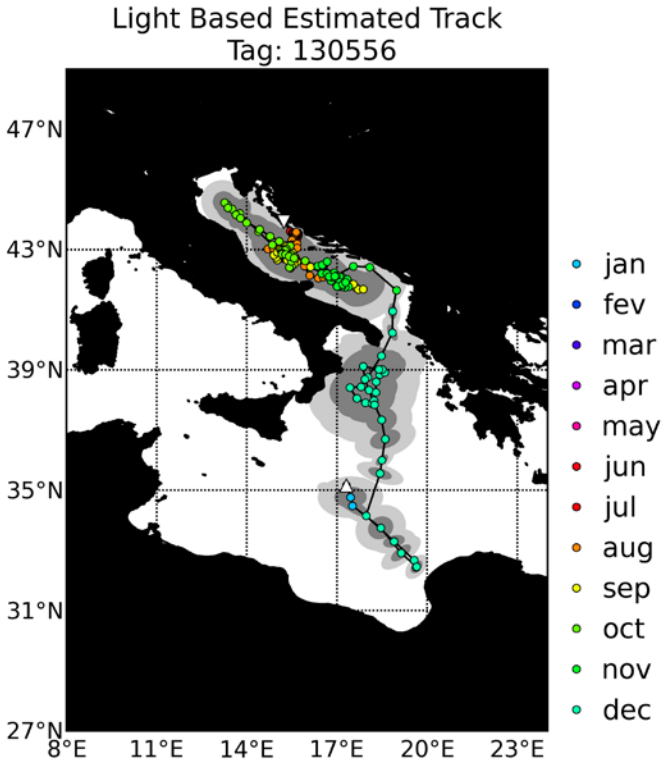



**Figure 10**. Track of one mini-PAT deployed by GBYP in the Adriatic Sea in 2013. This fish was the only one going to the Libyan waters.


**Figure 11.** Overview of the localities where the ICCAT-GBYP tag awareness material was distributed so far.

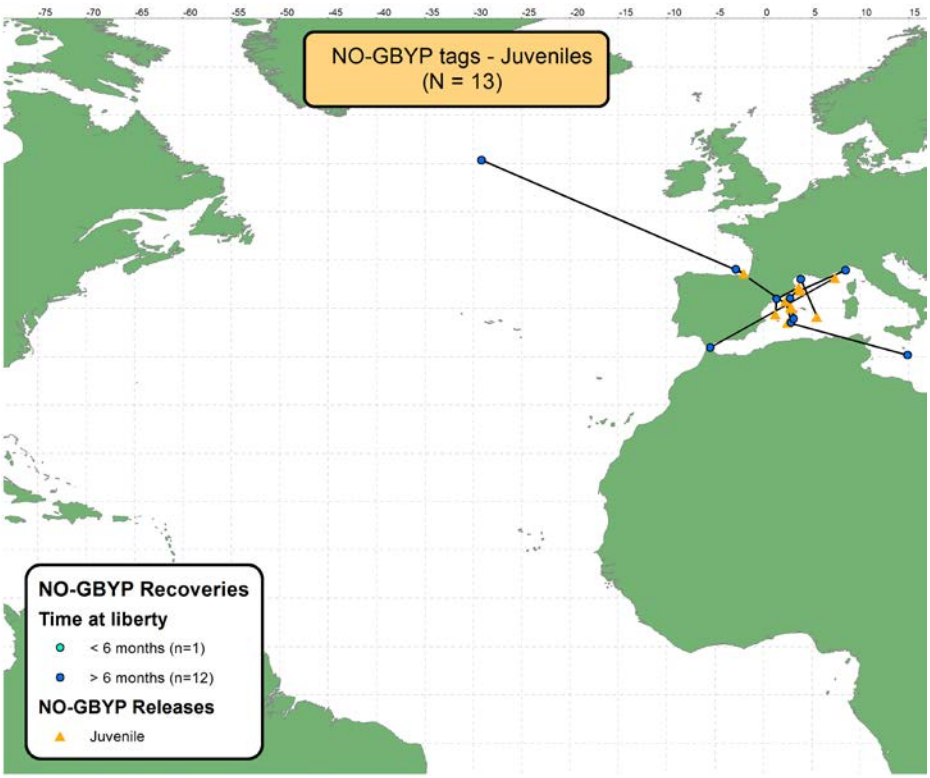



**Figure 12**. Trajectories of conventional tags implanted on juvenile bluefin tuna by non-GBYP programmes and recovered by ICCAT in the period 2005-2013.

