ICCAT GBYP ATLANTIC-WIDE BLUEFIN TUNA RESEARCH PROGRAMME 2012. GBYP COORDINATION DETAILED ACTIVITY REPORT FOR PHASE 2 (LAST PART) AND PHASE 3 (FIRST PART)

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SUMMARY

The Atlantic-wide Research Programme on Bluefin Tuna (GBYP) officially began on October 2009. The second phase of GBYP activities began in December 2010 and was extended up to May 2012, including: (a) continuation of data mining/recovery and elaboration; (b) continuation of aerial surveys on spawning aggregations; (c) biological and genetic sampling and analyses; (d) conventional tagging, including awareness and rewarding campaign; and (e) first steps of the modeling approaches. The extension period was used to improve several activities and particularly the data elaboration. Phase 3 was initiated on May 2012, including: (a) limited continuation of data mining/recovery and elaboration; (b) continuation of biological and genetic sampling and analyses; (c) continuation of conventional tagging, electronic tagging and including awareness and rewarding campaign; and (d) further steps of the modeling approaches. A very impressive amount of data was recovered in the first two phases, covering a period from 1509 to 200 and these data are now available for the normal ICCAT procedure. The aerial surveys allowed for a SWOT analyses requested by the Steering Committee. The conventional tag seeding in the first trial was close to the target and the second trial is on the way, while the miniPATs provided very interesting results. The extensive participation of scientific institutions in the biological and genetic studies is also providing the first results, but more effort is needed to have all the analyses done. In terms of modelling, the GBYP initially focused on risk analysis to identify the main perceived sources of uncertainty related to assessment and advice, extending the task to the third phase, and on the development of new tools for a better use of the various data sets collected so far, to improve knowledge of the species and for a more focused management.

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 deuxième phase des activités du GBYP a démarré en décembre 2010 pour se poursuivre jusqu'en mai 2012. Celle-ci prévoyait : (a) la poursuite de l'exploration /récupération et élaboration des données ; (b) la poursuite des prospections aériennes des concentrations de reproducteurs ; (c) l'échantillonnage biologique et génétique et les analyses ; (d) le marquage conventionnel, y compris les campagnes de sensibilisation et de récompense ; et (e) les premières étapes des approches de modélisation. La période d'extension a servi à améliorer plusieurs activités et notamment l'élaboration des données. La phase 3 a été lancée au mois de mai 2012 et incluait : (a) la poursuite limitée de l'exploration /récupération et élaboration des données ; (b) la poursuite de l'échantillonnage biologique et génétique et des analyses ; (c) la poursuite du marquage conventionnel et électronique, y compris les campagnes de sensibilisation et de récompense ; et (d) les étapes ultérieures des approches de modélisation. Un volume très impressionnant de données a été récupéré dans les deux premières phases, couvrant une période s'étirant de 1509 à 2010 et ces données sont désormais disponibles pour la procédure normale de l'ICCAT. Les prospections aériennes ont permis de procéder aux analyses SWOT qui avaient été requises par le Comité de direction. L'implantation des marques conventionnelles au cours du premier essai s'est rapprochée de l'objectif et le deuxième essai est en bonne voie, tandis que les mini PAT ont fourni des résultats très intéressants. La forte participation des institutions scientifiques aux études biologiques et génétiques fournit également les premiers résultats, mais des efforts restent à faire pour que toutes les analyses soient réalisées. 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, élargissant la tâche à la troisième phase, ainsi que sur l'élaboration de

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nouveaux outils visant à une meilleure utilisation des divers jeux de données recueillis jusqu'à présent, afin d'améliorer les connaissances sur les espèces et d'obtenir une gestion plus ciblée.

RESUMEN

El Programa de investigación sobre atún rojo para todo el Atlántico (GBYP) comenzó oficialmente en octubre de 2009. La segunda fase de las actividades del GBYP se inició en diciembre de 2010 y se amplió hasta mayo de 2012, incluyendo: a) continuación de la recuperación/minería de datos y elaboración de dichos datos; b) continuación de las prospecciones aéreas sobre concentraciones de reproductores; c) muestreo biológico y genético y análisis; d) marcado convencional, lo que incluye una campaña de concienciación y recompensas y e) primeros pasos en los enfoques de modelación. El periodo de ampliación se utilizó para mejorar varias actividades, y en particular, la elaboración de datos. La Fase 3 se inició en mayo de 2012 e incluía: a) continuación limitada de la recuperación/minería de datos y elaboración de dichos datos; b) continuación del muestreo biológico y genético y análisis; c) continuación del marcado convencional y marcado electrónico, lo que incluye una campaña de concienciación y recompensas y d) más pasos en los enfoques de modelación. En las dos primeras fases se recuperó una cantidad impresionante de datos, que cubrían un periodo desde 1509 hasta 2010 y estos datos están ahora disponibles para el procedimiento normal de ICCAT. Las prospecciones aéreas permitieron un análisis DAFO solicitado por el Comité directivo. La detección de marcas convencionales en el primer ensayo era cercana al objetivo y el segundo ensayo está en marcha, y las miniPAT produjeron resultados muy interesantes. La amplia participación de instituciones científicas en los estudios genéticos y biológicos está produciendo también los primeros resultados, pero son necesarios más esfuerzos para finalizar todos los análisis. En términos de modelación, el GBYP se centró inicialmente en análisis de riesgo para identificar las principales fuentes percibidas de incertidumbre relacionadas con la evaluación y el asesoramiento, ampliando la tarea hasta la tercera fase, y en el desarrollo de nuevas herramientas para utilizar mejor los conjuntos de datos recopilados hasta la fecha, con el fin de mejorar los conocimientos sobre las especies y lograr una ordenación más centrada.

1. Introduction

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

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

The total budget of the programme was estimated at about 19 million Euros in six years, with the engagement of the European Community and some other Contracting Parties to contribute to this programme in 2009 and in the following years. The initial year had a budget of 750,000 Euros, the second phase had a total budget of 2.502.000 Euros (against the original figure of 5,845,000 Euros and a revised figure of 3,476,075 Euros), while the third phase had a budget of 1,925,000 Euros (against the original figure of 5,845,000 Euros and a revised figure of 4,417,980 Euros).

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, while Phase 3 were joined also by China, Algeria, Korea and Tunisia. Several private or public entities[3] provided funds or in kind support; the detailed list is available on http://www.iccat.int/GBYP/en/Budget.htm.

The second phase (12 months) officially initiated on December 22, 2010, after the signature of the Grant agreement for co-financing the GBYP Phase 2 (SI2.585616) by the European Commission. Phase 2 had two

[3] 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) and, in kind, by Balfegó Grup (SP), IEO–Fuengirola (SP); INRH –Tangier (MO), Maromadraba SARL and Es Sahel (Fuentes Group)(MO), Roberto Mielgo Bregazzi (SP) and WWF Mediterranean Programme.

prorogations, the first up to April 22, 2012, and the second up to May 22, 2012. Phase 3 will expire on January 19, 2013. The activities up to November 2011 were presented to the SCRS and the ICCAT Commission in 2011 and they have been approved.

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

2. Coordination activities

The GBYP Coordination staff was reinforced with a Coordinator Assistant. Dr. M'Hamed Idrissi who started his duties on 1 March 2011. The ICCAT Secretariat nominated Dr. Laurence Kell as internal focal point for the GBYP activities. A technical support (already included in the budget), particularly for managing and organising the many data sets obtained by GBYP, was required to ICCAT. Some candidates were selected by an external job agency and then the final selection was carried out at the ICCAT Secretariat on October 19, 2011, by an *ad hoc* Selection Committee. Dr. Ana Justel Rubio was selected and she started the activity on 25 October, 2011, with a temporary contract.

A relevant activity at the early beginning of Phase 2 was the organisation of the three meetings planned in February, which required considerable effort. The participation of 44 scientists from 11 countries and the extremely positive comments received compensated all efforts and confirmed the positive reaction of the scientific community and stakeholders to the GBYP activities. Another meeting (the Symposium on Traps) was organised in Tangier in May 2011, with the participation of 58 scientists. A second GBYP Operational Meeting on Tagging, Biological and Genetic Sampling and Analyses was organized in Madrid on April 17 & 18, 2012, during the extension period of Phase 2, for discussing all practical aspects concerning the final activities of Phase 2 and the final plans for Phase 3. A total of 28 scientists joined the meeting, which resulted in intense and productive discussions, useful for better defining all the operational details and clarifying some uncertainties.

Another coordination activity in Phase 2 concerned the organisation of the electronic tagging activities carried out in a Moroccan trap in May 2011 and May 2012, and field inspections for the aerial survey activity in 2011. Furthermore, an intense activity was devoted to the tag awareness campaign, particularly during the extension period in the first part of 2012.

During Phase 2 it was necessary to issue eleven Calls for Tenders on various items and a total of 22 contracts were signed by the ICCAT Secretariat; several agreements for invited speakers and trainers were also issued. Four Calls for tenders were issued in the first part of Phase 3, releasing 3 contracts[4]. The list of the Call for tenders is on Annex I. A total of 23 deliverables (periodic reports) were produced in the framework of the EC Grant Agreement (Annex II). In Phase 2 and in the first part of Phase 3 of the GBYP, the coordination staff participated officially in 33 meetings in various countries. (Annex III).

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, in 2010 the Coordinator joined the Steering Committee for the bluefin tuna programmes of the NOAA, together with other 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 2012.

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.

In conformity with the Atlantic-Wide Bluefin Research Programme (GBYP) adopted by the SCRS and the Commission for Phase 2, the following research initiatives have been conducted or initiated (see also Table 2 at the end of the activities).

[4] Two Calls for tenders were still open at the momento of the preparation of this report.

3. Data mining and data recovery

As usual, the first preliminary activity was conducted at the ICCAT Secretariat. An updated analysis of the ICCAT data base on bluefin tuna was carried out, with the purpose to identify the most relevant gaps in the data series which are potentially useful for the stock assessment, taking into account the data already collected under GBYP Phase 1; this gap analysis was provided by GBYP to the SCRS Scientists and National statistical correspondents to help them in detecting the lacking data.

3.1 Objectives of the data recovery and data mining

The objective of data recovery and data mining activities is to fill the many gaps existing in several data series currently present in the ICCAT data base, concerning both recent and historical data, which causes a large amount of substitutions in the assessment process, increasing uncertainties. At the same time, data mining activities should provide reliable data series, longer that those currently available, recovering data from many sources, including archives having difficulties for the access. 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.

The objectives sets for data recovery and data mining in Phase 2 have been largely accomplished, even if the historical data from the Ottoman Archives and the video analyses were not accomplished, due to the lack of tenders for both tasks. These objectives will be partly moved to Phase 3, as recommended by the GBYP Steering Committee. The first Call for tender concerning the data recovery in Phase 3 had no bids, and it will be reissued.

3.2 Data recovered in Phase 1, Phase 2 and the first part of Phase 3

The data recovery and data mining activities in Phase 2 are described in detail on Deliverable B1.3 (issued on June 27, 2011), Deliverable B1.3.1 (issued on October 11, 2011) and Deliverable B1.3.2 (issued on April 22, 2012).

In total, ICCAT-GBYP issued 5 Calls for Tenders under this activity in Phase 2 (3 for data mining and data recovery, 1 for SST data and 1 for the elaboration of aerial survey data) , and 1 Call for tenders in Phase 3, releasing a total of 10 contracts. Considering also the activity in Phase 1, the total of Phase 1 to the first part of Phase 3 combined is 11 Calls for Tenders and 17 contracts.

The amount of data recovered by GBYP in the first two Phases is very relevant and the following **Table 1** shows the results for the major components.

In terms of number of records and number of fish sampled (Task II), most of the data are originating from various gears (BB, LL, HP, HL), while in terms of number of tunas and total bluefin tuna weight in the catches, the large majority of the data are from tuna traps.

These data are clearly showing the enormous improvement provided by GBYP to the ICCAT bluefin tuna data base in the first two years and it is the clear demonstration that the data recovery activity is able to find data sets which are sitting in various archives.

The second round of data mining and data recovery brings the full total of recovered catches to 23,225,853 tunas, 947,972 tons and 118,551 fishing operations, which constitutes a considerable improvement of the data available for scientific uses in the ICCAT data base. Even this data recovery and data mining was possible thanks to the passion, the dedication and the availability of several scientists, who worked well over the scheduled amount of workload established by the contracts. In particular, it was extremely remarkable the amount of additional reliable data series provided for tuna traps, which currently start from the year 1509, even if data from 1509 to 1525 are still not fully included in the data base. This fact labels the ICCAT bluefin tuna data base as the longest among those hold by all others RFMOs and possibly as the most extended among all fishery data series.

3.3 Bluefin tuna fishery data analyses

The analyses of data recovered in Phase 1 and Phase 2 were not the main goal for Phase 2, but it was decided to initiate this task, taking into account the considerable amount of work to be done.

The first part of the work concerned the quality control for incorporating the data in the ICCAT data base and this was done by individually checking all data, at first against the existing data sets in the ICCAT bluefin tuna data base, for confirming that there was not any potential duplication, and then by an in-depth control. This first part of the work is essential for going on with the regular ICCAT data process, which requires steps by the SCRS Bluefin Tuna Species Group and Subcomstat.

Immediately after the first essential quality control, which required a lot of time and several internal meetings, because it was necessary to individually check a total of 118,894 basic records, it was decided to initiate a series of basic analyses in strict cooperation with the ICCAT Statistical Department for providing a detailed overview of all data recovered and some very preliminary elaborations (length-weight correlations, length frequencies, etc.). A particular attention was devoted to trap data sets (see the following **Table 2**), both for the specificity of this gear type and for the extremely long data series, and for these reasons the analyses were conducted separately.

The analytical work is essential for including all data recovered so far and those that will be collected in the future in the bluefin tuna stock assessment process. The scientific reports about the preliminary analyses on the bluefin tuna data recovered by GBYP in the first two years of activities were officially presented to SCRS in 2012.

3.4 The Symposium on Tuna Trap Fishery

The first use of these data was during the ICCAT/GBYP Symposium of Trap Fishery for Bluefin tuna, held in Tangier (Morocco) from 23 to 25 May 2011, and included within the GBYP Data mining, data recovery and data elaboration activity. The Symposium was attended by 60 scientists (among them, 10 invited speakers), representatives of the industry and NGOs and 27 papers have been presented. The GBYP Coordination provided the Symposium with a comprehensive review of bibliography and iconography on tuna trap fishery. The Symposium was considered the most important on this ancient fishery never held in the world, also because it was possible to have an overview of some traditional trap fisheries from distant areas (Japan, US, Canada), and assembled together very detailed information about historical, cultural, social, economic and fishery aspects of an activity which is the most ancient industrial fishery in the world, dating back at least 2600 years. This action was detailed in the Deliverable B1.2, issued on June 27, 2011.

The full report of the Symposium is available on the ICCAT page (http://www.iccat.int/Documents/Meetings/Docs/2011_BFT_TRAP_SYMP_REPORT_ENG.pdf), and it was submitted to the GBYP Steering Committee and the SCRS in 2011 for approval. The scientific papers and presentations at the Symposium are published on the special issue of the ICCAT Collective Volume of Scientific Papers, vol. LXVII, 2012 (attached to the Deliverable 22 issued on June 22, 2012). The Symposium was also the opportunity for implementing the first cooperative electronic tagging activity in Morocco, and this additional action is reported in this report in paragraph 5.5.

3.5 Elaboration of Aerial Survey Data

According to the decision taken by the GBYP Steering Committee (June 26-July 1 2011), it was decided not to issue a third Call for Tenders as it was originally planned, but instead to provide a contract to the same team who made a satisfactory work in Phase 1, asking the team not only to elaborate on the aerial survey data from the 2011 activity, but also a more complex analysis to be conducted on the data from the last two years, with the purpose to develop recommendations on the minimum aerial survey design(s) required for use within a scientific management framework. All details are included in the ***Deliverable B2***, issued on February 10, 2012, concerning the GBYP Aerial Survey, while a synthesis is on paragraph 4.4 of this report.

4. Aerial Survey on Bluefin Tuna Spawning Aggregations

After the experience in the first year, which demonstrated possibilities, limits and capacities of the aerial survey on bluefin tuna spawners, the GBYP Steering Committee recommended to organise a Workshop on Aerial survey for Bluefin Tuna, for having a general overview of the best practices on this particular technique around the world and discussing the best possible approach in Phase 2 and in the next years. The Workshop was endorsed by SCRS.

4.1 Objectives of the Aerial Survey for bluefin tuna spawning aggregations

The aerial surveys have the scope to provide fishery independent indices, concerning various fractions of the bluefin stock. The aerial surveys targeting spawning aggregations can potentially provide indices for the spawning stock biomass, while aerial surveys targeting aggregations of juveniles can potentially provide indices for the recruitment. In every case, surveys shall be conducted with a statistically sound design and for several years in order to get reliable indices. The aerial surveys can provide trends over a given period, which is usually never less than 6 years, along with yearly variability of apparent abundance in the surveyed areas, associated with the CV.

