INTERNATIONAL COMMISSION FOR THE CONSERVATION OF ATLANTIC TUNAS

COMMISSION INTERNATIONALE POUR LA CONSERVATION DES THONIDES DE L'ATLANTIQUE

COMISION INTERNACIONAL PARA LA CONSERVACION DEL ATUN ATLANTICO

ATLANTIC-WIDE RESEARCH PROGRAMME FOR BLUEFIN TUNA

(ICCAT GBYP)

PHASE 13

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GBYP SCIENTIFIC AND TECHNICAL FINAL REPORT FOR PHASE 13

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Table of Contents

1. Introduction

The results and conclusions from all the scientific activities carried out within GBYP Phase 13 are detailed in the deliverables associated to each of these tasks, uploaded to CINE system, and are, or will be shortly, also publicly available, as final reports or scientific papers, through the ICCAT GBYP webpage. However, this report provides additional information about administrative issues, some context and historical perspective to the different lines of research, and compile in a single document the main results from Phase 13 research activities, aiming to provide a general overview of the progress and recent contributions from the GBYP program. Therefore, a historical background, budgetary information and coordination tasks, as well as a description of the scientific work carried out within each main line of research supported by GBYP, is summarized below.

1.1 Historical background

The Atlantic-Wide Research Programme for Bluefin Tuna was officially adopted by the ICCAT Commission in 2008, endorsing the SCRS Chair's report on Bluefin Tuna Research Priorities and Potential costs. In 2009 the SCRS advised the Commission that, to substantially improve the scientific advice, such program would focus on the improvement of basic data collection through data recovery, understanding of key biological and ecological processes, improvement of assessment models and provision of scientific advice on stock status.

During the Commission Meeting in 2009, several Contracting Parties expressed a willingness to make extra-budgetary contributions to such a Programme with a view towards initiation of activities related to different priorities: programme coordination, data recovery, aerial surveys and tagging studies, with additional research activities to be undertaken in the following years. The provision to accept additional contributions from various entities and private institutions or companies was also agreed.

GBYP (Grand Bluefin Tuna Year Programme) was then adopted as official acronym of the research programme. Given that budgetary contributions would be provided annually the Programme has been implemented by annual Phases. To facilitate its coordination and management a post of Programme Coordinator was created, and a Steering Committee (SC) was set.

It was initially envisaged as a 6-year programme, but in 2014 the GBYP Steering Committee and the SCRS (documents SCRS/2014/194 and SCI 005/2014) recommended extending the GBYP activities up to 2021 and this proposal was endorsed by the Commission during its November 2014 meeting, along with the SCRS report. A new plan for the GBYP activities to be done during these additional years was approved along with the extension. Consequently, the donors maintained their contributions, allowing the continuity of the programme. In its report for the biennial period 2020-2021, Part 2 (2021), adopted in the 27th regular meeting of the Commission, the SCRS request explicitly further funding of the GBYP for the period 2022-2026.

From 2015 GBYP is being complemented by a twin programme addressed to USA research teams, the BTRP, funded by NOAA-NMFS, which focuses its research activities on the western Atlantic Ocean.

1.2 Objectives

At the beginning of the programme the GBYP Steering Committee defined as the main objective of the GBYP the improvement of the knowledge and understanding of the Atlantic bluefin tuna (*Thunnus thynnus*) stocks and populations. Aiming at the achievement of this strategic objective, a series of general objectives was set considering the priorities initially stated by SCRS (data collection, understanding of key biological and ecological processes and assessment improvement). These broad objectives have been maintained throughout the program, but along the successive phases they have been updated based on the "state of the art" as regards scientific knowledge on bluefin tuna, to better match SRCS research needs and Commission recommendations and requests. In addition, since Phase 10, two new general objectives have been considered, one addressing the need of a closer coordination between GBYP program and CPCs research programs, and the other on the need for improving data management.

The first was set aiming at increasing the efficiency of GBYP program, taking advantage of any potential synergy, and preventing any duplicity. The second is a strategic objective, since the only way to make a proper use of the huge amount of data generated along the successive phases of GBYP program is to integrate this sparse data sets in information systems based on fully operative relational databases, as those proposed on biological and spatial data coming from the GBYP biological studies and tagging programs. These will allow to perform joint analyses of broad data sets, getting more accurate and reliable results and conclusions, and hence improving the stock assessment.