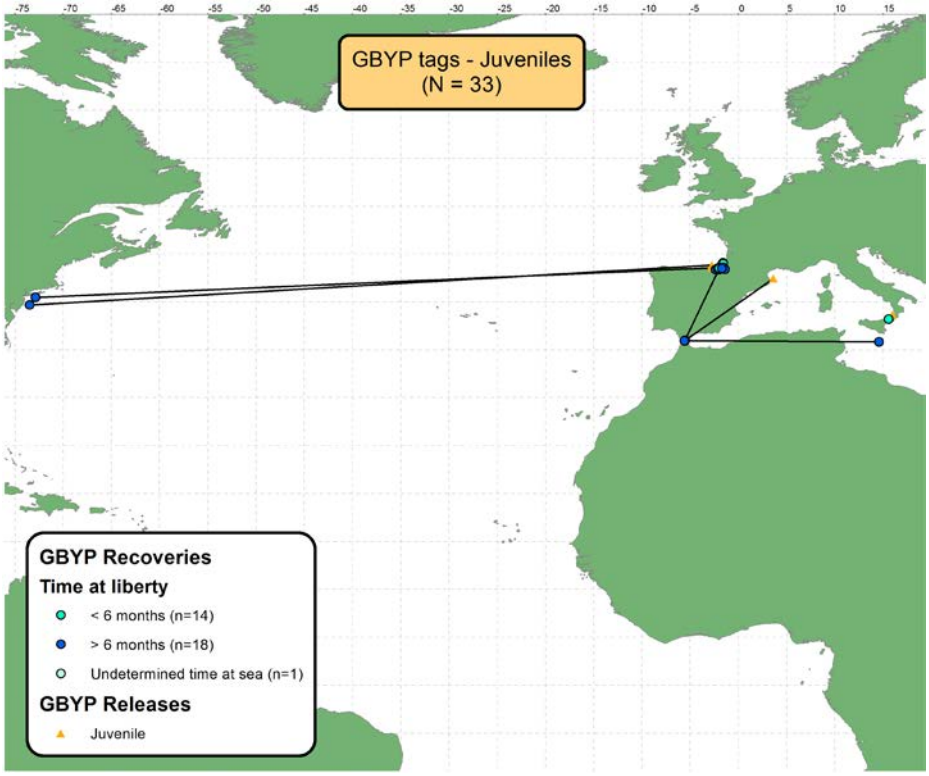



**Figure 13**. Trajectories of conventional tags implanted on juvenile bluefin tuna by GBYP and recovered by ICCAT in the period 2005-2013.