The GBYP, in Phase 1 and 2, within the objectives, was able to reach the **following results**: 1) identify a defined methodology for the aerial survey of bluefin tuna spawners and verify the feasibility; 2) identify a survey design approach which can be modified in real-time for responding to emergency imposed changes or opportunities; 3) identify operational limits and needs; 4) obtaining for the first time fishery independent estimation of quantities of bluefin tuna spawners in the survey areas, with the associated CVs and variability between years; 5) identify the basic elements for defining the correct strategy for obtaining trends of apparent abundance and, consequently, define the minimum limits for having a reliable extended survey under various scenarios.

Considering the serious budget reduction and the many operational constraints of various types encountered in both Phase 1 and Phase 2, the results obtained by these two first years of survey can be considered satisfactory, even if critical events of *force majeure* partly limited the survey activity in some areas.

4.2 The ICCAT-GBYP Workshop and the Training Course on Aerial Survey for Bluefin Tuna

The ICCAT-GBYP Workshop on Aerial Survey for Bluefin Tuna, recommended by the GBYP Steering Committee and by the SCRS in 2010, was endorsed by the Commission in its 2010 meeting.

The GBYP tagging activity was planned from Phase 2 and then in following phases. The tagging design was defined in the first part of Phase 2. The first operational meeting on biological sampling was held at the ICCAT Secretariat in Madrid on February 17, 2011, to discuss the many aspects of this complex activity and the GBYP Tagging Design, including the GBYP Tagging Manual, which were officially adopted. The meeting was attended by 42 scientists. The full report of the GBYP Workshop on Aerial Survey is available on the ICCAT page (http://www.iccat.int/Documents/Meetings/Docs/2011_GBYP_WORKSHOPS_ENG.pdf), while the details and the presentations were included in the Deliverable C1**,** issued on March 11, 2011. The difficulties presented by the GBYP Aerial Survey were discussed in details, particularly for the aspects concerning the fact that the Mediterranean Sea is shared among 24 aerial spaces, managed by each country (**Figure 2**), and the difficulties for getting the permits in some areas, where procedures might be particularly complex.

The Workshop provided several recommendations, some of them to be immediately enforced in GBYP Phase 2. The GBYP Steering Committee held a meeting on February 17-18, 2011 (Deliverable 23), immediately adopting some of the recommendations proposed by the Workshop (Distance method, survey restricted to June, mandatory use of bubble windows, two scientific observes on each aircraft, four areas to be monitored, use of geo-stabilised cameras if possible, aerial survey on juveniles to be encouraged on CPCs funds), moving others to SCRS for the aspects concerning the next years (extensive synoptic survey).

The GBYP set up general rules for standardising the aerial surveys to be conducted: all aircraft shall have upper wings, two engines and bubble windows (one per side) shall operate at an altitude of 300 (with 10% tolerance) over the sea level and at a speed of 300 km/h (10% tolerance), and shall have a GPS able to continuously recording the track and the related data. Each aircraft shall be identified by an ICCAT number in contrasting colour with the aircraft, on one lower side of the wings and on one side of the aircraft. In Phase 2, according to the outputs of the GBYP Workshop on Aerial Survey, each team on board shall include an expert pilot, a professional tuna spotter and two scientific observer. All sightings shall be properly recorded on a common form in excel (improved after the experience of the first year), to facilitate the data elaboration, and documented by photos.

The decision to organise a training course for the pilots, the professional spotters and the scientific spotter was confirmed, setting the date in May 2011, after the Call for tenders, the selection of bids and the signature of the various contracts.

The GBYP Training course for the Aerial Survey was held on May 17 &18, 2012, attended by 21 participants and 3 instructors. The details are on Deliverable C2, issued on June 27, 2012. The training course was unanimously considered very useful by all participants. These activities were presented to the SCRS in 2011, and they were approved.

4.3 The ICCAT-GBYP Revision of the Aerial Survey Design for Phase 2

According to the discussions, the conclusions and the recommendations of the ICCAT-GBYP Workshop on Aerial Surveys and to the following recommendations provided by the GBYP Steering Committee (Deliverable 23), it was decided to fully revise the GBYP aerial survey design adopted in Phase 1, following the same methodological approach for providing a revised design to be used in Phase 2.

A preliminary work was done at the ICCAT Secretariat, using the VMS data from bluefin tuna purse-seiners for the years 2008, 2009 and 2010, was very useful for better defining the boundaries of the various sub-areas, always taking into account the already existing knowledge on the biology and ethology of the eastern Atlantic bluefin tuna stock during the spawning season. After an internal discussion, taking into account the situation in several North African countries, and particularly the operational problems encountered by the companies engaged in the GBYP aerial survey in Phase 1 for obtaining the flight permits in the Tunisian and Egyptian air-space, it was decided to modify the sub-areas 3, 4, 7 and 8 established in 2010, by cutting the eastern boundaries in the Gulf of Sirta from the previous sub-area 4, and by joining and reshaping the previous sub-areas 3, 7 and 8. The design was made by the same team who made the design in Phase 1 (Alnilam Investigación y Conservación SL, SP), by using the "DISTANCE" software tools and the details are reported by the Deliverable C3, issued on April 28, 2012.

Then, just before finally refining the design, there was a further deterioration of the situation in the North African area and then it was decided to ask for a design having two alternative scenarios, the first including the Libyan air space (with the new sub-areas 3CL and 4) and the second without the Libyan air space (with the new sub-area 3CM, **Figure 3**). According to the UN Security Council Resolution 1973/2011 on March 17, 2011, establishing a no-fly area in central-southern Mediterranean (released on March 18 and enforced immediately after), and taking into account the various problematic socio-political situations in other areas, it was decided to limit the GBYP Aerial Survey for bluefin tuna spawning aggregations to sub-areas 1, 2, 3CM and 6. As a consequence, the second scenario was the one adopted for the aerial survey activity in Phase 2, according to the field situation at that time.

The full report for the revised design in Phase 2, along with the new tracks for all areas, was submitted on March 21, 2011 and it was approved by ICCAT-GBYP after checking the contents at the Secretariat. The design was further revised during the survey, due to the unexpected prohibition to use the southern part of area 3CM, due to military reasons, which forced our aircraft to abandon this corridor. This last change did not affected so much the observations in sub-area 3-CM.

4.4 The ICCAT-GBYP Aerial Survey for Bluefin Tuna Spawning Aggregations in Phase 2

The Deliverable C4, issued on October 11, 2011, describes in detail the results of the aerial survey on spawning aggregations in 2011, and included also the first preliminary report on the analyses carried out on the survey, made for preliminary information to GBYP Steering Committee, the SCRS and the ICCAT Commission.

Three companies carried out the aerial survey in Phase 2 (Grup Air-Med, Spain, for sub-area 1; Consorzio UNIMAR, Italy, for sub-area 2; Périgord Travail Aérien, France, sub-areas 3CM and 6). In agreement with the GBYP Steering Committee, the beginning of the survey was delayed for avoiding any potential interference with the purse seine fishery and then it was adopted the following calendar: June 7 in sub-area 6 (eastern Mediterranean Sea), June 12 in sub-area 3CM (Central Mediterranean) and June 15 in sub-areas 1 (Balearic Sea) and 2 (south Tyrrhenian Sea); it was agreed to eventually anticipate the beginning of the survey if the quota will be reached before these dates by the fleets fishing in each of these areas. The aerial surveys initiated on June 10 in sub-area 1 (the quota was reached on June 9, 2011), on June 20 in sub-area 2 (due to a technical problem to the aircraft), on June 12 in sub-area 3CM, while the aircraft was moved to sub-area 6 on June 11.

The aerial survey in Phase 2 was done on schedule in sub-area 1, 2 and 3CM, while it was not conducted in sub-area 6. The aerial survey activity in Phase 2 was characterised by several difficulties which were impossible to

consider in advance. Sub-area 1 was affected by many days of strong winds, which caused the request to extend the ending date by 5 days (agreed by the GBYP Steering Committee). The aircraft used in sub-area 2 had several mechanical problems, besides of the correct maintenance schedule and revision (checked by GBYP) and it was necessary to alternate two aircrafts with the same characteristics. The aircraft operating in sub-area 3 CM on June 15 was forced by a NATO French aircraft to stop flying in the 20 miles large area north of the UN No-Fly zone; this prohibition was further confirmed to the contracted company by the Malta Aviation Authority, justified with security or military reasons; this limitation caused the reduction of the survey area, exactly in the same way experienced in Phase 1.

The worse situation was reported in sub-area 6, because the aircraft got on site only with the landing permit, waiting for the survey permit, which never arrived before July 10, besides of direct interventions of the ICCAT Executive Secretary. The Turkish Authorities finally released the survey permit on July 15, 2011, with the obligation to carry on board a Turkish observer. This date was outside the spawning season and the survey was cancelled for *force majeure*.

The aerial survey on spawning aggregation in 2011 was affected not only by the above mentioned problems, but also by the unusual situation in terms of temperatures and winds. The surface temperature was unusually very hot at the beginning of the potential spawning period (May) in the Tunisian waters and in the Eastern Mediterranean. Waters became wormer even in the Western Mediterranean, close to the Balearic area, well in advance of the usual average time and anticipated spawning was noticed in this area before the beginning of the GBYP aerial survey. The waters in Southern Central Mediterranean had a serious delay in reaching the suitable temperature for spawning, possibly due to the strong winds that characterized this part of Mediterranean in late spring 2011. It was very interesting to notice a large area of warm surface water in the Ionian Sea, reaching also the coasts of Cirenaica and creating an unusual area potentially suitable for spawning in this large portion of the Mediterranean Sea. The winds which arrived in the Western Mediterranean in June created problems for keeping the warm water layer close to the surface, while winds affected also the first part of the spawning season in the Southern Tyrrhenian Sea and for several days in the Eastern Mediterranean, impeding the thermocline to stabilize at the right depth for allowing bluefin tuna spawning in these periods and in those subareas[5].

These environmental/oceanographic conditions were clearly reflected by the reduced surface surveyed in sub-area 3CM, because it was impossible to spot the bluefin tunas far from the aircraft track when they were swimming well below the sea surface.

The data obtained in the various sub-areas by the aerial survey were elaborated and analysed by the same company (Alnilam Investigación y Conservación SL, SP) which carried out the elaboration in Phase 1, and the full report was provided by Deliverable B2, issued on February 10, 2012. Bluefin tuna sightings in GBYP Aerial survey in 2011 are showed on **Figure 4**.

CVs for density of schools in all models varied between 26 % for sub-area 3M and 36 - 37% for sub-areas 1 and 2 (figure 3). The precision of mean school size was in the same range, between 26 and 44%. CVs for estimates of total weight were high in all sub-areas: 41% for sub-area 3M, 43% for sub-area 1 and 54% for sub-area 2. Summing over all sub-areas surveyed, the CV of total abundance was 41 %, and much lower than the CV in 2010. The coefficients of variation have gone down considerably in all sub-areas in 2011, when the number of sightings has increased. **Table 3** reports the data obtained by the GBYP aerial survey in Phase 2 and the comparison with those obtained in Phase 1.

In sub-area 1, there was 27% more effort in 2011 than in 2010 while there was a 57% increase in number of sightings, resulting in a similar increase in encounter rate (27%) and density of schools (25%). However, the mean weight of the schools has decreased 30% in 2011 with respect to 2010. Therefore, it seems that in 2011 there were more groups but smaller (in terms of weight) than in 2010, resulting in a decrease of 17% (211 t) in final total weight for this sub-area from 2010 to 2011, which, given the wide CVs, are no significantly different. The GBYP considers that, taking into account the additional information available and as mentioned before, the

[5] According to the environmental and fishery observations available from several sources, bluefin tuna spawning in 2011 was scatterd into different time blocks in the various areas, being more continous and regular in the eastern Mediterranean, unusually abundant in the eastern-central Mediterranean, more delayed and concentrated in the southern-central Mediterranean, anticipated, interrupted and slightly delayed in the southern Tyrrhenian Sea and anticipated, interrupted and then consideralbly extended up to the beginning of the fall in the western Mediterranean close to the Balearic area.

lower quantity of bluefin tuna in this area is possibly due to an anticipated presence of bluefin tuna in the area, induced by an anomalous anticipated warming of the surface waters in the Balearic areas at the beginning of May; these two factors, combined with the late beginning of the aerial survey, can possibly explain the variability. Tagging data from IEO confirms that several bluefin tuna spawners anticipated their presence in the western Mediterranean in 2011, leaving the area well before the usual time.

In sub-area 2, the effort was very similar in both years but with more sightings in 2011 (67% more), resulting in a larger encounter rate (57% larger). However, density of schools is smaller (32%) in 2011. This is due to a much larger *esw*[6] in 2011 than in 2010, so even if encounter rate of schools is larger, it refers to a much smaller searched area, and therefore when extrapolating the density within the searched area to the whole sub-area, the overall density is much larger. Also the mean weight per school was much lower in 2011 than in 2010 (66% lower). All this yields provided a considerably smaller total weight of bluefin tunas in sub-area 2 with respect to 2010: 1176 t less, representing a decrease of 76%.

The GBYP considers that, taking into account the additional information available and as mentioned before, the late beginning of the survey was only partly able to intercept the bluefin tuna schools that were previously present in the area (similar to sub-area 1) and that were noticed by the purse-seine vessels fishing there at the beginning of the fishing season, possibly because of the higher temperatures at the beginning of June. As a matter of fact, the SST on June 12 started to slowly decrease for a couple of days, logically inducing some changes in the behavior of spawners.

Sub-area 3 had different size in 2011 due to some changes done to the limits of the block, resulting in an area 10,000 km^2 larger (around 10%), even considering the shortcut imposed in the southern part. In 2011 much more effort was done in this area, more than the double than in 2010, resulting also in a much larger number of observations, but in a proportional way to the increase in effort. Therefore, the encounter rates of schools remain very similar in both years. However, the *esw* in 2011 is considerably smaller than in 2010: 330m *versus* 4,830m (right truncation distance in 2011 was 800m, while it was 7,500m in 2010). This very large difference in *esw* could be explained, at least partially, with potential differences in searching protocol and/or with the particular environmental situation noticed in the area. In addition, the mean weight per school has increased to around double in 2011 with respect to 2010, the contrary of what happened in sub-areas 1 and 2. As a consequence of all these factors, the total weight estimated for this sub-area is extremely larger in 2011 than in 2010 (1820% increase).

The GBYP considers that, taking into account the additional information available, it is possible that tuna schools in sub-area 3CM were more present during the survey period, because the strong winds that characterized the first part of the season (May) were much less strong in June-July, allowing for a later stabilization of the thermocline. In this case, the late beginning of the survey intercepted a more favorable condition for spawning, while the huge presence of a very warm and stable large water mass between SE Italy, Cyrenaica and SW Greece created for several weeks a very attractive area for bluefin tuna spawners, possibly increasing their eastward movements in the Strait of Sicily towards this large area. At the same time, the fact that most of the bluefin tuna schools were not at the surface but just below it was the clear reason for the much lower *esw* in 2011, because it was impossible to detect them far from the aircraft track. This fact further confirms the validity of the high estimation of the number of tunas in this area.

The GBYP considers that the changes induced by the technical decisions adopted by the Steering Committee might be a part of the variability encountered in 2011, particularly about the different esw; as a matter of fact, changes in *esw* were expected, because flat windows were used in 2010, while mandatory bubble windows were used in 2011. At the same time, all observers reported problems in using the declinometers (mandatory in 2011), because the precision provided by the tool is very similar to the estimation provided by the pilot and small gains in terms of precision are not compensating the time for using this tool and the difficulties for keeping the tunas within the observer's detection range. These two technical issues should be further tested in future surveys.

Under the GBYP Data Recovery Framework it was required to include an evaluation of the importance of environmental covariates, such as sea surface temperature data, in the aerial survey design and analyses. Density surface modelling is an approach that uses physical and environmental data to help explain variation in

[6] *esw* is the estimated effective strip half-width

distribution and density and predict areas that are important for the focal species. When combined with line transect sampling (called the "model-based method"; Hedley et al. 1999), it is an alternative technique to conventional line transect sampling ("design-based method"; Hiby and Hammond 1989; Buckland et al. 2001). The final report includes spatial models, using methods (density surface modelling) described in Cañadas & Hammond (2006; 2008), to explore the relationship between bluefin tuna density and environmental covariates. The report also provides maps of the predicted densities of bluefin tuna in the survey blocks. The best model included three covariates: latitude and longitude as an interaction and depth_mean, but none of the sea surface temperature covariates, as they did not improve the model at all. This model explained 48.1% of the deviance and these covariates were highly significant.

The values reported for area 3CM were considerably higher than in 2010 and then they were considered the most uncertain. It was necessary to carry out additional work with the observers for confirming each value, deeply analysing each sighting. All these data were confirmed and then the analysis carried out in the report is confirmed as well. The model provided the estimates and the CVs showed on **Table 4**.

The final report also considers other recently available models (Drouon *et al*., 2011), but the combination of real-time aerial observations, reliable SST data and other additional information as used by ICCAT-GBYP methodology is considered much more reliable than any other existing modelling approach in this field, particularly because real-time data are not included elsewhere.