Therefore, nowadays the current general objectives of GBYP program are:

a) Improve basic data collection.
b) Improve understanding of key biological and ecological processes.
c) Improve assessment models and provision of scientific advice on stock status.
d) Enhance the coordination between GBYP activities and the monitoring and research activities on BFT carried out by other institutions, both at national and international level.
e) Contribute to the implementation within ICCAT Secretariat of new BFT information management systems.

In relation to each of these broad objectives, the specific objectives set for GBYP Phase 13 were to:

a.1. Contribute to the optimization of BFT biological sampling programs, ensuring that sampling activities carried out by CPCs and those funded by GBYP are complementary and collect representative biological samples
b.1. Enhance the information available on BFT spatial distribution and mixing, by promoting and supporting electronic tagging campaigns, and continuing the support to CPCs conventional tagging activities
b.2. Provide SCRS with updated and reliable data on biological parameters and stock structure
b.3. Develop a feasibility analysis and planning for the implementation of the Close Kin Mark Recapture methodology to BFT Eastern stock
c.1. Update and improve fishery independent aerial survey index of abundance
c.2. Support the further development and implementation of BFT Management Strategy Evaluation (MSE)
c.3. Support the external review of the ongoing ICCAT MSE processes
d.1. Contribute to the implementation of an internationally coordinated and optimized BFT sampling system
d.2. Promote the joint analysis of the ICCAT electronic tags DB
e.1. Contribute to the design and implementation, in close coordination with ICCAT Secretariat Research and Statistics departments, of an Information System on BFT biological data, that will integrate relational databases including all relevant available information from GBYP and that provided by CPCs research teams.
e.2. Contribute to the design and implementation, in close coordination with ICCAT Secretariat Research and Statistics departments, of an Information System on electronic tags data, integrating etags data sets from ICCAT and CPCs e-tagging programs.

1.3. Programme management and financial aspects

The GBYP programme development is supervised by a Steering Committee, which has the role to guide and supervise its implementation. It is composed by the SCRS chair, W-BFT rapporteur, E-BFT rapporteur, one external member and the ICCAT Executive Secretary, which can be substituted by his deputy. The Steering Committee is regularly informed and consulted by the GBYP Coordinator for all relevant issues. The Steering Committee meets not less than once a year, to verify the activities done, refine and propose the follow-up of the Programme, and adopt the detailed budget proposal presented to the EU, based on the budget structured in main lines of research proposed by the SCRS and adopted by the Commission

The GBYP coordination team carries out the day to day tasks related to the implementation of the project, including the elaboration of the Calls for subcontracting different types of activities and for Expressions of Interest to collaborate with some of the GBYP lines of research, the drafting of contract and Memorandum of Understanding proposals, supervising the reports received from contractors or collaborating institutions, organizing GBYP related meetings and workshops, taking care of the regular

reporting on the GBYP activities to the SCRS relevant groups and the elaboration of the final annual global and executive reports presented to the SCRS Plenary and to the main donor, the EU.

Furthermore, the GBYP coordination team participates, or provides scientific support whenever requested, in national or international initiatives which are potentially able to increase the effectiveness of the GBYP and the achievement of its objectives. For example, since 2010 the GBYP coordinator has been part of the Evaluation Committee of the NOAA BTRP and has participated regularly in the meetings of the EU Regional Coordination Group on Large Pelagic since its creation.