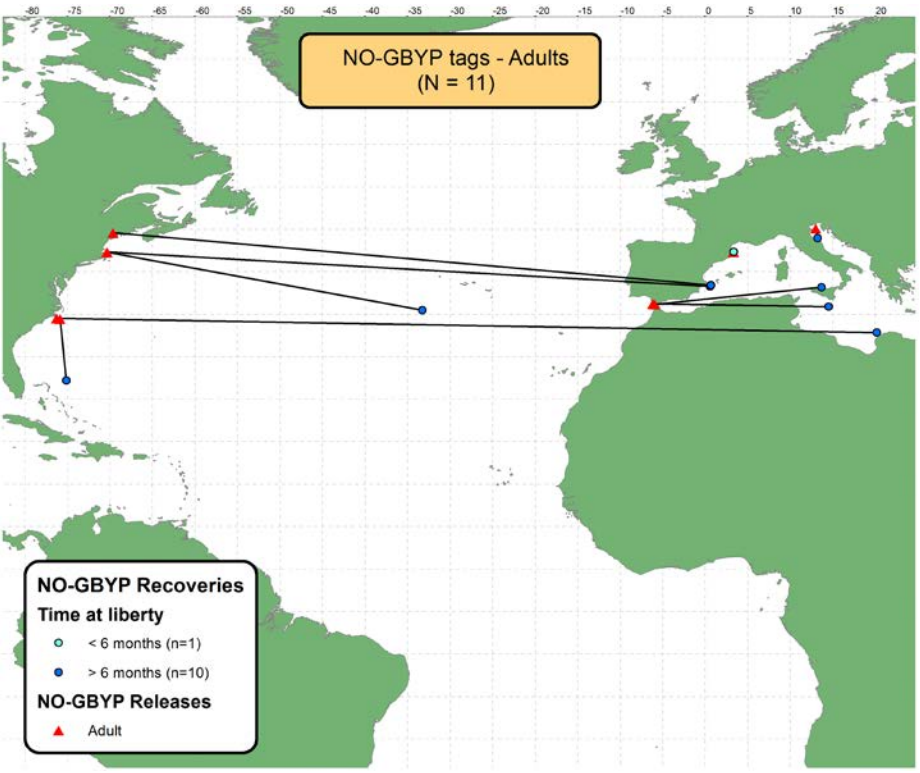



**Figure 14**. Trajectories of conventional tags implanted on adult bluefin tuna by non-GBYP programmes and recovered by ICCAT in the period 2005-2013.

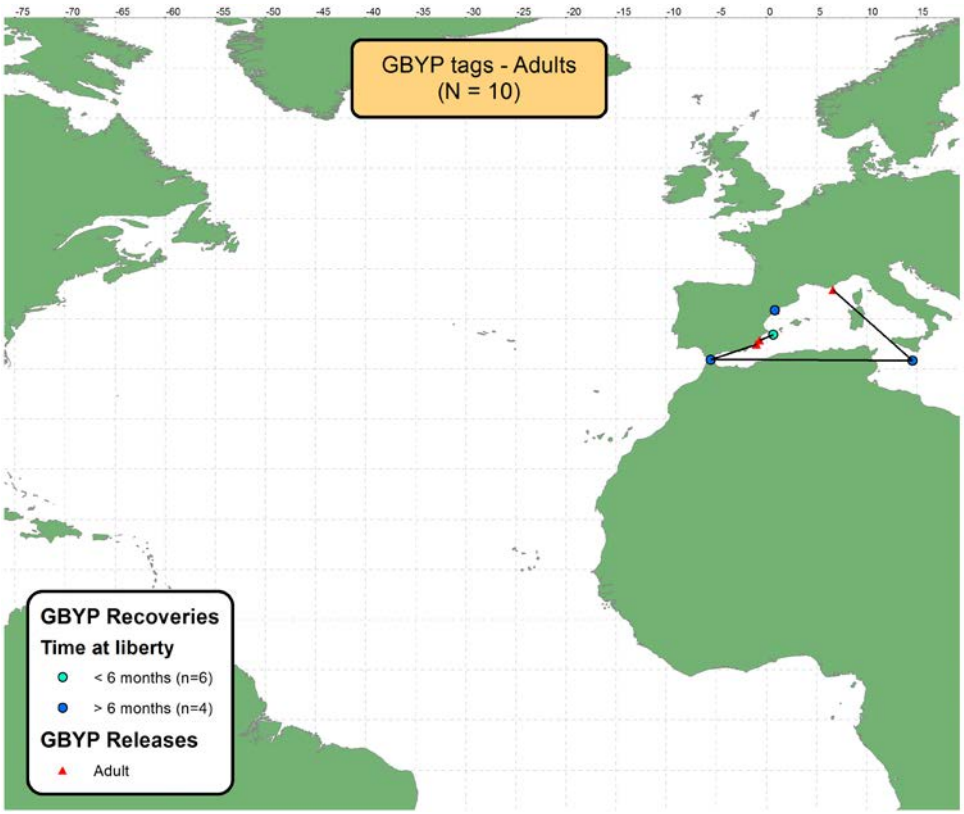



**Figure 15**. Trajectories of conventional tags implanted on adult bluefin tuna by non-GBYP programmes and recovered by ICCAT in the period 2005-2013.

| | | | Predicted Origin | | |
|---|---|---|---|---|---|
| **Region** | **year** | **N** | **% East** | **% West** | **% SD** |
| Central North Atlantic (east of 45ºW) | 2011 | 28 | 100 | 0 | ± 0.0 |
| Central North Atlantic (east of 45ºW) | 2012 | 150 | 83 | 17 | ± 6.4 |
| Central North Atlantic (west of 45ºW) | 2012 | 18 | 6 | 94 | ± 7.8 |
| Morocco | 2012 | 49 | 100 | 0 | ±0.0 |
| Morocco | 2013 | 59 | 98 | 2 | + 4.3 |
| Canary Islands | 2013 | 23 | 79 | 21 | + 14.0 |

**Figure 16**. Maximum likehood prediction of the origin of large (>100 kg) bluefin tuna collected from central and eastern North Atlantic Ocean (provisional data). 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 Deliverable No. 3 of the Consortium headed by AZTI).