This second year activity of aerial surveys confirmed the validity of the methodological approach in general[7], as one of the very few methodologies able to provide fishery independent data and trends, but over a minimum time frame which exceeds the current duration of the GBYP and the number of years actually available for the aerial survey. The budget level which is necessary for ensuring a sufficient extended coverage as recommended by the GBYP Steering Committee should be also considered, because it requires a well-defined engagement and the alternation among the various GBYP activities[8]. At the same time, the problems encountered showed the need to get very precise engagements by all the CPCs concerned, in order to have the necessary flight permits on time.

4.5 Evaluation and estimation of basic requirements for allowing the ICCAT-GBYP Aerial Survey for Bluefin Tuna Spawning Aggregations to fully reach its objective

The analyses requested to the contractor included also the evaluation and estimation of the basic requirements for allowing the ICCAT-GBYP Aerial Survey on Bluefin Spawning Aggregation to fully reach its objective, particularly considering that the aerial survey is able to provide trends, but it is necessary to have various years of data for getting reliable trends. The recommendation by the GBYP Steering Committee was to extend the survey to a much larger area, with the purpose of more reliably coverage of a bigger portion of the spawning areas in the Mediterranean Sea and for better detecting variability among areas. Due to the high variability of the bluefin tuna spawning aggregations by year, which is conditioned by many factors, and particularly by the instant oceanographic conditions and the short and medium time evolution of winds and temperatures, it is extremely difficult imagining the various scenarios according to the current knowledge, which is certainly limited. In any case, using the data obtained by the GBYP Aerial Surveys in 2010 and 2011 and with a continuous dialogue with the GBYP Coordination, it was possible to obtain some possible scenarios under different approaches. This part of the study was presented to the Steering Committee, to SCRS and to the ICCAT Commission in 2011, and it was included in the Deliverable C4, issued on October 11, 2011.

The basic question was the following: how much searching effort is required to achieve a CV of abundance that will allow a given rate of recovery to be detected with reasonable power?

The analyses provided that there are two main scenarios to be considered, also taking into account reasonable budget and operational constraints: the first one covering 100,000 km per survey, for almost half of the potential Mediterranean bluefin tuna spawning areas, and a second one covering 200,000 km per survey, for almost all of

[7] Many data on marine Mammals and sea turtles have been collected during the survey in Phase 1 and Phase 2. Besides their high interest, these data were not elaborated so far and they will be analysed in the following years, because this is not a priority task of GBYP.

[8] The contemporary engagement for carrying out the aerial survey and other expensive activities like the extensive tagging and the bio-genetic sampling and analyses implies a high level of budget, similar to the original one adopted by the ICCAT Commission, while the current level of reduced budget does not permit to have all those activities at the same time.

the potential Mediterranean bluefin tuna spawning areas[9]. These two basic scenarios were fitted with various recovery rate assumptions and the relative CV. The power analysis showed that the rate of recovery detectable decreases as CV of abundance decreases and number of surveys increases (**Table 5**). At the same time, the power analysis showed that number of surveys required decreases as rate of recovery increases and CV of abundance decreases (**Table 6**).

Within the best possible scenario (20% recovery rate in the survey period and 15% CV), the number of survey required should be at least 5, while under the worse possible scenario taken into account (5% recovery rate and 27% CV) the minimum number of surveys required should be 13. Considering the strict management measures, the reduced fishing season, the sequence of recent years with strong recruitment, it would be possible that a reliable trend of abundance of bluefin tuna spawning biomass could be obtained after a minimum of 6 years of extensive aerial surveys[10].

The conclusion is that with the aerial survey methodology it is possible to collect data which are potentially useful for management. Those data, which could be considered more reliable than fishery data, can be used in the assessment models like other abundance indices (i.e.: CPUE).

4.6 Aerial Survey on spawning aggregations versus aerial survey on juveniles

This particular point was raised by the GBYP Steering Committee on February 2012, who requested the GBYP Coordination to assess the possibility of shifting the target of the aerial survey from spawning aggregations to juveniles, possibly by attributing this task to an external expert. Due to the lack of available experts and also to the absence of a specific budget issue, the analysis was conducted directly by the GBYP Coordination, based on the internal expertise and knowledge. It was decided to carry out a SWOT analysis (SCRS/2012/140). Both approaches are useful, but the survey on spawners has much more strengths than that on juveniles, while opportunities are similar and weaknesses are higher for the juveniles.

5. Tagging activity

According to the general programme, it was planned to begin the tagging activity in GBYP Phase 2, including a preliminary operational meeting and then a field activity with conventional tags and a limited activity with electronic tags. A second operational meeting was organized during the extension period of Phase 2 while a tag awareness programme was also launched in Phase 2 and continued in the first prt of Phase 3.

5.1 Objectives

The specific objectives of the GBYP tagging activity on the medium term (according to the GBYP Tagging Design) 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[11].
b) Estimate the natural mortality rates (M) of bluefin tuna populations by age or age-groups and/or total mortality (Z).

[9] The potential spawning areas in the Mediterranean were calculated considering the historical and current scientific knowledge on bluefin tuna spawning and including also marginal areas where oceanographic conditions might allow spawning in some years; the areas excluded are the Strait of Gibraltar, the Alboran Sea, the Gulf of Lion, the Ligurian-Provençal basin, a narrow strip along the western Sardinian coast, a narrow strip along the SW part of Sicily, a narrow strip area along E Sicily, the northern Adriatic Sea and some N-NE parts of the Aegean sea. This approach should be able to include also marginal areas.

[10] Due to the current reduced budget and the possible continuation of similar budget constraints in future years, it would be reasonable to consider the possibility of alternating various GBYP activities, but always maintaining a minimum of two year consecutive aerial surveys; under this scenario, if the assumed recovery rate will be confirmed, the CV might increase. This is to be taken into account when considering the various GBYP activities, their objectives and the balance between financial resources and expected results.

[11] Additional elements will be provided by the GBYP biological and genetic sampling and analayses.

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.

A well-designed tagging programme, developed over several years schedule and with a progressive methodological approach, will therefore be important in improving our understanding of bluefin tuna ecology and ethology and for developing better stock assessment methods.

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 objectives set for Phase 2 have been mostly accomplished, taking into account all the various changes and constraints the GBYP had to face. In particular, the synthesis for each item is the following:

- ✓ Operational meetings: fully accomplished, including one additional meeting not originally included;
- ✓ Tagging material: fully accomplished[12] and additional material is already available for allowing Phase 3 activities beginning without delay;
- ✓ Conventional tagging: mostly accomplished, due to "force majeure" operational problems in some areas;
- ✓ Mini-PATs electronic tagging: not originally included, was carried out also in the extension period obtaining very useful results.
- ✓ Tag reward policy: fully accomplished, with the new improved system officially in place.
- ✓ Tag awareness campaign: fully accomplished, with all new awareness material distributed in all the convention area and among all CPCs and entities.
- ✓

All activities concerning tagging and related issues are reported in details on the Deliverables D1.1 (issued on March 21, 2011), "All Tasks.1" (issued on July 31, 2011), D1.2 (issued on July 31, 2011), D2.1 (issued on October 11, 2011) and D2.2 (issued on June 22, 2012).

The tagging activity in Phase 3 started on schedule.

5.2 Operational Meetings on Bluefin Tuna Tagging

The activity at the early beginning of Phase 2 included also the organization of the ICCAT-GBYP Operational Meeting on Tagging for Bluefin Tuna, recommended by the GBYP Steering Committee and the SCRS and endorsed by the ICCAT Commission in its 2010 meeting. The GBYP Steering Committee on 17 February 2011 (Deliverable 23, issued on June 22, 2012) identified some additional issues that were discussed during this first Operational Meeting.

The Meeting was held at the ICCAT Secretariat in Madrid, on 18 February 2011 and was attended by 42 scientists from various ICCAT CPCs, industry and NGOs representatives, including 2 invited speakers. The GBYP Tagging Design

(http://www.iccat.int/GBYP/Documents/Annex%201.%20Tag%20design%20report_fin_rev.pdf) and the GBYP TaggingManual (http://www.iccat.int/GBYP/Documents/ICCAT%20GBYP%20TAGGING%20MANUAL_fin_rev.pdf) were discussed in details during this meeting and some additional refinements were required. The high attendance was very useful for discussing many practical and theoretical issues about the tagging to be carried out in 2011 and in the next years. The recommendations included the indication to limit tagging in the first year to juvenile tunas and the request for double tagging 40% of the tagged individuals, for studying the retention rate of the various types of tags. The full details and the presentations were included in the Deliverable D1.1 (issued on March 21, 2011.

A second GBYP Operational Meeting on Tagging, Biological and Genetic Sampling and Analyses was organized in Madrid on April 17 & 18, 2012, during the extension period of Phase 2, for discussing all practical aspects

[12] Except for PIT tags, because the order was cancelled for the reasons detailed on Deliverable "All Tasks.1".

concerning the final activities of Phase 2 and the final plans for Phase 3. It was decided also to continue the electronic tagging activity with miniPATs experimentally conducted in Morocco in May, 2011 and a further trial was conducted in May, 2012. Other electronic tags were used during the conventional tagging activities in Phase 2.

A total of 28 scientists joined the meeting, which resulted in intense and productive discussions, useful for better defining all the operational details and clarifying some uncertainties. The full details are available on Deliverable 2.2 (issued on June 22, 2012).

5.3 Tags and correlate equipment

ICCAT-GBYP, in the first Phases, acquired the following tagging material, to be used in Phase 2 and following Phases of GBYP:

Conventional spaghetti tags:

a) 35,000 Dart single-barb FT-1-94 + 2,500 applicators
b) 22,000 small-head double-barb FIM-96 + 9,300 applicators
c) 123000 big-head double-barb BIM-96 + 6,200 applicators

Mini-PATs:

a) 50 mini-PATs AM-P247A + 4 applicators + related satellite services
b) 26 mini-PATs AM-P247A provided by WWF-MedPO and 3 mini-PATs AM-P247A provided by IEO.

Implanted archival tags:

a) 50 archival tags TDR-MK9

PITs[13]:

a) 30 series 100 Wand readers
b) 20 series 350 Palm readers.

Details up to that date are on Deliverable "All Tasks.1", issued on July 31, 2011.

5.4 Conventional tagging

All details about the conventional tagging activities are included in Deliverables D1.1 (issued on March 21, 2011), "All Tasks.1" (issued on July 31, 2011), D1.2 (issued on July 31, 2011), D2.1 (issued on October 11, 2011) and D2.2 (issued on June 22, 2012). The tagging was carried out following the GBYP Tagging Desing and Protocols, focusing the activity og juvenile bluefin tunas. This decision implies that tags will be possibly mostly recaptured in future years, over a longer period.

The activity was carried out by a Consortium, which provided several reports. The Consortium encountered several problems for tagging, particularly in the western and central Mediterranean Sea, mostly due to causes of "*force majeure*" (bad weather conditions, fishery technical accidents and absence of juvenile tunas at the surface when the vessels where on site) .), but also partly due to some mistakes in the strategy adopted by the taggers.. Furthermore, the tagging strategy revealed some limitations (the tagging platforms were different and the mortality caused by tagging from purse-seiners was high, while the choice to explore the SW Sicily area did not provided results). There was a continuous discussion with the contractor and it was possible to reach an agreement for extending the tagging in the area of Gibraltar, for better balancing the number of tagged fish against the target. All these problems combined resulted in a final agreement for a partial reduction of the allocated budget.

[13] The order for 1,000 PITs was stopped for the motivations detailed on Deliverable "All Tasks.1". The readers were already delivered to ICCAT-GBYP before this event.

The tunas tagged in each area are as follows: 1278 in the Gulf of Biscay, including the opportunistic tagging by the sport fishers (38.89% double tagging), 1389 in the area of the Strait of Gibraltar (43.48% double tagging); 911 in the Western Mediterranean, including tagging when tunas were released from cages and the opportunistic tagging by sport fishers (28.65% double tagging), and 0 in the central Mediterranean Sea (see **Table 7**). It total, 4950 tags were implanted, on 3578 bluefin tunas (71.6% of the target or 79.51% of the target without 10% allowed contingency; with 38.07% double tagging, against a target of 40%); considering all the history of this first tentative effort for contemporary tagging bluefin tunas in several areas, the final result can be considered acceptable.

The tagging activity in Phase 3 was defined by the Steering Committee on 7-8 February 2012 and then refined on 20-21 March 2012, adopting the strategy to use exclusively baitboat vessels and to have a tagging coordinator for following the field activities in real time and maintaining a continuous contact with the GBYP coordination. The Call for tenders was issued on March 26, 2012, anticipating the official beginning of Phase 3 for allowing the field activities to start on time. The contract was awarded on June 21, 2012, to another Spanish Consortium of nine entities.

Even in this second year the field activity had many problems, some of them related to the permits for operating in waters of various CPCs. Some problems were solved in time, while others are still there, because of the various domestic procedures existing in the CPCs concerned. Furthermore, the vessels transferred to the Mediterranean for tagging had several problems, caused by "*force majeure*" (lack of juvenile concentrations in some areas, lack of fish at the surface, very little presence of bait, bad weather and technical troubles). At the moment on which this report was set-up, the tagging activity was completed even slightly over the target in the Bay of Biscay (3384 tagged fish against a target of 3350, with 41.3% double tagging), while only 63 tunas have been tagged so far in the Gulf of Lion (against a target of 3,200). The tagging activity in the central Mediterranean is currently starting, while tagging in the Strait of Gibraltar will start later.

As previously mentioned, the conventional tagging activity on juveniles will provide results in the following years, depending on the reporting rate that will be reached and the success of the tag awareness activities.

5.5 Electronic Tagging in Phase 2 and 3

The electronic tagging was not originally included in Phase 2 activities, except for PIT tagging which was cancelled as reported by the Deliverable D1.2, due to a formal problem raised by the Japanese Government according to a domestic regulation. A first opportunistic electronic tagging activity (with miniPATs) was possible in May 2011, while a further activity with miniPATs was carried out in May 2012 (Phase 2 extension period), in agreement with the recommendations made by SCRS and the GBYP Steering Committee, as reported by the Deliverables D1.2, D2.1 and D2.2. Internal archival tagging was complimentary carried out by WWF MedPO.

The electronic tagging with mini-PATs on bluefin tuna pre-spawners in a Moroccan trap in 2011 was described on Deliverables 1.2 and 2.1. It concerned a special activity organised by IEO and WWF-MedPO, assisted by the DPMA of Marocco and ICCAT-GBYP, sponsored by INRH, Ricardo Fuentes e Hijos s.a., Association Marocaine de Madragues, A.N.S.A. Almadrabas de Norte s.a., Maromadraba s.a.r.l. and Madragues du Sud. The tagging was carried out in a tuna trap in Larache (in the Atlantic coast of Morocco): 8 large bluefin tunas were tagged by WWF-MedPO and 3 by IEO[14]. Among the tunas tagged by WWF-MedPO, there were 4 premature detachments and only one individual entered into the Mediterranean Sea; the other 7 individuals remained in the Eastern Atlantic. Three tracks were particularly interesting: the specimen who entered in the Mediterranean Sea went in the Balearic area during the spawning season and then left the Mediterranean going to NE Atlantic and to some feeding grounds, and then releasing the tag off the Azores after 300 days; a specimen who went South of the Canary Islands in mid-July (in an area where some authors hypnotized that there is an occasional spawning area, and another specimen who went close to the Canary Islands and then to E Azores, to another area where some authors hypnotized that there is an occasional spawning area (**Figure 5**). These indications provided by two last specimens were discussed by the SCRS Bluefin tuna Species Group in 2011 and it was supposed that the behavior might be biased by the fact that all specimens were tagged out of the water, inducing a stress[15]. For this

[14] IEO did not provided any report on these tagged tunas.

[15] The data concerning the specimen who entered in the Mediterranean and then went to Azores were not available at the time of the discussion in the SCRS Species Group.

reason, it was recommended testing two strategies for pop-up tagging (out of the water and underwater) in next trials in traps.

Other 14 miniPATs were implanted in various parts of the Mediterranean Sea (13) and in the Strait of Gibraltar (1) by WWF-MedPO, along with 5 internal archival tags, using various platforms and often in cooperation with sport fishers. All the miniPATs showed trajectories which remained inside the Mediterranean, but those implanted on two juvenile tunas were particularly interesting, showing a possible "residence" area between the Balearic Islands and the North-African coast.

Following the recommendations provided by the SCRS, the GBYP Steering Committee, the GBYP Operational Meeting in 2012, and thanks to the kind availability of the WWF-MedPO, the INRH, the Moroccan DPMA/DPRH and the tuna trap industry, it was possible to carry out a second electronic tagging trial in the tuna trap of Larache (Morocco) on May 13-17, 2012.

The tagging was carried out on bluefin tunas maintained for a few days in the trap of Larache, after that the individual quota was reached by this trap and before releasing the fish into the wild. The first operation concerned 16 miniPATs, deployed by WWF-MedPO scientists, with the cooperation of INRH and GBYP scientists. The second operation was carried out by GBYP scientists, with the cooperation of INRH and WWF-MedPO scientists, implanting 10 miniPATs.

According to the recommendation made by SCRS, 50% of the tunas were tagged out of the water and 50% underwater, with the purpose to discriminate possible differences in the post-tagging behavior. Those tagged on board were immediately released in the wild, one after the other, while those tagged underwater were released along with other about 250 tunas in the late morning of May 16, 2012.