The GBYP is funded by voluntary contributions of CPCs and other entities, as Chinese Taipei. Among CPCs, EU provides up to 80% of total budget. In addition, several private or public entities also provide few additional funds or in-kind support. The budget is set annually, by phase. The evolution of the total budget along the Programme, by type of activity, is shown in **Table 1** (in euro):

Table 1. GBYP Budget by type of activity, per Phase

Activity / Phase	Phase 1	Phase 2	Phase 3	Phase 4	Phase5	Phase 6
Coordination	210,000	453,000	225,000	600,245	342,000	383,000
Data Recovery	200,000	149,000	30,000	40,250	20,000	165,000
Aerial Survey	300,000	465,000		518,426	519,500	
Biological Studies		505,000	430,000	364,000	363,000	556,000
Tagging	40,000	890,000	1,175,000	1,229,979	669,500	844,000
Modelling		40,000	65,000	122,100	211,000	177,000
FINAL	**750,000**	**2,502,000**	**1,925,000**	**2,875,000**	**2,125,000**	**2,125,000**

Activity / Phase	Phase 7	Phase 8	Phase 9	Phase 10	Phase 11	Phase 12	Phase 13
Coordination	415,745	312,500	227,000	478,000	379.000	491.000	440.000
Data Recovery	25,000	58,000			55.000	30.000	
Aerial Survey	405,000	494,500	535,775	321,000	370.000	80.000	396.000
Biological Studies	580,000	583,000	710,000	750,000	380.000	494.500	230.000
Tagging	262,000	159,000	177,500	315,000	221.000	262.500	160.000
Modelling	121,240	143,000	99,725	136,000	195.000	142.000	24.000
FINAL	**1,808,985**	**1,750,000**	**1,750,000**	**2,000,000**	**1.600.000**	**1.500.000**	**1.250.000**

It must be pointed out that this annual and variable funding scheme, relying on voluntary contributions, instead of a multi-year and more stable funding system, is one of the major problems for GBYP, as it make particularly difficult mid- and long-term planning of the activities, which would be a more efficient strategy for the program. For this reason, both the GBYP Steering Committee and the SCRS have recommended several times the adoption of a more stable funding system, but all proposals submitted so far by the ICCAT Secretariat or some CPCs to the Commission (i.e.: scientific quota, CPCs contribution proportional to quota, etc.) were discussed but they were never approved. The uncertainties linked to the funding at each Phase have created operational problems since the beginning of the programme, because it is difficult to plan all activities and provide all necessary contracts when the effective funding for a given Phase is only confirmed soon before the end of the previous one. This fact implies a continuous attention to the effective budget availability at each step of the programme by the Coordination team and Steering Committee and the impossibility to operate with multi-year contracts for multi-year activities. Fortunately, this situation has improved recently, thanks to the adoption of a biannual funding system for Phase 14.

It is also worth to mention than despite the absolute value of the coordination costs, which include staff salaries, overheads, Steering Committee (SC) external expert contract, audit costs, coordination related travels, consumables and equipment and SC travel, is similar to the mean value of such coordination costs along the whole program, in relative terms the percentage of coordination costs have raised from around 20% of the total budget to 34% in Phase 13. One reason that has prevented to further reduce these relatives costs is that since the project overall annual budget has been following a progressive decreasing trend, while fixed costs (e.g. staff cost, external SC member) are kept. is the managed through the CINEA system the overheads (considered as coordination costs), which in the past were a fixed amount of 20000€ by year (it is around 1% of the total annual budget), have now raised to the 7% of the overall cost, which in spite of the important reduction in the annual budgets have resulted in a significant increase,

from 20000€ to around 90000€. Other new additional cost is the fee for the external audit, estimated in 8000€.
However, the main reason of the important increase in the percentage of coordination costs, is simply the progressive and relevant reduction of the project annual budget, which have decreased along the last four Phases from over 2 million euros to 1250000€ in Phase 13..

To download this high percentage of coordination costs, a new measure have been agreed that will applies to Phase 14 onwards, to reduce the dedicated coordination team funded by the project itself. So, from January 2024, the GBYP Assistant Coordinator left her post, to occupy a new post in ICCAT Secretariat, following a decision taken by the Commission during the November 2023 meeting. Similarly, the GBYP database specialist will leave GBYP coordination team in January 2025, and his tasks in relation to GBYP be assumed by ICCAT Secretariat Statistics department, which will allow to further reduce both the absolute and relative values of Coordination costs within GBYP program.