Some specimens were caught after very few days, one by the last Moroccan tuna trap still fishing and one in the Alboran Sea, possibly by an unidentified longliner which threw the tag at sea after catching this tuna. Several tags had possibly a premature release or maybe the tunas were fished, but the detailed data are still not available. All tags implanted by GBYP popped-up prematurely: four tags popped-up in the Atlantic Ocean, while 6 popped-up in the Mediterranean Sea (**figure 6a**). Even 8 of the tags deployed by WWF-MedPO popped off prematurely, but the different type of anchor allowed the tags to stay more on the tuna, providing more interesting results (**Figure 6b**).

Even if the results are still very preliminary and elaborated data are necessary, it seems that some specimens are confirming the fact that there are movements from North-West Africa toward the areas SE of Azores and W Madeira during the spawning season, while the majority of the pre-spawners enter into the Mediterranean Sea. It is interesting to note the complex course of the specimen which entered into the Mediterranean for spawning and then moved to Ireland and far North, between the Faröer Isles and Norway, an area were bluefin tunas were absent since several decades.

All available data were provided for evaluation to SRCS in its 2012 meeting. Even if it will be necessary to have the full data sets from each tag before drawing any conclusion, these preliminary results pose several new question marks to be further investigated in the future steps of GBYP.

5.5.1 Discussion about the use of miniPATs and the preliminary results.

One of the major preliminary doubts about the use of miniPATs was the difficulty of recovering a sufficient amount of data from the Mediterranean areas, because this was always a serious problem in previous experiments, due to the electronic noise in the area, preventing most of the transmitted data to be recovered by the ARGOS satellites. Thanks to the technical improvements made by Wildlife Computers after the experiments carried out by the EC programme "MADE", it seems that now this problem is almost overcome and most of the data can be successfully recovered.

Tagging pre-spawners in Morocco, originally planned for calibrating the results of GBYP aerial survey, revealed the high scientific importance of better understanding the behavior of the bluefin tunas coming northward along the West African coast. For sure, it seems confirmed that a majority of these fish enters in the Mediterranean Sea for spawning, reaching at least the Western and Central Mediterranean. At the same time, it seems confirmed that some of these fish do not enter in the Mediterranean Sea, but go to Atlantic areas where, in the past, some

authors (De Buen, 1926; Matters III, 1995) hypothesized the presence of additional and maybe not-constant spawning areas. Even if bluefin tuna larvae were never found during the few larval campaigns carried out in those areas, the temperature at sea and the general oceanographic conditions where these recent tags popped-off were potentially suitable for spawning. This fact is particularly interesting from a scientific point of view and needs further investigations, due to the potential implications in terms of stock structure**.**

At the same time, it is equally important to investigate the behavior 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 use of miniPATs, as showed by the tagging carried out by WWF-MedPO in the Mediterranean Sea and by other projects, is also very important for better understanding the behavior of bluefin tunas juveniles, while also the behavior of pre-spawners in all the Mediterranean Sea and particularly in the eastern basin should be further investigated.

Long-time setting for more tags is very useful, but a further improvement of the anchoring system should be tested, possibly discussing again this issue with the US scientific team having the largest experience in this field. Continuous contacts with the US and EU scientists carrying out electronic tagging on bluefin tuna will be continued in Phase 3.

5.6 Tag awareness campaign, tag reporting and tag recovery activities

These activities are considered essential for improving the very low tag reporting rate existing so far in the Eastern Atlantic (max about 5%) and the Mediterranean Sea (max about 1%).
The Deliverable D2.1 issued on October 11, 2011, provided the first information about the tag awareness campaign, while Deliverable D2.2 updated the information and all details. The GBYP Steering Committee, on February 2012, provided additional recommendations about the development of the tag awareness campaign (Deliverable 23).

5.6.1 Production and distribution of tag awareness material

Following all the recommendations by the GBYP Steering Committee and taking into account the budget available, 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, 11030 posters of various sizes (A1, A3 and A4) and 13300 stickers were produced; all posters are also available on the ICCAT-GBYP web page. A capillary distribution of the tag awareness material was carried out, sending copies to all stakeholders such as: Government Agencies, scientific institutions, tuna scientists, tuna industries, fishers, sport fishery federations and associations and the RACs concerned; the coverage was complete in the ICCAT Convention area, including also non-ICCAT countries and those countries or entities fishing in the area. The map clearly shows the distribution effort (**Figure 7**). The ICCAT-GBYP web page has the full list of contacts http://www.iccat.int/GBYP/en/AwCamp.asp .

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.

5.6.2 Tag reward policy

Following the recommendations made by SCRS and the GBYP Steering Committee, the ICCAT-GBYP tag reward policy was considerably improved, with the purpose to increase the tag recovery rate which is currently extremely and unacceptably low (according to the last available data, only five bluefin tags were reported to ICCAT in 2011). 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. The first ICCAT-GBYP Lottery will take place on October 1, 2012.

The design for the T-shirt was provided by one of the best artist in this field and the T-shirts were produced with a high-quality printing and cotton (resistant to UV), in 1200 specimens, in three different blue colors. The ICCAT-GBYP T-shirts are used as reward for those reporting a tag and for all those helping in the tag-awareness activity.

5.6.3 Advertising

For improving information and awareness about the tagging programme, ICCAT-GBYP is developing contacts with various stake-holders organizations and with journalists. Information on GBYP are now present on various web pages (besides of the institutional ICCAT-GBYP one http://www.iccat.int/GBYP/en/), while some articles on the press have been promoted. In particular, an article should appear soon on the EC journal "Fisheries and Aquaculture", which usually reaches many stakeholders in many countries and it is translated into several languages.

Meetings with ICCAT ROPs were also organised, for informing them about the ICCAT-GBYP tag recovery activity and for asking them to pay the maximum attention to tags (and to natural marks) when observing harvesting in cages or any fishing activity at sea. Travels to several countries are also planned for 2012, for improving the local knowledge of these activities and promoting the tag recovery.

6. Biological and Genetic Sampling and Analyses

According to the general programme, it was planned to begin the biological and genetic sampling and analyses activity in GBYP Phase 2, including a preliminary operational meeting and then a field activity and a laboratory analysis activity until the end of Phase 2, including the extension period. Additional activities concerned having a bio-sampling design and holding a second operational meeting in 2012, for discussing the ongoing activities in the extension of Phase 2 and for planning in details the activities in Phase 3.

6.1 Objective

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 2 objective was initiating 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.

The objective is set for at least three years of the programme and this first year activity was clearly able to accomplish its objective. Of course, the activities in following Phases of GBYP are set for completing and improving the first results and for better defining some issues, such as the sub-population hypothesis, which requires several years of data and many analyses, depending on the available budget.

All information is available in detail on Deliverables "All Tasks.1" (issued on July 31, 2011), E2 (issued on October 11, 2011) and E3 (Issued on July 9, 2012).

6.2 Operational Meetings on Biological Sampling for Bluefin Tuna

The activity at the early beginning of Phase 2 included the organization of the ICCAT-GBYP Operational Meeting on Biological Sampling for Bluefin Tuna, recommended by the GBYP Steering Committee and the SCRS, and endorsed by the Commission in its 2010 meeting.

Biological and genetic sampling and analyses have been originally planned from Phase 2 and the following phases. The details were discussed during a specific operational meeting held at the ICCAT Secretariat on February 17, 2011, which was attended by 42 scientists. The meeting discussed in depth all the various aspects and suggested having a common scheme. The Steering Committee, on the same day, endorsed this suggestion and recommended issuing a Call for Tenders for a "Biological Sampling Scheme" to be used to more precisely establish the sampling levels in the various areas and fisheries in the Phase 2 activity. The Call was issued on

March 11, 2011, and only one bid was received, which was awarded to a consortium of 13 institutions from 8 countries on July 14, 2011.

The Tagging Design was officially adopted by the Steering Committee and it is considered extremely relevant, because an appropriate tagging activity is a better estimate of natural mortality rates (M) by age or age-groups and/or total mortality (Z), of course if the tag reporting rate substantially improves, reaching a sufficient level by major fisheries and areas, and this should improve knowledge on the habitat utilisation and movement patters of bluefin tuna in the various areas. It is the base for carrying out the tagging activities in the following years, with important implications on the GBYP budget.

A second GBYP Operational Meeting on Tagging, Biological and Genetic Sampling and Analyses was organized in Madrid on April 17 & 18, 2012, during the extension period of Phase 2, for discussing all practical aspects concerning the final activities of Phase 2 and the final plans for Phase 3. A total of 28 scientists joined the meeting, which resulted in intense and productive discussions, useful for better defining all the operational details and clarifying some uncertainties. The Call for tenders was issued on March 26, 2012, anticipating the official beginning of Phase 3 for allowing the field activities to start on time. The contract was awarded on June 6, 2012, to an International Consortium of twelve entities. The sampling is currently almost on schedule.

6.3 Biological Sampling Scheme

The GBYP biological sampling design was the one provided by a team of scientists under the coordination of the Institut National de Recherche Haulieutique (INRH - Morocco) (annex to Deliverable E2) and approved on March 14, 2011, enforcing it in GBYP Phase 2. The final version is also available on the ICCAT-GBYP web site (http://www.iccat.int/GBYP/Documents/Biological_Sampling_Plan_GBYP_2011.pdf).

6.4 Biological and Genetic Sampling and Analyses

The preliminary interim report and the second interim report have been provided along with Deliverable E2, issued on October 11, 2011, while the final report was provided along with Deliverable E3, issued on July 9, 2012[16]. The preliminary results were officially presented to the ICCAT-SCRS bluefin tuna Species Group, to the SCRS Plenary and to the ICCAT Commission in 2011. A provisional draft final report was provided on December 5, 2011, but immediately after it was clear that Phase 2 will have a prorogation and then a similar extension was provided to the Consortium.

The total number of samples was lower than the target, because of the late delivery of the contract (awarded on May 27, 2011, and signed on July 18, 2011) and the lack of any legal provisions for sampling tunas outside the commercial fishery season. As a matter of fact, even if it was theoretically possible sampling bluefin tunas using a dedicated research fishing activity, this was not possible because most of the fisheries got their quota at the beginning of the season and then it was possible to sample some tunas only from those few fisheries still continuing the activity for reaching their quota. The late beginning of the activity had particularly affected the gonads sampling, because the peak of the spawning period was almost finished when the activity was conducted and the trap fishery, one of the few where sampling for gonads is easier, was already almost closed because they reached their quota in the first part of the season. Additional technical and logistic problems were noticed by the Consortium.

Taking into account that some areas and fisheries included in the "Biological Sampling Scheme" cannot be sampled due to concurrent geo-political factors, the sampling activity under contract included a total of 1950 genetic samples, 1900 otoliths, 1900 spines and 600 gonads; the percentage of achievement was 68%, mostly due to the late beginning of the activity, which started after the main fishing season. The plan for the analyses included 960 NGS-TS, 160 NGS-RRSG, 600 microchemical determinations, 810 age readings and 80 histological analyses; in this case, thanks to the extension of Phase 2, it was possible to have an achievement of 101,5%. Even if the results are still to be improved by the analyses which will be conducted in the following phases, the first set of analyses provided very useful data. The targets and the final achievements, as total number of samples and analyses (a maximum 10% tolerance was allowed for each item) are showed on **Table 8**.

[16] The delay in providing the final report of this task was caused by the late submission of the final revised report by the Consortium, due to the additional work required during the extension period of Phase 2 and the several observations made by the GBYP Coordination on the four draft versions.

Even if the target for sampling was not reached (and most of the problems are considered caused by *force majeure*), the total number of analyses was slightly higher than the target and this is considered an acceptable balance in terms of overall results.

Among the most relevant results, the **genetic analyses** are clearly showing and confirming the genetic characteristics and difference between the specimens from the Western Atlantic and the Eastern Atlantic. It is still premature further defining subpopulations (an hypothesis of 23 sub-populations was analysed, see **Figure 8**), but it appears that the bluefin tunas in the western Mediterranean Sea have a higher genetic diversity level, almost the double of the other spawning and feeding specimens in other areas; further investigating these areas will be a future task. Almost the totality of samples from the Eastern Atlantic and the Mediterranean Sea are typically eastern bluefin tunas; one single specimen was originated from the Gulf of Mexico.
The two strategies used for genetic analyses so far (NGS-TS and NGS-RRSG) showed different capabilities and, at the moment, the NGS-RRSG seems the most powerful, but further efforts are needed for better exploring both strategies.

The **microchemistry analyses**, carried out on otoliths, also provided very useful and interesting results, further discriminating the two main bluefin tuna populations according to the individual origin of each fish (western and eastern Atlantic Ocean). Estimates are given as percentages and the mixed-stock analysis (HISEA program) was run under bootstrap mode with 1000 runs to obtain standard deviations around estimated percentages (± %). Summary results are showed on **Table 9**.

Even from these analyses, it seems confirmed that almost all bluefin tunas in the eastern Atlantic and in the Mediterranean Sea have an eastern origin, while very minor mixing (<1%) may be found in Gibraltar and in the Bay of Biscay. In the central-North Atlantic the mixing increases (about 16%) (**Figures 9a, 9b and 9c**).

The **ageing analyses** provided a first GBYP data set for age-length key (ALK), which can be used in future assessments. The ageing analysis was carried out on 749 samples (less than the target of 810) due to some problems encountered, mostly caused by sampling procedures or shipping. Many additional samples have been collected and stocked for future analyses. The target objective for sampling 10 specimens by 10 cm length range was nearly achieved. **Figure 10a** shows the ALK obtained from otoliths, while **Figure 10b** shows the ALK from spines. **Figure 11** provides the comparison between ALK from otoliths and spines.

The **gonads analyses** were carried out on 189 samples but, due to the late beginning of the contract, the fish sampled in 2011 should not be considered as representative of the normal reproductive population. The results obtained in 2011 are confirming most of the current knowledge about the spawning season of the eastern Atlantic stock, even if the results from some samples need further confirmation in future years for better understanding their indications (like the post spawning samples from a Sardinian tuna trap). A continuous sampling immediately before, during and after the main spawning season in various areas may confirm extended or non-typical spawning seasons in some years, when the oceanographic conditions show this possibility.

7. Modelling approaches

The ICCAT-GBYP activity on Modelling Approaches in Phase 2 is strictly following the course recommended by the GBYP Steering Committee, endorsed by ICCAT-SCRS and approved by the ICCAT Commission in 2011.

After many consultations among the SCRS Chair, the BFT Rapporteurs, the WG Chair and the ICCAT Secretariat, the ICCAT Working Group on Stock Assessment Methods (WGSAM) was postponed from the original date of March 21-24, 2011 and instead held on June 27 - July 1, 2011. One day (June 28) was devoted to the bluefin tuna issues. The report of this meeting, which was attended by 21 scientists (including two invited scientists by GBYP), is available on http://iccat.int/Documents/Meetings/Docs/2011_WG%20METHODS-ENG.pdf.

The preliminary reports about the modeling task are included in Deliverables F1.1 (issued on July 12, 2011), "All Tasks.1" (issued on July 31, 2011) and F1.2 (issued on October 21, 2011).

7.1 Objectives

As reported in paragraph 1, one of the main objective of GBYP is the improvement of 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.

An important element of the GBYP is then to develop a robust advice framework consistent with the Precautionary Approach. This requires the development of new stock assessment methods that take into account the main sources of uncertainty and utilise the new data sets and knowledge provided by the GBYP. New data sets include for example historic catch and effort data, aerial surveys of spawning aggregations and tagging of juveniles. In order to evaluate novel approaches the SCRS is developing a Management Strategy Evaluation (MSE) framework that includes a simulation or Operating Model. This will allow current and alternative assessment and advice frameworks to be evaluated with respect to their ability to meet multiple management objectives.

First initial sets of trials were made in Phase 2 and these were considered consistent with the objective set by the Steering Committee and the SCRS, even if additional work will be necessary in Phase 3 and in the following Phases of GBYP before reaching the final objective.

In Phase 3, two Calls for tender were issued on September 6, 2012: the first one on Risk Assessment and the second on Modelling Approaches to Support the Stock Assessment (a: Statistical conversion of catch-at-size to catch-at-age; b) Data Imputation). The first contract on Risk Assessment was award on September 19, 2012.

7.2 Phase 2 activities for modeling.

A main outcome of the GBYP will be the development of a new long-term advice framework to be implemented once the current recovery plan has succeeded. This framework must be consistent with the Precautionary Approach and support fisheries that produce the maximum continuing catch. Therefore a Management Strategy Evaluation (MSE) Framework will be used to evaluate the impact of uncertainties on the current scientific advice framework, based on the Kobe II Strategy Matrix, and identify how data and knowledge gained under the GBYP can improve advice in the future.

MSE requires the building of a simulation model that can be used to model alternative plausible hypotheses about stock and fleet dynamics. This can then be used to test alternative advice frameworks, when an advice framework comprises the data collection regime, the stock assessment method and the management advice based upon it. Under Phase II two tasks were completed: a risk assessment to identify the main uncertainties and examples of MSE and new advice frameworks.