The general information about GBYP activities and its results from the very beginning of the programme till nowadays, as well on budgetary and other administrative issues, is available from ICCAT GBYP webpage (https://www.iccat.int/GBYP/en/). All the relevant documents related to the programme development, including final reports of every activity and derived scientific papers, annual reports to SCRC and European Union, as well GBYP workshops or Steering Committee meetings reports, are also easily available therefrom.

2. Budget in Phase 13

The thirteenth Phase of the ICCAT GBYP officially started on 1 May 2023 following the signature of the Grant agreement for the co-financing of the ICCAT GBYP Phase 13 (101133291) by the European Commission. Initial duration of the Phase was one year, but it was amended in April 2024 to extend three months the duration of the agreement and to rearrange the available budget, in order to better match the updated SCRS workplan, thus officially ending on 31 July 20 24.

The main motivation for extending the Phase was the need to finish the ongoing study by the University of Stanford based on the whole DNA sequencing, which started later than planned due to unexpected delays in the negotiation of the contract with Stanford administrative services and was afterwards further delayed due to retaining of samples in Spanish customs. Moreover, extending the Phase 13 allowed carrying out the tagging campaign in the Levantine Sea, which was also considered of high priority. In addition, the Steering Committee identified two new research needs with respect to the Close-Kin Mark-Recapture methodology, whose corresponding activities had to be developed within Phase 13 and hence incorporated to the work plan.

It is worth to mention that the GBYP Phase 13 overlapped with Phase 12 in the period between 1 May 2023 and 23 July 2023. In addition, it overlapped with Phase 14, which necessarily had to start in February 2024 to allow the organization and development in time of the 2024 GBYP aerial surveys, which had to be funded under Phase 14 budget. However, apart from the burden related to to GBYP management, it is worth noting that the same activities did not overlap between the different Phases. Moreover, it has been possible to develop in parallel the different phases without major problems, since each phase has a well-defined work-plan and budget, and hence every cost can be assigned univocally to the activities detailed in the respective Grant Agreements.

A report of the GBYP activities in Phase 13 up to September 2023 was provided to the BFT Species Group (SCRS/2023/159) and the SCRS (SCI 44A/2023 and SCI 142/2023). The final report of Phase 13 activities will be submitted to SCRS in September 2024 and presented within the SCRS 2024 Plenary meeting.

In Phase 13, the budget had the following funders when the proposal was presented (in order of contribution already received):

European Union	900,000.00 €
Morocco	66,280.30 €

Japan	55,782.93 €
Tunisia	47,258.00 €
Türkiye	46,575.34 €
Libya	45,643.84 €
Algerie	36,239.90 €
Canada	20,529.68 €
Norway	19,000.00 €
Albania	4,719.17 €
Iceland	4,021.64 €
Korea	3,958.90 €
TOTAL BUDGET	**1,250,000.00 €**

As of today, given that the executed costs in GBYP Phase 13 were 1.035.095, 64€, whereas the approved budget was 1.250.000€, the contributions from funders other than the EU will generate residuals for amounts representing the difference between their contributions and the amounts of executed costs not covered by the EU. The percentage of residuals by CPC will be proportional to the quantities detailed in the lists above, EU contribution will not generate any residual because in the final payment received from EU after the approval of Phase 13 technical and financial reports, only the pending amounts to cover the actual executed costs will be paid. These and residuals of previous GBYP Phases originated from contributions provided by CPCs other than the EU have been, or will be, used for balancing the reduction on the EU contribution, as have been done in Phase 14, and for compensating costs which were not covered by the EU funding in the various Phases. Additional eventual residuals from Phase 13, originated from late payments of amounts requested, or further voluntary contributions from other CPCs, would be also used for the following Phases of GBYP. It should be noted that some contributions for the current and previous GBYP Phases are still pending from several ICCAT CPCs.