7.2.1 Risk analysis

Uncertainty is inherent and universal in decision-making. In recent decades there have been steady strides towards a risk based management approach for fisheries. A first step towards acknowledging uncertainty is to identify, describe, and catalogue the sources of uncertainty that might have an impact on decision-making. This initial work carried out under the GBYP activities introduces a methodology based on a novel range of tools developed in Excel that has been used to formalise the process of elicitation of uncertainties, from both experts and stakeholders, for the International Commission for the Conservation of Atlantic Tunas (ICCAT). Other examples in fisheries are also considered. The aim of the elicitation is to deconstruct each source of uncertainty into components in order to facilitate the next stages, which are the quantification and mitigation of risks. The tools presented on Deliverable F1.2 and on the paper included in Deliverable 22 assist in prioritisation of uncertainties, while also indicating and visualising the degree of consensus among experts and/or stakeholders on particular issues. Perceptions of uncertainty in fisheries often vary widely among scientists, industry and interest groups, and hence tools that can ensure inclusivity and that are able to represent differences of opinion are invaluable where decision-making depends on broad agreement and more generally, where effective management depends on commitment from stakeholders.

A paper describing this work was presented at the World Fisheries Conference in 2011 and a paper has been submitted to the Journal of Fisheries Biology describing this initial activity carried out within GBYP Phase 2.

7.2.2 Modeling approaches

The intention is that alternative frameworks will be evaluated using an MSE framework. This will allow a range of scenarios to be constructed to first evaluate the existing BFT assessment and management framework and then to compare the performance of alternative frameworks. This will be used to evaluate how well candidate assessment and advice frameworks perform relative to the management objectives specified by the Commission. This will allow alternative methods to be evaluated with respect to how they perform: with respect to the quality of the data used for assessments to date (catch at size/age, abundance indices, growth curves) and when supplied with data of the kind being collected under the GBYP (e.g. aerial surveys and tagging).

A generic MSE approach for simulation was developed (SCRS2011-110). This involved the use of an Operating Model to evaluate the impact of structural uncertainty on the perception of stock status obtained via Adapt-VPA. Structural uncertainty related to population structure (i.e. 2 subpopulations) and the stock recruitment relationship (i.e. constant recruitment or compensatory dynamics). The authors found that structural assumptions (1 stock versus 2), and the source of various indices (stock 1 or stock 2) were critical assumptions, which had much greater impact than the stock recruitment assumptions. This has important implications for the structure of assessment models and for the development of management procedures that are robust to structural uncertainty and demonstrated the importance of fisheries independent data and a better understanding of stock dynamics as being provided by the GBYP.

In addition under the GBYP a contract was awarded for the development of a prototype of an alternative assessment and advice framework this involved an assessment method and a harvest control rule, designed to work in tandem which form the management procedure (MP) component of an MSE. The assessment method proposed is broadly similar to that already used for BFT, but in order to be able to make use of a variety of different kinds of data, and to capture most of the main sources of uncertainty, it is cast in a formal Bayesian form with specific likelihood functions for each kind of data. The choice of prior distributions of parameters is driven primarily by the requirement for good management performance, rather than by prior beliefs about likely values. Prior information about likely ranges for parameter values can be taken into account in the construction of the test scenarios which be used to test all candidate procedures. The conventional management reference points B_o, B_{MSY} and F_{MSY} are used, but defined in a way such that they remain appropriate in the presence of possible regime changes. A simple harvest control rule is proposed: constant F when the stock is above B_{MSY}; F linearly proportional to B/B_{MSY} when $B < B_{MSY}$. The harvest control rule is based on a notional unselective standard fishery. To convert the results to an actual TAC for a real mix of fisheries, weighting factors are determined for each fishery to relate the effect of a unit catch from each fishery to the effect of a unit catch from the notional standard fishery.

7.3 Further actions on modeling

The results of the Risk Analysis will be presented at the SCRS and used to inform discussion on the "Unquantified Uncertainties". Where appropriate they may be used to specify what scenarios to include in any MSE work conducted in later phases.

The MSE examples included many elements that would be important in building a robust advice framework taking advantage of new data and knowledge made available under the GBYP. These will have to be further developed in later Phases before they can be utilised in providing management advice. The preliminary MSE framework showed how the data and knowledge gained under the GBYP can be used to develop alternative robust advice frameworks. However, much work still needs to be conducted in later phases before such and advice framework can become operational.

8. Legal framework

The first period of activity revealed the absolute need to have specific provision for allowing the field research included in the programme adopted by the Commission (see Deliverable E2). As a matter of fact, the legal framework, as it is established according to the bluefin tuna management plan, did not include any special

provision for research needs and time and space constraints were considerably affecting the research possibilities. This problem, originally discussed at the early beginning of ICCAT-GBYP activities, was discussed again in 2011 by the Bluefin tuna Species Group and by the SCRS, presenting a specific recommendation to the Commission meeting.

Thanks to this preparatory work carried out in the first part of Phase 2, it was possible to have the ICCAT Rec. 11-06, adopted by the Commission in its meeting in Istanbul on November 2011, which allows for a "research mortality allowance" of 20 t 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. For implementing the recommendation, the ICCAT Secretariat released the Circular #2296 on May 22, 2012, which will help the GBYP activities in Phase 3 and in future years.

9. Definition of GBYP Publication Policy, Editorial and Data Rules

The GBYP publication policy, along with editorial and data use rules adopted in Phase 1 were updated by the GBYP Steering Committee. They are included in **Deliverable "All Tasks.1"**.

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. Jean-Marc Fromentin, the ICCAT Executive Secretary, Mr. Driss Meski, and an 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 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. So far, the Steering Committee held six meetings in Phase 2 and in the first part of Phase 3 (June 27-July 1, 2011; September 29, 2011; 7-8 February 2012; 20-21 March 2012 and September 7, 2012), discussing various aspects of the programme, providing guidance and opinions. The reports of all GBYP Steering Committee meetings held in Phase 2 are included in Deliverable 23, issued on June 22, 2012.

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. In Phase 3, the programme was funded by the following CPCs and entities (in order of contribution):

European Union (grant agreement)	Euro	1,425,000.00
United States of America (donation)	Euro	187.500.00
Kingdom of Morocco (donation)	Euro	68,587.35
Tunisia (donation according to quota)*	Euro	50,539.38
Libya (donation according to quota)*	Euro	46,952.58
Japan (donation)	Euro	43,704.08
Turkey (donation according to quota)	Euro	27,836.23
Canada (grant agreement)	Euro	22,000.00
Norway (donation)	Euro	20,000.00
Croatia (donation)	Euro	19,518.90
Algeria (donation according to quota)*	Euro	7,177,05
Korea (donation according to quota)	Euro	4,024.52
Chinese Taipei (donation)	Euro	3,000.00
Popular Republic of China (donation according to quota)	Euro	1,609.81

*to be received at the moment of the preparation of the report

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 Phase 3 (Euro 1,925,000.00).

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. This approach is creating a favourable environment for GBYP, and one of the best proof were the tagging activities carried out in Morocco in Phase 2 (2011 and 2012), when it was possible to reach a very difficult but extremely productive agreement among State institutions, research Institutes, tuna industry and an NGO, who worked all together with the only and clear objective to get neutral fishery independent data on tuna behaviour.

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 April 28, 2011.

GBYP, in these first three 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 there is the list, in alphabetic order:

- ✓ Asociación de Pesca, Comercio y Consumo Responsable de Atún Rojo (SP): Euro 6,000.00 (for GBYP in 2010).
- ✓ Association Marocaine de Madragues, donation in kinds of a social dinner in Tangier; estimated value to be 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 2011 and 2012.
- ✓ Grup Balfegó (SP), donation in kinds of tuna heads prepared for sampling otoliths; estimated value: Euro 300,00 (for the GBYP Operational Meeting on Biological Sampling in 2011).
- ✓ Grupo Ricardo Fuentes e Hijos S.A. (SP): Euro 10,000.00 (for the Symposium on Trap Fishery in 2011) and the practical support for tagging in Moroccan traps in 2011 and 2012.
- ✓ 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 2011 and 2012).
- ✓ Instituto Español de Oceanografia, Fuengirola, donation in kinds of 3 PATs and staff assistance for tagging in Morocco: estimated value to be defined (for GBYP Tagging in 2011).
- ✓ 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 2011 and 2012).
- ✓ Mielgo Bregazzi Roberto (SP), donation in kinds of many thousands of individual tuna data from auctions, estimated value: 50,000.00 Euro (for GBYP Data Recovery in 2011) and 300,000 Euro (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 to be defined (for GBYP biological and genetic analyses in 2011).
- ✓ 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 2011 and 2012).

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 updating includes also the budget page, where all contributions (monetary of in kinds) are regularly listed, to ensure a full transparency.

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 various recommendations will be evaluated by

the SCRS in September 2012. Those which will be retained will be proposed to the ICCAT Commission in November 2012.

In addition, 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, a programme revision is necessary, finding the right balance among funding possibilities, research needs and duration. The funding system shall be better defined and improved.
b) Data recovery and data mining: a clarification "*pro veritate*" about the mandatory requirements and limits established by ICCAT regulations for providing Task II data is needed for better defining the future plans and avoid unnecessary discussions, sometimes based on personal interpretations of the rules.
c) Aerial survey: the suspension caused by the impossibility for budget shortage to carry out this activity along with others questioned also the objective, the strategy and the time frame; GBYP is preparing a SWOT analyses for providing the essential elements to SCRS.
d) Tagging: the first year (Phase 2) can be regarded as a complex large scale experiment and the strategy adopted for Phase 3 will be used for testing a different strategy and approach. It is necessary to extend the tagging activities to other areas (such as the Eastern Mediterranean Sea), always considering the budget constraints. The tag awareness activity shall be firmly continued, improving media communication.
e) Biological and genetic sampling and analyses: according to the current situation, it is clear that it is impossible to analyse all samples which have been collected (due to budget limits), while it is also clear that a wide sampling in the various areas is essential even if not always easy. A medium term strategy is needed.
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.

14. Deliverables

The list of the deliverables produced in this first part of GBYP Phase 2 according to the EC Grant Agreement SI2.585616 is provided in **Annex II**.

15. Acknowledgments

The GBYP would like to warmly acknowledge the very supporting efforts made by all the colleagues of the ICCAT Secretariat staff to allow the Atlantic-Wide Research Programme for Bluefin Tuna to stay on schedule, besides of the short time available for carrying out all the necessary duties, sometimes under a very short notice. In particular, the GBYP caused a considerable increase of workload to the ICCAT Administration and we would like to officially acknowledge the continuous, professional and generous support we are still having.

The GBYP also acknowledges the strong collaboration of the GBYP Steering Committee, who responded very often in real time, particularly on very difficult scientific and practical issues.

Table 1. Total data recovered by GBYP in Phase 1 and Phase 2.

TOTAL PHASE 1 + PHASE 2		Total	Total OG+TP
# Records	**OG**	87,834	118,551
	TP	30,717	
BFT (n)	**OG**	34,753	23,225,853
	TP	23,191,100	
BFT (t)	**OG**	119,227	947,972
	TP	828,745	
# Fish Sampled	**OG**	94,932	102,542
	TP	7,610	

Table 2. Details of the data recovered from tuna traps by GBYP in Phase 1 and Phase 2.

GBYP DATA RECOVERY AND DATA MINING: TUNA TRAPS					
Reference: Calls for Tenders 01/2011, 02/2011, 11/2011 (Phase 2)					
Country	**1st year**	**last year**	**no. of Traps**	**no. of matanzas**	**no. of BFT**
Italy	1708	1935	73	9.985	3.427.076
Libya	1915	1942	18	1.203	339.509
Morocco	1927	2007	13	1.080	399.538
Portugal	1837	1972	23	10.029	5.404.873
Spain	1525	2009	51	7.190	12.581.269
Tunisia	1863	1932	8	1.174	1.035.940
Total Phase 2 Traps	**1525**	**2009**	**186**	**30.661**	**23.188.205**
Reference: Calls for Tenders 02/2010 (Phase 1)					
Country	**1st year**	**last year**	**no. of Traps**	**no. of matanzas**	**no. of BFT**
Italy	1994	2008	6	56	2.895
Total Phase 2 Traps	**1994**	**2008**	**6**	**56**	**2.895**
Total bluefin tuna trap fishery data recovered by GBYP in Phase 1 and Phase 2					
	1st year	**last year**	**no. of Traps**	**no. of matanzas**	**no. of BFT**
TOTAL	**1525**	**2009**	**187**	**30.717**	**23.191.100**

Table 3. Comparison of main results on effort, encounter rates and density of schools, and mean and total weight in the three subareas, between 2010 and 2011.

Year	2010				2011			
Sub-area	1	2	3 (left truncation)	6	1	2	3CM (left truncation)	6
Survey area (km^2)	62,264	52,461	90,796	55,034	62,264	52,461	100,471	nd
Number of transects	52	45	42	55	131	77	65	nd
Transect length (km)	6,301	8,703	5,288	3,482	9,977	8,771	11,429	nd
Effective strip width x2 (km)	9.66	2.92	9.66	2,92	7.03	7.03	0.66	nd
Number of schools	7	6	19	31	11	10	35	nd
Encounter rate of schools	0.0011	0.0007	0.0036	0.0089	0.0014	0.0011	0.0031	nd
%CV encounter rate	51	43	39	25	32	31	24	nd
Density of schools (1000 km^2)	0.157	0.237	0.508	3,054	0.196	0.162	3,98	nd
%CV density of schools	55	53	44	39.8	37	36	26	nd
Mean weight (t)	127.1	124.2	50.6	62.1	84.8	42.7	102,8	nd
%CV weight	8	5,6	2.5	12.9	26	44	27	nd
Total weight (t)	1,244	1,54	2,335	10,434	1.033	364	44,837	nd
%CV total weight	56	53	51	41.9	56	54	41	nd

Table 4. Predicted total weight (in Kgs) and animal abundance of bluefin tuna (in no.) in each survey block from spatial modelling (model-based method) and from conventional distance sampling (CDS, design-based method). CV values are in brackets. Sub-area 6, surveyed only in 2010, is not included.

Block	**Mean Weight (CV)**	CDS Weight (CV)	**Mean Animal abundance (CV)**	CDS Animal Abundance (CV)
1	1,198,833 (0.583)	1,033,000 (0.429)	11,154 (0.582)	9,616 (0.429)
2	238,485 (0.679)	364,000 (0.544)	1,625 (0.605)	2,477 (0.458)
3M	51,828,826 (0.569)	44,837,000 (0.414)	642,819 (0.592)	549,276 (0.420)
Total	**53,266,144**	**46,234,000**	**655,598**	**561,369**

Table 5. Power analysis: identification of the various CVs under the two hypothesis of total number of surveys and the various rate of recovery scenarios during the survey period.

CV of abundance	**Number of complete surveys**	**Rate of recovery per survey period**
0.27	5	26%
	10	7%
021	5	20%
	10	6%
0.19	5	19%
	10	5%
015	5	15%
	10	4%

Table 6. Power analysis: identification of the minimum number of aerial surveys required under the various scenarios of recovery rates during the survey period and the different CVs.

Rate of recovery per survey period	CV of abundance	Number of complete surveys
5	27%	13
	15%	9
10	27%	9
	15%	7
20	27%	6
	15%	5

Table 7. Details of the ICCAT-GBYP conventional tagging activities in Phase 2.