3. Programme Coordination in Phase 13

3.1. Steering Committee

The Steering Committee in the Phase 13 was composed by the SCRS chair (Dr Craig Brown), the Western BFT rapporteur (Dr John Walter), the Eastern BFT rapporteur (Dr Enrique Rodríguez Marín), the ICCAT Executive Secretary (Mr. Camille Jean Pierre Manel) and the external expert. The contract for the external member of the Steering Committee was signed with Dr Ana Parma, former researcher at the Centre for the Study of Marine Systems – CONICET (Argentina). This contract was signed following the decision of the Steering Committee *ex officio* members of extending the contract of Dr Ana Parma, who was selected as member of the GBYP SC in the GBYP Phase 11, to Phase 13, to contribute to the project planning, supervision and decision making. Dr. Ana Parma was selected considering her experience in lines currently crucial for the SCRS BFT group, as MSE processes and CKMR studies. It is worth to point out that Dr Ana Parma is a worldwide reputed scientist, with direct experience both in MSE and CKMR processes, who has been directly involved in similar processes already implemented in Southern Bluefin Tuna, which makes her profile very useful to ensure a good supervision of GBYP activities related to these topics. Moreover, it must be said that she has not only provided general advice on these matters, but participated very actively in some specific tasks, as the modelling related to CKMR Eastern stock feasibility study, transferrin her know-how the EU scientist in charge of this modelling/programming work, Dr Carmen Fernandez (see Deliverable 10).

Another contract was signed with Dr Daniel Ruzzante, selected through an open Call launched in March 2024 following the usual ICCAT procedures (see ICCAT GBYP Circular G-00129/2024), for providing external advice to the Steering Committee on Close-Kin Mark-Recapture issues. In particular, there was a need to evaluate the appropriateness of the different genetic analytical approaches that can be used for developing CKMR related studies.

During the Phase 13, one SC meeting have been held, in January 2024. Other decisions have been taken via email, following the regular correspondence held between the GBYP Coordinator and GBYP SC members for all relevant issues.

3.2. Coordination Team

In the Phase 13 the Coordination Team has been composed by the GBYP Coordinator (Dr Francisco Alemany), the Assistant Coordinator (Mrs. Stasa Tensek) in 2023 and the Database Specialist (Mr. Alfonso Pagá). The ICCAT Secretariat provided administrative and overall support for all GBYP activities on a daily basis.

3.3. Project management activities

During Phase 13, a total of 5 calls for tenders and 1 official invitation have been released, which have resulted in a total of 8 contracts awarded to various entities (**Annex 1**). In addition, one call of Expression of Interest for collaborating with GBYP electronic tagging program was published, which resulted in 12 Memorandums of Understanding signed.

Other routine project management activities have been the actions related to GBYP Research Mortality Allowance, the maintenance of the Tag awareness and reward program, the regular communication with the Steering Committee members and the updating of the GBYP web page.

Regarding RMA, during 2023 the Research Mortality Allowance was used for covering the incidental death of 47 specimens of bluefin tuna, which equals to a total of 2414 kg, reported through 11 RMA forms. Considering the number of specimens, most of these correspond to sampling activities, while considering the weight, the most correspond to incidental deaths due to electronic tagging activities.

In addition to the coordination tasks related to activities developed under these contracts or agreements and other day to day communication tasks with different stakeholders, the GBYP coordination team has participated in all SCRS meetings focused on bluefin tuna:

- Bluefin tuna Species Group Meeting (Madrid, 18-22 September 2023)
- Standing Committee on Research and Statistics (SCRS) meeting (Madrid, 25-29 September 2023)
- 28th Regular Commission meeting (Cairo, 13-20 November 2023), during which the GBYP Coordinator, within a side even organized by GBYP, presented to ICCAT commissioners a series of fact sheets on GBYP Programme, focusing on its main activities, outputs and future challenges.
- Intersessional Meeting of Bluefin Tuna Species Group (Malta, 15-18 April 2024)

In addition, the GBYP Coordinator participated, in person or online, in the following meetings, also focused or related to BFT and GBYP program management:

- SCRS Subcommittee on Statistics (Madrid, 22-23 September 2023)
- Collaborative Workshop to evaluate the incidental capture of Sea Turtles in the ICCAT fleets in the Mediterranean Sea (Fuengirola, 2-4 October 2023)
- Coordination Meeting ICCAT/DGMare (Brussels, 16-17 October 2024)
- SCRS Officers meeting (Madrid, 6 February 2024)
- Panel 2 intersessional meeting (Madrid, 5-8 March 2024)
- SCRS Workshop (Madrid, 18-20 March 2024)
- Intersessional SCRS BFT Group meeting (Malta, 15-18 April 2024)
- Regional Coordination Group Large pelagics meeting (Olhão, 24-26 June 2024)
- Ad hoc Working Group on coordination of tagging information (Madrid, 5 July 2024)