AREA/GEAR/DATE	BASIC TAGGING	DOUBLE TAGGING	TOTAL NUMBER OF TAGS
Bay of Biscay, BB (Summer, 2011)	1259	497	1756
Bay of Biscay - Recreational fishing (Summer, 2011)	19	0	19
Western Mediterranean, PS (Summer, 2011)	110	45	155
Western Mediterranean, PS (Summer, 2011)	591	216	807
Western Mediterranean - Recreational fishing, CEPRR (Summer, 2011)	115	0	115
Western Mediterranean farms at Gorguel (Cartagena, Murcia), Ricardo Fuentes e Hijos, S.A. (February, 2012)	45	0	45
Western Mediterranean farms at L´Ametlla de Mar (Tarragona), *Grup Balfegó*, SL (May, 2012)	50	0	50
Straits of Gibraltar, BB (November-December, 2011)	708	212	920
Straits of Gibraltar, BB (January-February, 2012)	681	392	1073
TOTAL TARGET, WITHOUT 10 % CONTINGENCIES	3578	1362	4940
ACCOMPLISHED OBJECTIVES (%), UP TO 21/05/2012	71.6	67.3	70.3
ACCOMPLISHED OBJECTIVES BY AREA (%)	**BASIC TAGGING**	**DOUBLE TAGGING**	**TOTAL NUMBER OF TAGS**
Bay of of Biscay, BB + Recreational	102	99.4	100.3
Western Mediterranean (2 PS campaignes) + Farms & Recreational	73	52.2	67
Central Mediterranean, PS	0	0	0
Straits of Gibraltar, BB (2 campaigns)	102	121	114

Table 8. Samples collected and analyses carried out by the Consortium in GBYP Phase 2 (including the extension period), with the target and percentages of achievement.

item	*Target no.*	*Achievement no.*	*% of achievement*	*% considering 10% tolerance*
bluefin tunas to be sampled	1950	1916	98.26	na
genetic samples	1950	1632	83.69	92.99
otoliths	1900	1324	69.68	77.43
spines	1900	1078	56.74	63.04
gonads	600	275	45.83	50.93
NGS-TS analyses	960	919	95.73	na
NGS-RRSG analyses	160	192	120.00	na
microchemical analyses	600	600	100.00	na
age readings	810	749	92.47	na
histological analyses	80	189	236.25	na
TOTAL	**10910**	**8874**	**81.34**	**90.38**
Total sampling	6350	4309	67.86	75.90
Total analyses	2610	2649	101.49	na

Table 9. Summary results of the microchemistry analyses carried out in Phase 2 for defining the individual origin of each bluefin tuna sampled in 2011.

		predicted origin		
Region	**no. samples**	**East (%)**	**West (%)**	**error (%)**
Central North Atlantic	117	84.1	15.9	7.9
Bay of Biscay (juveniles)	135	99.1	0.9	0.9
Bay of Biscay (adults)	122	99.0	1.0	1.2
Strait of Gibraltar	38	99.8	0.2	0.1
Balearic Sea	39	100	0	0
Malta	82	100	0	0
Sardinia	20	100	0	0
Adriatic Sea	47	100	0	0

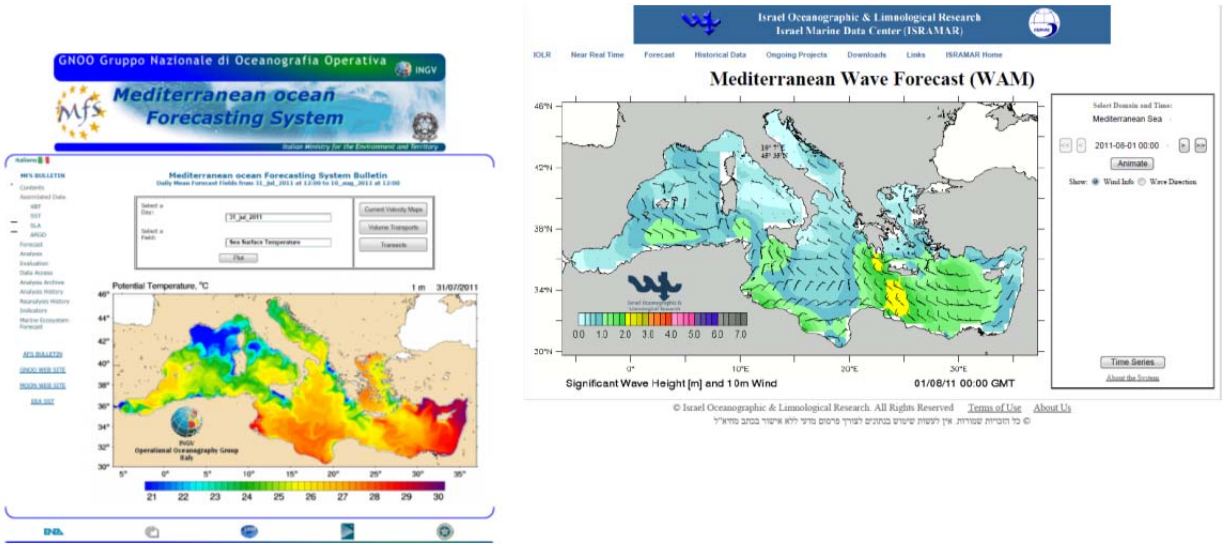

Figure 1. An example of the daily maps for sea surface temperatures (left) and waves (right) collected by GBYP during the aerial survey campaign in 2011.

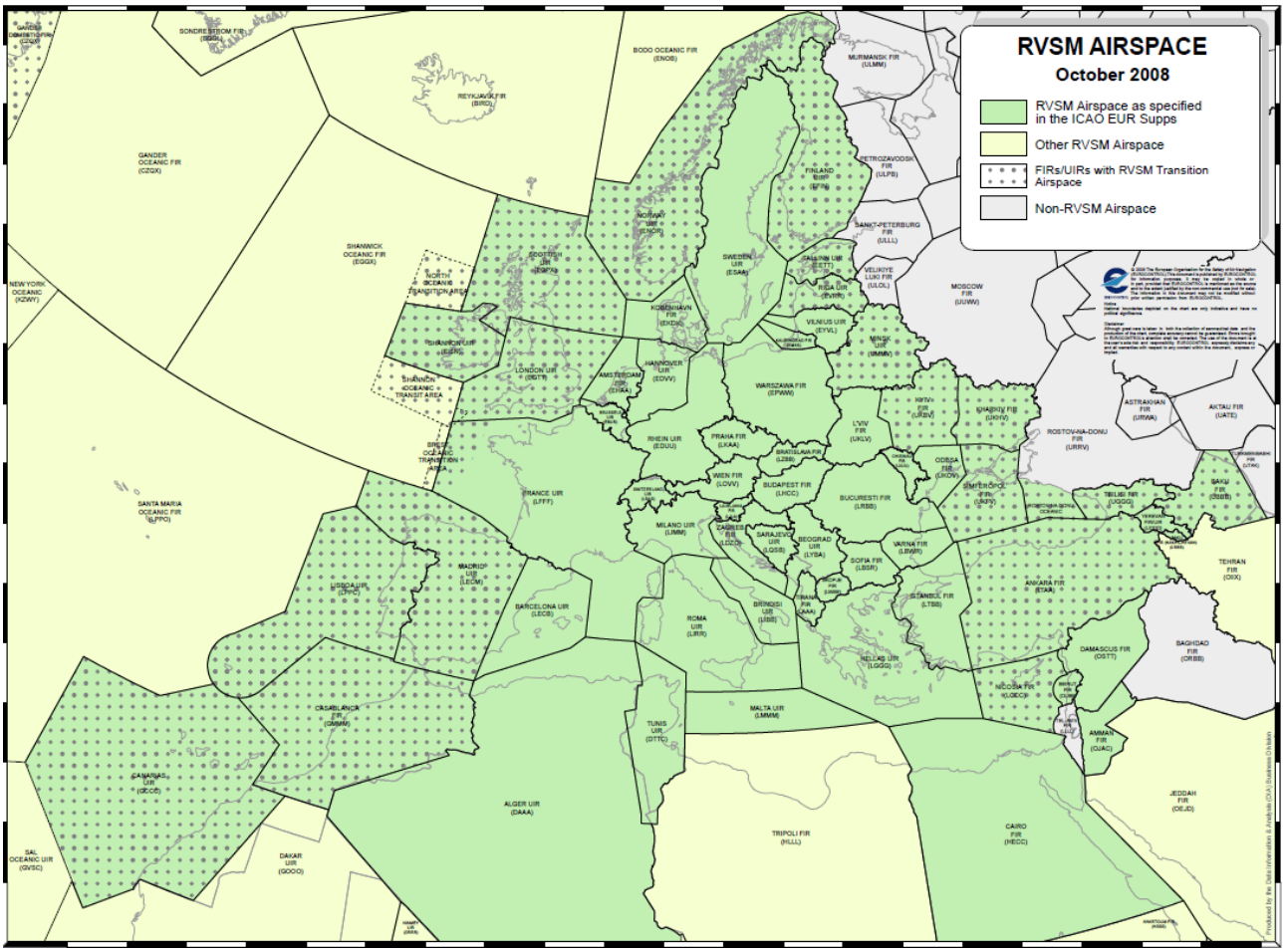

Figure 2. Boundaries of the national air-spaces in the Mediterranean Sea (the Black Sea is excluded), showing the complexity of operating in a geographical area with 24 Countries (16 are ICCAT CPCs), with various rules.

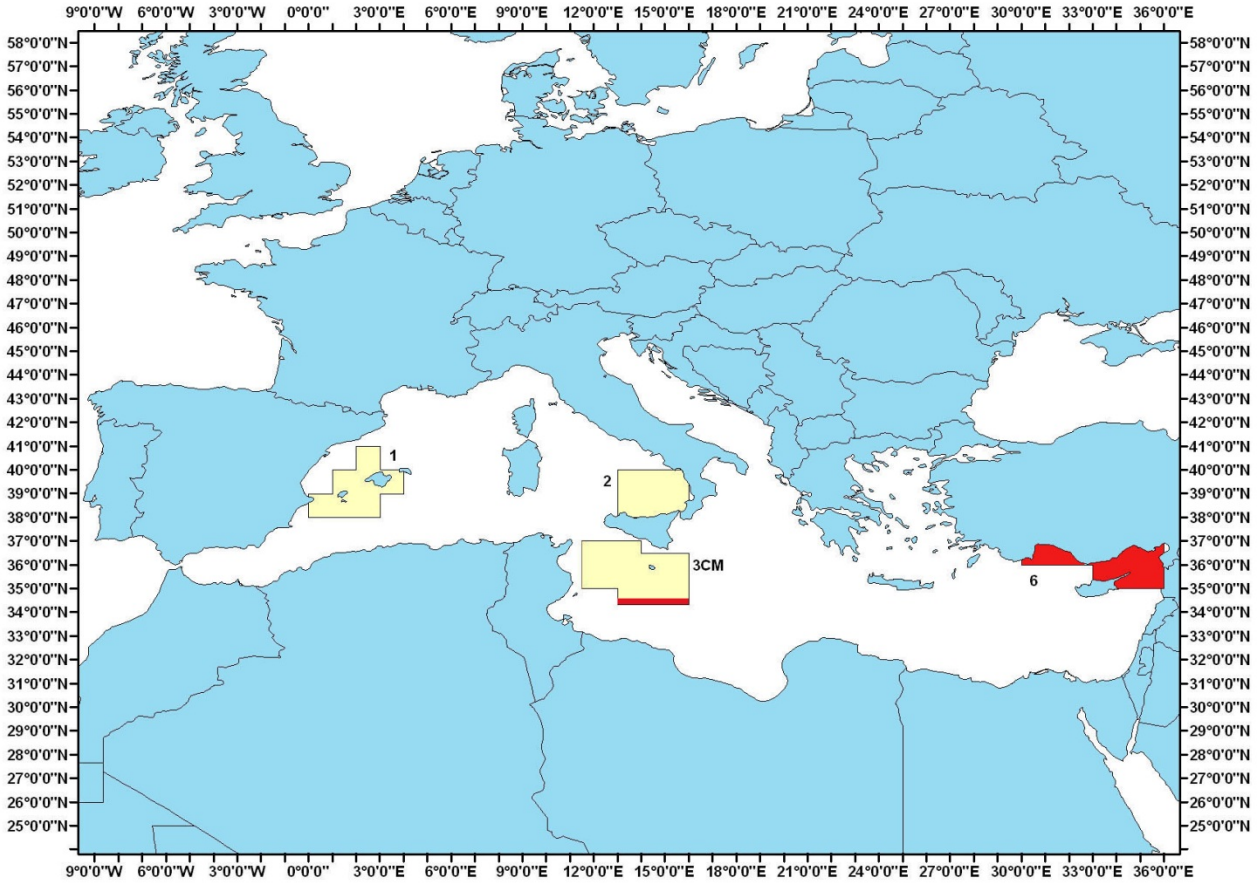

Figure 3 – The final scenario for the aerial survey on bluefin tuna spawning aggregation in Phase 2 (2011), with 4 sub-areas. This scenario was the one initially adopted for the survey in 2011. The red areas (S of sub-area 3CM and sub-area 6) show where it was impossible to carry out the survey for *force majeure* motivations.

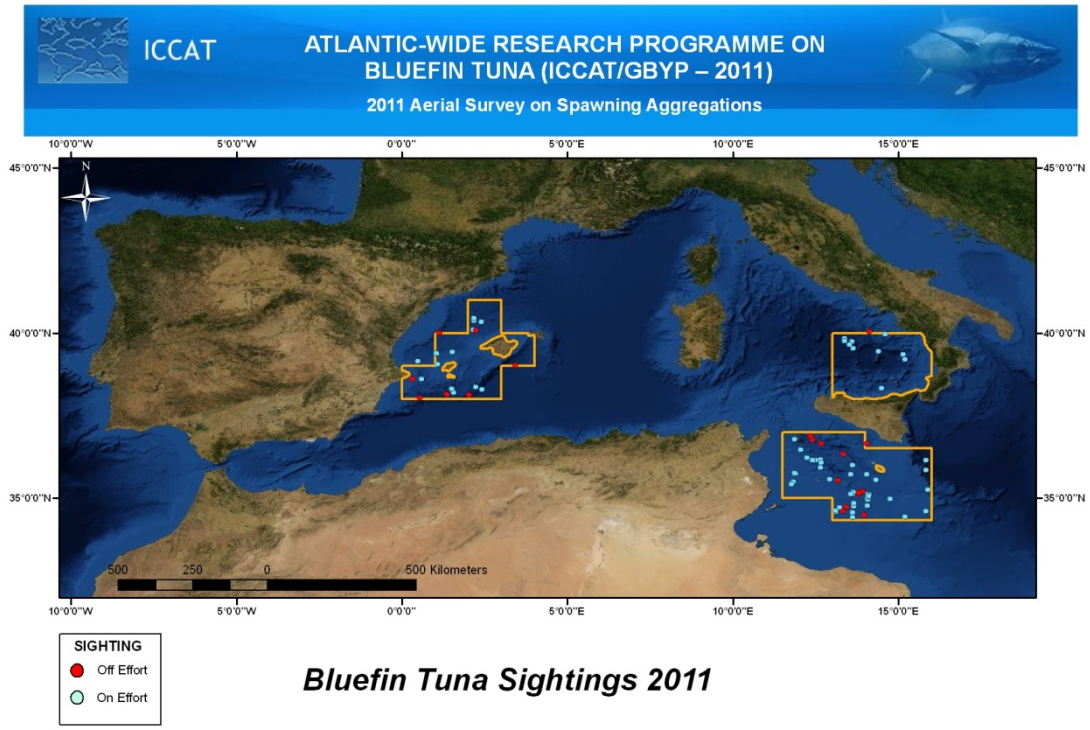

Figure 4. Sightings of bluefin tuna on (white spots) and off (red spots) effort in sub-areas 1, 2 and 3CM in 2011.

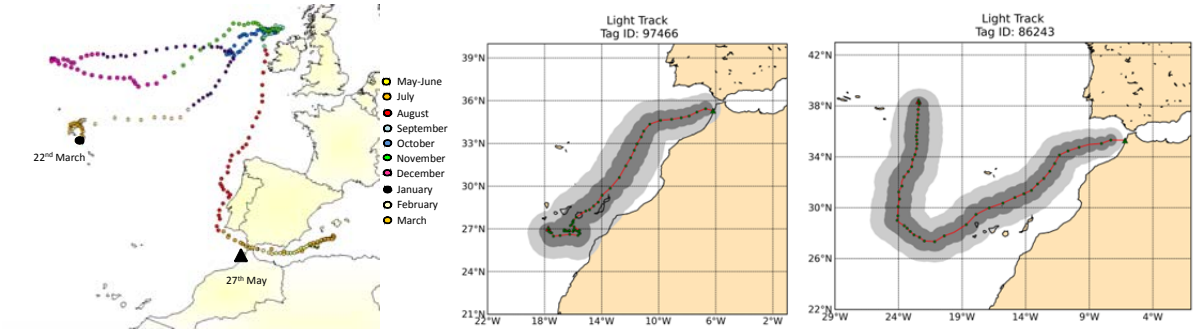

Figure 5. Tracks of three tags implanted in Morocco in 2011 by WWF-MedPO on pre-spawners: a 10-month track showing a complex behavior (left), a migration to the Canary islands (center) and a migration to Madeira and the Azores (right).

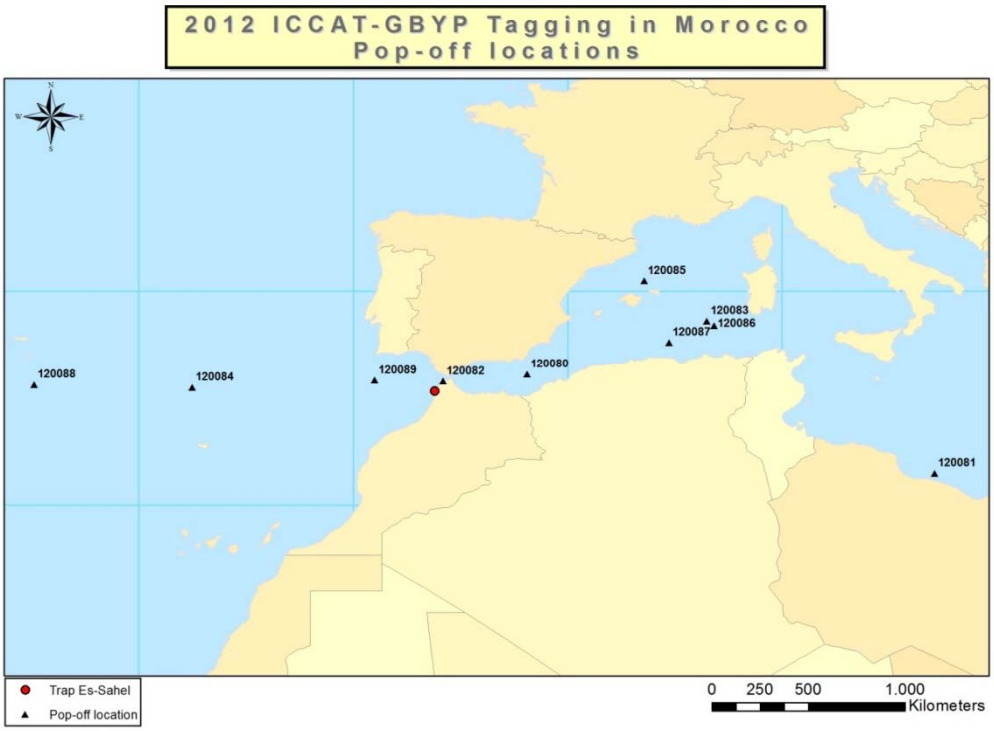

Figure 6a. Preliminary overview of the location where the miniPATs implanted by GBYP in the tuna trap of El Sahel (Morocco) on 16 May 2012 popped-off or where fish were captured.

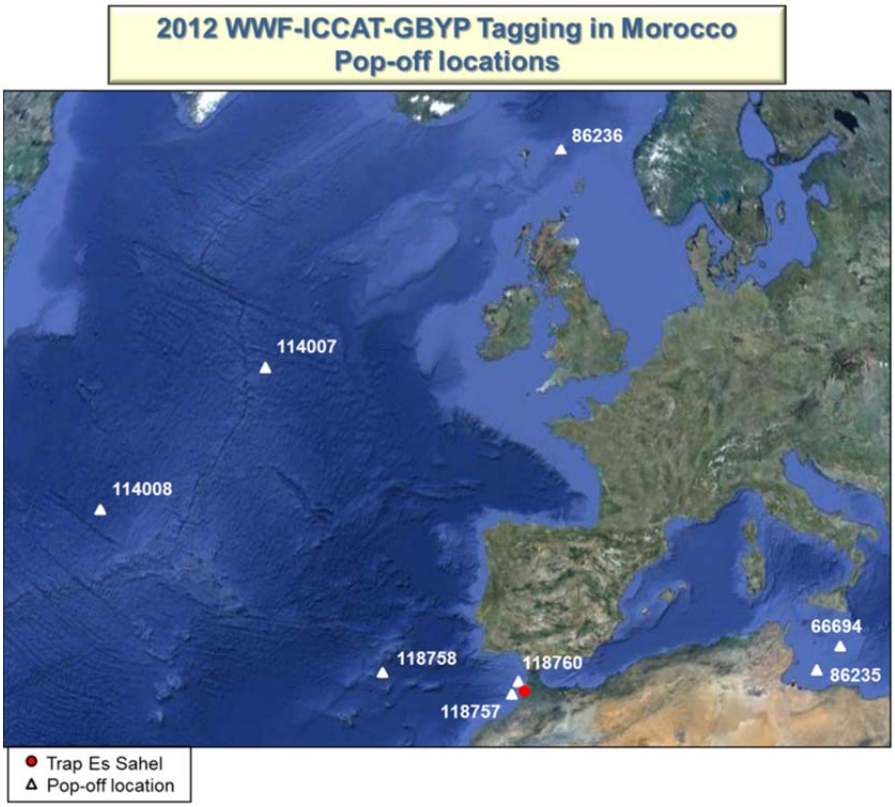

Figure 6b. Pop-off locations of the miniPATs deployed by WWF-MedPO team in Larache (Morocco) on May 14, 2012.

Figure 7. Overview of the localities where the ICCAT-GBYP tag awareness material have been distributed in Phase 2.

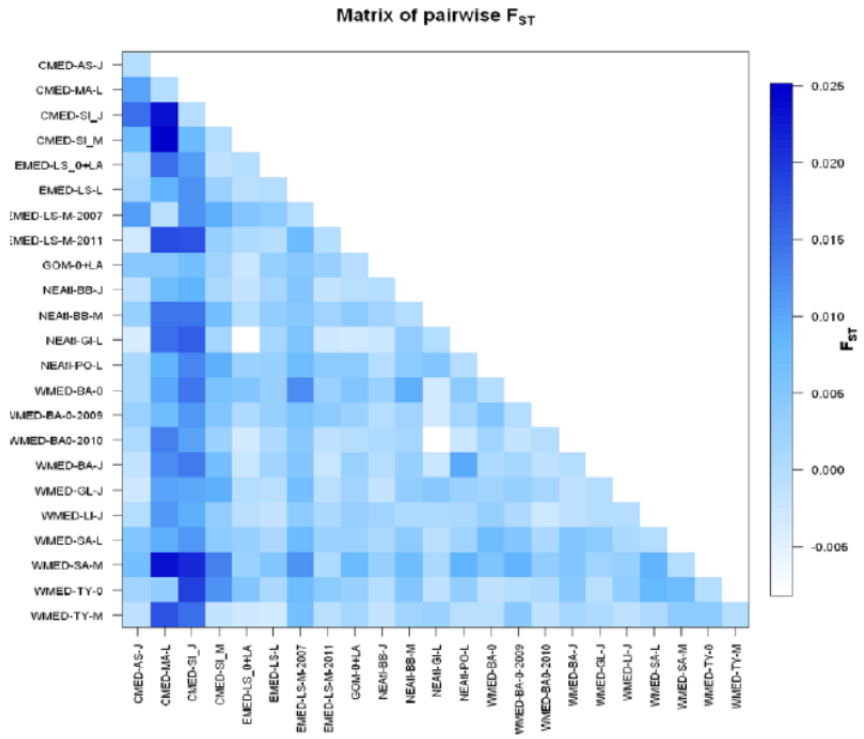

Figure 8. Genetic differentiation among all 23 "population" samples at the 52 loci with F_{ST}>0.005. Pairwise F_{ST} matrix.

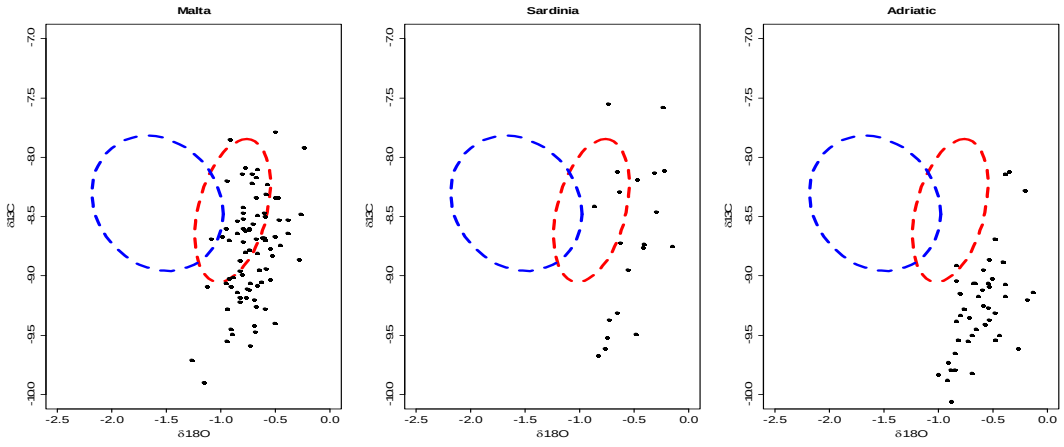

Figure 9a. Otolith $\delta^{13}C$ and $\delta^{18}O$ of bluefin tuna from Malta (n = 82), Sardinia (n = 20) and the Adriatic Sea (n = 47) (Mediterranean Sea). Points shown in relation to confidence ellipses (with p=0.6827) based on otolith $\delta^{13}C$ and $\delta^{18}O$ of yearling bluefin tuna from each region (baseline developed with yearling samples collected during 1998-2009; Blue = West (n =103), Red = East (n = 176)).

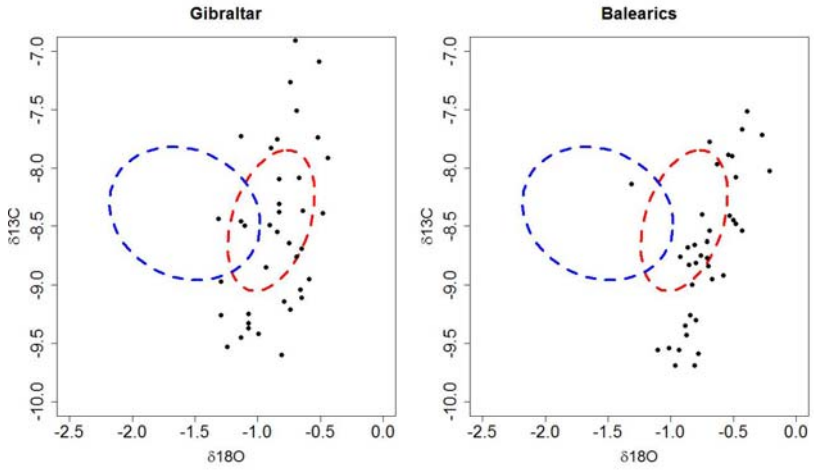

Figure 9b. Otolith $\delta^{13}C$ and $\delta^{18}O$ of bluefin tuna from the Strait of Gibraltar (n = 38) and the Balearic Sea (n = 39). Points shown in relation to confidence ellipses (with p=0.6827) based on otolith $\delta^{13}C$ and $\delta^{18}O$ of yearling bluefin tuna from each region (baseline developed with yearling samples collected during 1998-2009; Blue = West (n =103), Red = East (n = 176)).

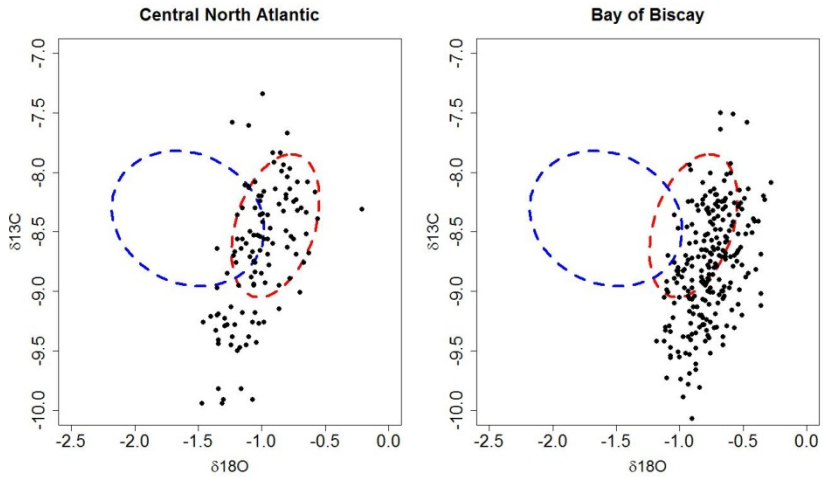

Figure 9c. Otolith $\delta^{13}C$ and $\delta^{18}O$ of bluefin tuna from the Central North Atlantic (n = 117) and Bay of Biscay (n = 257). Points shown in relation to confidence ellipses (with p=0.6827) based on otolith $\delta^{13}C$ and $\delta^{18}O$ of yearling bluefin tuna from each region (baseline developed with yearling samples collected during 1998-2009; Blue = West (n =103), Red = East (n = 176)).

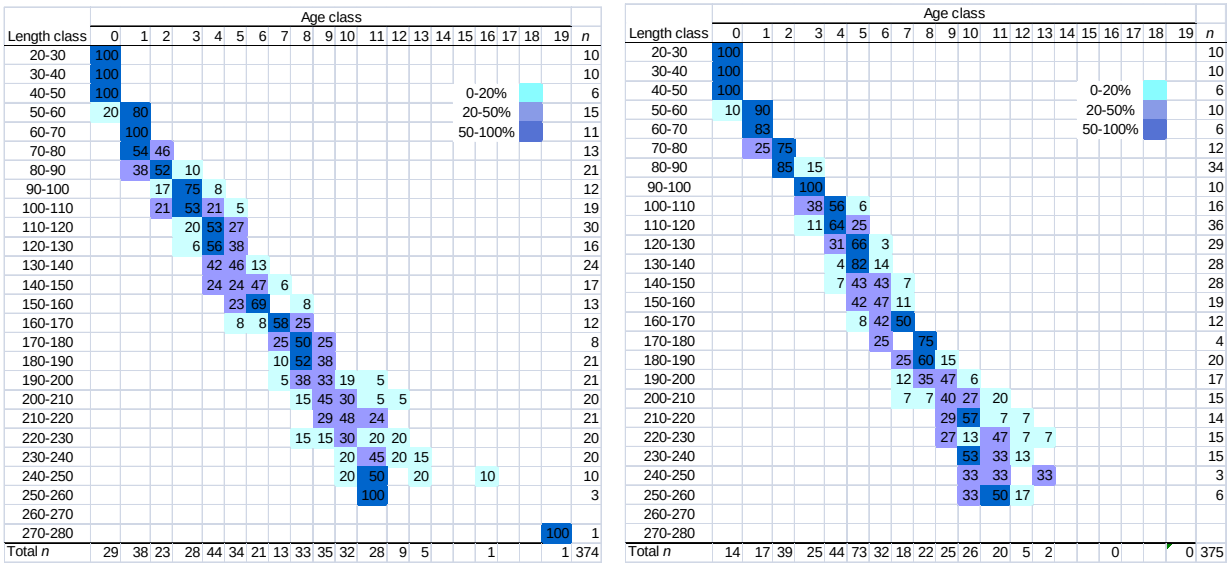

Figure 10. Age-length key based in age interpretation from Atlantic bluefin tuna otoliths (**10a, left**) and spines (**10b, right**) sections. Numbers represent percent by number by length class (SFL, cm).

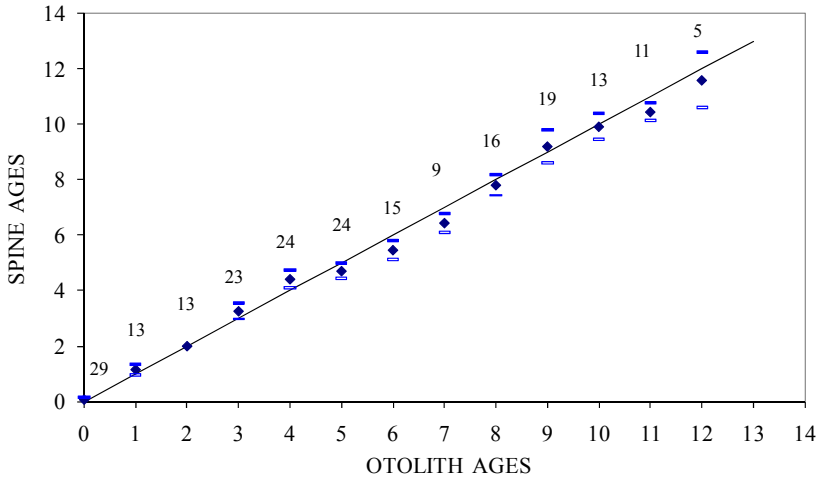

Figure 11. Bias comparison between spines and otoliths age readings. Spines age readings are presented as the mean age and 95% confidence interval corresponding to otolith age readings (numbers above values represent number of calcified structures used; total number of paired structures: 214).

Annex I

Summary status of the various items included in Phase 2 and 3 of GBYP

Item	*Date of Call for Tenders*	*Award date or contract date*	*deliverables*		
			Preliminary report	*Draft final report*	*Final report*
Data Recovery Plan - Trap Fishery (ICCAT-GBYP 01/2011) (3 contracts)	26/01/2011	02/03/2011 & 28/03/2011	15/04/2011	28/04/2011	07/05/2011
Data Recovery Plan - all BFT fisheries (ICCAT-GBYP 02/2011) (4 contracts)	26/01/2011	18/03/2011 & 28/03/2011	02/09/2011	23/09/2011	03/10/2011
Biological sampling design (ICCAT-GBYP 03/2011) (1 contract)	11/03/2011	29/03/2011	-	-	31/03/2011
Modelling Approaches and Risk Analysis (ICCAT-GBYP 04/2011) (2 contracts)	15/03/2011	06/04/2011	20/06/2011	-	20/04/2012
Aerial survey on spawning aggregations (ICCAT-GBYP 05/2011) (3 contracts)	05/04/2011	05/05/2011	24/06/2011	31/07/2011	23/09/2011
Biological and Genetic Sampling and Analyses (ICCAT-GBYP 06/2011) (1 contract)	27/04/2011	27/05/2011	24/06/2011	02/12/2011	09/07/2012
Tagging Programme (ICCAT-GBYP 07/2011) (1 contract)	12/05/2011	-	30/08/2011	21/11/2011	30/11/2011
Tagging Programme (ICCAT-GBYP 08/2011) (1 contract)	16/06/2011	11/07/20110	30/08/2011	13/01/2012	21/05/2012
Tag awareness and awards campaign (ICCAT-GBYP 09/2011) (2 contracts)	28/07/2011	01/09/2011	17/09/2011	26/09/2011	30/11/2011
Data recovery - Supply of SST data and maps. (1 contract)		22/07/2011	03/08/2011	-	05/09/2011
Data recovery - Aerial Survey Data Elaboration (1 contract)		31/07/2011	23/09/2011	-	15/12/2011
Modelling Approaches (ICCAT-GBYP 10/2011) (1 contract)	13/10/2011	02/11/2011			16/12/2011
Data Recovery Plan – all BFT fisheries (ICCAT-GBYP 11/2011) (1 contract)	20/12/2011	19/04/2012			16/05/2012
Analyses of underwater videos of tuna transfers	20/03/2012	No bids			
Tagging Programme (ICCAT-GBYP 01/2012A) (1 contract)	26/03/2012	21/06/2012	06/07/2012		
Biological and Genetic Sampling and Analyses (ICCAT-GBYP 01/2012B) (1 contract)	26/03/2012	07/06/2012	18/09/2012		
Modelling approaches: Risk Assessment (ICCAT-GBYP 02/2012) (1 contract)	06/09/2012	19/09/2012	28/09/2012		
Modelling approaches (ICCAT-GBYP 03/2012)	06/09/2012				
Data Recovery (ICCAT-GBYP 05/2012)	07/09/2012	No bids			

Annex II

List of deliverables and scientific papers in GBYP Phase 2

List of deliverables produced within the EC Grant Agreements n. SI2.585616

1. B1.1 – Report on the ICCAT-GBYP expected improvements in Phase 2 - January 31, 2011: 1- 15.
2. B1.2 – Report on the ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna – June 27, 2011: 1-14 and Annex 1-351.
3. B1.3 – Report on the ICCAT-GBYP Data Recovery Activity in 2011 – June 27, 2011: 1-4 and Annex 1-103.
4. B1.3.1 – Updating Report on the ICCAT-GBYP Data Recovery Activity in 2011 – October 11, 2011: 1-4 and Annex: 1-103.
5. B1.3.2 – Final Report on the ICCAT-GBYP Data Recovery Activity in Phase 2 – June 22, 2012: 1-6 and Annex I (ICCAT Call for Tenders 11/2011: 1-4), Annex II (Data recovered with ICCAT Call for Tenders 11/2011: 1-6) and Annex III (Preliminary elaboration of Bluefin tuna data recovered by GBYP in Phase 1 and Phase 2: 1- 61).
6. B2 – Elaboration of 2011 data from SST and the Aerial Survey on Spawning Aggregations, February 10, 2012. Annex I (preliminary final report: 1-30), Annex II (PowerPoint presentation to SCRS: 1-16), Annex III (GBYP Annual Report to SCRS: 231-237), Annex IV (Final report. December 15, 2011: 1-57).
7. C1 – Report on the ICCAT-GBYP Workshop on Aerial Surveys for Bluefin Tuna – March 21, 2011: 1-23 and Annex: 1-294.
8. C2 – Report on the ICCAT-GBYP Training Course for Aerial Survey for Bluefin Tuna Spawning Aggregations – June 27, 2011: 1-5 and Annex 1-74.
9. C3 – Report on the Revision of the GBYP Aerial Survey Design for Bluefin Tuna Spawning Aggregations in 2011 – April 28, 2011: 1-12 and Annex 1-72.
10. C4 – Report on the GBYP Aerial Survey for Bluefin Tuna Spawning Aggregations in 2011 – October 11, 2011: 1-12 and Annex: 1-162.
11. D1.1 – ICCAT-GBYP Operational Meeting on Tagging – March 21, 2011: 1-17 and Annex: 1-54.
12. D1.2 – Report on the ICCAT-GBYP Tagging Activity – July 31, 2011: 1-10 and Annex: 1-66.
13. D2.1 – Updating Report on the ICCAT-GBYP Tagging and Tag Awareness Activity – October 11, 2011: 1-5 and Annex: 1-60.
14. D2.2 - Final Report on the ICCAT-GBYP Tagging and Tag Awareness Activity – June 22, 2012: 1-8 and Annex I (Final Report on Conventional Tagging: 1-77), Annex II (Electronic tagging carried out by WWF in 2011: 1-10); Annex III (GBYP Electronic Tagging carried out in Morocco in 2012: 1-17), Annex 4 (GBYP Tag Awareness campaign: 1-34) and Annex V (a. ICCAT Rec.11-06; b.ICCAT Circular #2296: 1-6).
15. E1.1 – ICCAT-GBYP Operational Meeting on Biological Sampling for Bluefin Tuna – March 21, 2011: 1-15 and Annex: 1-106.
16. E2 – Report on the GBYP Biological and Genetic Sampling and Analyses in 2011 – October 11, 2011: 1-18 and Annex: 1-35.
17. E3 – Final report on the GBYP Biological and Genetic Sampling and Analyses in Phase 2 – June 22, 2012: 1-18 and Annex I (Final report on the short-term contract for biological and genetic sampling and analyses: 1-145+15).
18. F1.1 – Report on the ICCAT-GBYP Modelling Approaches. July 12, 2011: 1-5 and Annex 1-47.
19. F1.2 – Updating Report on the ICCAT-GBYP Modelling Approaches. October 21, 2011: 1-4 and Annex: 1-84.
20. All Tasks.1 – GBYP mid-term Scientific and Technical report for Phase 2- 2011 Activities. July 31, 2011: 1-23 and Annex 1-26.

21. All Tasks.2 - GBYP Final Scientific and Technical preliminary report for Phase 2 Activities. July 9, 2012: 1-45

22. Scientific Papers produced by GBYP in Phase 2, June 22, 2012: 1-274 + 1 volume of 398 p + 1 DVD.

23. Reports of the GBYP Steering Committee in Phase 2. June 22, 2012: 1-53

List of scientific papers:

SCRS/2011/015 ICCAT-GBYP Symposium on Trap Fisheries for Bluefin Tuna (Tangier, May 23-25, 2011). Collect. Vol. Sci. Pap. ICCAT, 67(1):3-30 (2012).

SCRS/2011/036 The iconography of tuna traps: an essential information for the understanding of the technological evolution of this ancient fishery. Di Natale, A. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier, May 23-25, 2011.

SCRS/2011/037 The literature on Eastern Atlantic and Mediterranean tuna trap fishery. Di Natale A. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier, May 23-25, 2011

SCRS/2011/038 Factors to be taken into account for a correct reading of tuna traps catch series. Di Natale A. and Idrissi M. ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier, May 23-25, 2011.

SCRS/2011/039 Tuna trap data in the ICCAT data base and GBYP contributions. Ortiz M., Palma C., Pallarés P., Kell L., Idrissi M. and Di Natale A., ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna, Tangier, May 23-25, 2011.

SCRS/2011/110 An evaluation of the implications of population structure on the current bluefin tuna advice framework. Kell L.T., Fromentin J.M., Bonhommeau S.

SCRS/2011/152 New data about the historical distribution of bluefin tuna (Thunnus thynnus L.), in the Arctic Ocean. Di Natale A.

SCRS/2011/166 ICCAT GBYP – Atlantic-wide Research Programme for Bluefin Tuna 2011. GBYP Coordination Detailed Activity Report for Phase 2. Di Natale A., Idrissi M.

SCI/037/2011 ICCAT GBYP Atlantic-wide Research Programme for Bluefin Tuna. Activity Report for 2011 (Phase 2).

- Bluefin tuna and Oceanography: how a careful analysis of the ancient bibliography can contribute to enlarge our knowledge on the distribution of this species. 1st Conference of the Historical Oceanography Society, Porto Venere. Di Natale A. (presentation)

- A preliminary assessment and communication of uncertainties in Atlantic bluefin tuna (*Thunnus thynnus*) stock assessment. Leach A.W., Levontin P., Holt J., Kell L.T., Mumford J.D. (in press on: Journal of Fisheries Biology).

- ICCAT-GBYP Symposium on Trap Fisheries for Bluefin Tuna. Collect. Vol. Sci. Pap., ICCAT, LXVII: 1-398 + 1 DVD.

SCRS/2012/116 Review and preliminary analysis of size frequency samples of bluefin tuna (*Thunnus thynnus*) 1952-2010. Justel Rubio A., Ortiz M.

SCRS/2012/125 Preliminary analyses of the ICCAT VMS data 2010-2011. Justel Rubio A., Parrilla A., Ortiz M.

SCRS/2012/139 ICCAT-GBYP Atlantic-wide Research Programme for Bluefin Tuna 2012. GBYP Coordination detailed activity report on Phase 2 (last part) and Phase 3 (first part). ICCAT Secretariat (Di Natale A., Idrissi M.)

SCRS/2012/140 ICCAT-GBYP Aerial Survey: Spawners vs. juveniles. A SWOT analysis for both perspectives. ICCAT Secretariat (Di Natale A., Idrissi M.)

SCRS/2012/141 BFT catch and size historical data recovered under the ICCAT Atlantic-wide Research Programme for Bluefin Tuna (Phases 1 and 2). ICCAT Secretariat (Di Natale A., Idrissi M., Justel Rubio A.)

SCRS/2012/142 The mystery of Bluefin tuna (*Thunnus thynnus*) presence and behavior in the central southern Atlantic in recent years. Di Natale A.

SCRS/2012/143 Preliminary information on GBYP pop-up tagging activities in Morocco in 2012. Quílez-Badia G., Cermeño P, Sainz Trápaga S., Tudela S., Di Natale A., Idrissi M., Abid N.

SCI/2012/034 ICCAT GBYP Atlantic-wide Research Programme for Bluefin Tuna. Activity Report for 2012 (extension of Phase 2 and first part of Phase 3).

Annex III

List of meetings and activities attended by GBYP coordination staff (*) or external invited experts (**)

Date	*Place*	*Meeting or activity*	*Motivation and participation*
7-11/01/2011	Madrid (SP)	Workshop on the use of R tools in the data preparatory work for ICCAT-SCRS	Coordination of the data preparatory work, including bluefin tuna data (J. Ortiz de Urbina**, P. Pallarés, L. Kell, M. Ortiz, C. Palma)
27-31/01/2011	La Spezia (IT)	Historical Oceanography Society	Board meeting – organisation of the first international congress and use of ancient bluefin tuna data in correlation with historical oceanographic and climate parameters to better understand the distribution of bluefin tuna in some marginal areas of its range. (A. Di Natale*)
14-16/02/2011	Madrid (SP)	ICCAT-GBYP Workshop on Aerial survey analysis	Review of the current knowledge on aerial survey techniques and approaches, the data obtained by the GBYP in Phase 1, operational problems encountered and proposals for a more focused approach in the next phases. (A. Di Natale*, G. Donovan**, M. Lutcavage**, J.M. Fromentin**, P. Pallarés, L. Kell, M. Ortiz, C. Palma)
17/02/2011	Madrid (SP)	ICCAT-GBYP Operational Meeting on Biological and Genetic Sampling and Analyses	Review of the best approaches in terms of coverage and techniques, TORs for Call for Tenders for the sampling design (A. Di Natale*, M. Lutcavage**, J.M. Fromentin**, O. Sakay**, P. Pallarés, L. Kell, M. Ortiz, C. Palma)
18/02/2011	Madrid (SP)	ICCAT-GBYP Operational Meeting on Bluefin Tagging	Discussion about the GBYP Tagging design and the GBYP Tagging manual, possible operational approaches (A. Di Natale*, J. L. Cort**, E. Belda**, M. Lutcavage**, J.M. Fromentin**, P. Pallarés, L. Kell, M. Ortiz, C. Palma)
23-24/02/2011	Cartagena (SP)	Un nuevo amanecer para el atún rojo (organised by the Regional Government of Murcia, the IEO and the State Secretary for the Sea)	Presentation of GBYP and discussion about the possibility to develop joint or parallel research activities in Spain to enlarge the GBYP possibilities. (A. Di Natale)
28/04/2011	Madrid (SP)	Cuaderno de bitácora del atún rojo: sostenibilidad, trazabilidad, gastronomia (organised by Balfegó Group)	Contacts with the stakeholders and the Spanish Administrations. (D. Meski, A. Di Natale*, M. Idrissi*)

17-18/05/2011	Madrid (SP)	ICCAT-GBYP Training Course for Aerial Survey on Bluefin Tuna Spawning Aggregations	Training for pilots, professional spotters and scientific observers working for the GBYP aerial survey. (A. Di Natale*, M. Idrissi*, G. Donovan**, A. Cañadas**)
20-26/05/2011	Tangier (MA)	ICCAT-GBYP Symposium on Trap Fishery for Bluefin Tuna	Review of the knowledge on tuna trap fishery and data A. Di Natale*, M. Idrissi*, P. Pallarés, M. Ortiz)
27-29/05/2011	Larache (MO)	ICCAT-GBYP electronic tagging	Tagging with miniPATs at the tuna trap of Larache, carried out by WWF-MedPO and IEO (M. Ortiz).
01-02/06/2011	Genova (IT)	UN Ocean Day conference	Presentation of the GBYP activities (A. Di Natale*)[17]
27/6-1/7/2011	Madrid (SP)	Joint Meeting of the ICCAT Working Group on Stock Assessment Methods and the Bluefin Tuna Species Group to Analyse Assessment Methods developed under the GBYP.	Review of various approaches and methods and presentation of the preliminary advancements of the GBYP modelling approaches (A. Di Natale*, M. Idrissi*, J. Cooke**, P. Levontin**, A. Leach**, P. Pallarés, L. Kell, M. Ortiz)
27/6-1/7/2011	Madrid (SP)	GBYP Steering Committee meeting	Review of GBYP activities (A. Di Natale*, M. Idrissi*)
04/07/2011	Rome (SP)	Italian Society of Marine Biology national meeting on biological sampling (including bluefin tuna)	Presentation of GBYP Phase 2 programmes and discussion about the cooperation of various Institutes within the ICCAT-GBYP Biological and Genetic sampling activities (A. Di Natale*[18])
08-11/07/2011	Ibiza (SP)	Aerial Survey	Field inspection of the activities (M. Idrissi*)
10-18/09/2011	Mahe (Seychelles)	MADE project	Presentation of the GBYP tag activities and tag awareness strategy (A. Di Natale)[19]
20-21/09/2011	Malta	RAC-MED	Presentation of the GBYP tag activities and tag awareness strategy (A. Di Natale)[20]
26-30/09/2011	Madrid (SP)	SCRS Species Group Meeting	Presentation of GBYP activities (A. Di Natale*, M. Idrissi*)
29/10/2011	Madrid (SP)	GBYP Steering Committee meeting	Review of GBYP activities and plans for Phase 3 (A. Di Natale*, M. Idrissi*)

[17] Participation without costs for GBYP.

[18] Participation on personal basis, not officially on behalf of GBYP.

[19] Participation without costs for GBYP.

[20] Participation without costs for GBYP.

30/09-01/10/2011	Porto Venere (IT)	1st Congress of the Historical Oceanography Society	Presentation of GBYP findings on the historical presence of BFT in the Arctic Ocean and correlation with oceanographic data (Di Natale*)
03-07/10/2011	Madrid (SP)	SCRS Plenary Meeting	Presentation of GBYP activities in Phase 2 and plan for Phase 3 (A. Di Natale*, M. Idrissi*)
02-03/11/2011	Madrid (SP)	SELFDOTT Project Meeting	Presentation of ICCAT-GBYP (A. Di Natale*)
10-20/11/2011	Istanbul (TK)	ICCAT Commission Meeting	Presentation of GBYP activities in Phase 2 and plan for Phase 3 (A. Di Natale*, M. Idrissi*)
14/11/2011	Istanbul (TK)	Meeting with the Turkish Delegation	Discussion about the problems encountered during the aerial survey in 2011 (A. Di Natale*, M. Idrissi*)
17-19/01/2012	Paris (FR)	OSPAR 2nd Informal Meeting of Competent Authorities on the Management of Selected Areas in ABNJ in the North-East Atlantic	Presentation of ICCAT-GBYP activities (D. Meski, A. Di Natale*)
07-08/02/2012	Madrid (SP)	GBYP Steering Committee meeting	Review of GBYP activities and plans for Phase 3 (A. Di Natale*, M. Idrissi*)
20-21/03/2012	Madrid (SP)	GBYP Steering Committee meeting	Updated plans for Phase 3 (A. Di Natale*, M. Idrissi*)
29-31/03/2012	Melilla (SP)	World Congress of the International Federation of Sport Fishing	Presentation of the GBYP tag activities and tag awareness strategy (A. Di Natale*)
17-18/04/2012	Madrid (SP)	ICCAT-GBYP Operational Meeting on Tagging, Biological and Genetic Sampling and Analyses	Review of the improvements in knowledge from Phase 2 activities, and discussions about the best approaches in terms of practices, coverage, strategies and techniques for Phase 3 (A. Di Natale*, M. Idrissi*, A. Justel*, L. Kell).
13-17/05/2012	Larache (MO)	Electronic tagging in trap	Electronic tagging activity with INRH and WWF (A. Di Natale*, M. Idrissi*)
5-11/09/2012	Madrid	Bluefin Tuna Assessment Meeting	Presentation of the major GBYP activities and data recovery (A. Di Natale*, M. Idrissi*, A. Justel*).
24-25/09/2012	Madrid	SCRS Sub-Committee on Statistics	Overview of the GBYP data recovery (A. Di Natale*)
1-5/10/2012	Madrid	SCRS Plenary	Presentation of the GBYP activities and plans (A. Di Natale*, M. Idrissi*)