It is worth noting that, upon a request by the SCRS, the GBYP coordinator participated in the collaborative workshop to evaluate the iimpact of ICCAT fisheries on Marine Turtles, as sightings of marine turtles have been systematically recorded within the GBYP aerial surveys, and hence GBYP holds is a source of major information to estimate the abundance of turtles in the regions where most of fishing effort directed to bluefin tuna and other large pelagics are concentrated - the main East BFT stock spawning areas.

Finally, the GBYP data management specialist participated in the meeting of the online reporting technology Group (WG-ORT) (Online, 7-8 February 2024), given his involvement in ICCAT data management issues.

4. Activities in Phase 13

The Phase13 activities, adapted to the current SCRS research needs and Commission requests, were structured considering the main lines of research established since the beginning of the programme, i.e. data recovery and management, biological studies, tagging, stock indices (aerial surveys) and modelling, All activities carried out throughout the GBYP Phase 13, as well their final or preliminary results and the related coordination activities, are summarised in this report.

In general, most of the activities were successfully implemented according to the planned timetable. An extension of the GBYP Phase was requested in order to be able to finish some already ongoing studies and to carry out some CKMR related activities, newly identified as priority ones.

4.1. Data recovery and management

Most of the efforts have been directed to the development of information systems allowing the proper storage of the data from GBYP funded research activities along the successive phases of the program, or other data provided by CPCs research programs relevant for BFT management not yet included in the current ICCAT databases.

The support to the development of the broad biological data information system within ICCAT Secretariat, in which all the information and data on BFT generated by the program along its successive phases will be integrated, continued in this phase. This activity, considered a strategic initiative within ICCAT Secretariat, is very important for GBYP, since it will allow to make the best use of the available biological data on BFT,

and hence improving the parameterization of the models used for stock management. It is planned that this information system will integrate first data generated by all the science programs managed by ICCAT Secretariat, already available at ICCAT Secretariat. However, it aims to incorporate also any relevant data provided by CPCs, be those already presented to SCRS species groups or new data that could be gathered through official data requests. Regarding the latter, within the framework of the meetings of the EU Regional Coordination Group on large pelagic meetings, in which Secretariat and GBYP staff have participated actively from its creation, it have been considered the possibility of launching a data Call to compile all the relevant data and metadata on biological sampling and analyses on species of interest for ICCAT carried out within the EU Data Collection Framework, but the exact terms of such Data Call should be further discussed and agreed by the involved EU scientists in coordination with ICCAT, as end user of such information

The process for the design and implementation of this new information system within ICCAT Secretariat is driven by the Statistics department, which the support of GBYP coordination team, as an "in house" activity. However, due to the work overload in the Statistics Department, which needs to attend as a priority the continuous data requests from SCRS and Commission to provide the data from the already existing databases (Tasks 1 and 2), including for the stocks assessments carried out every year; as well as for a high number SCRS meetings held by year, make that the time dedicated to the development of new broad databases cannot be fully fixed in advance. Therefore, in addition to the routine tasks regarding to the compilation and consolidation of all the relevant data produced within GBYP, the specific activities towards the design and implementation of the ICCAT biological data information system carried out by GBYP staff within each phase are agreed and coordinated with the Statistics department. Specifically, in Phase 13, in addition to advances in the design of the whole DB structure, templates to standardize the biological data collection for all ICCAT species have been produced in close collaboration with the ICCAT Secretariat Statistics Department.

Once terminated and functional, this relational database will allow to develop broad collaborative studies to estimate more reliable biological parameters and to optimize sampling programs, ensuring that those carried out within science programs managed by ICCAT Secretariat and by CPC are complementary.

Other in-house activity carried out has been further development of ETAGS database. Testing of already installed database revealed various issues which will have to be addressed in the future phases, along with the further optimization of the database function and its fine tuning. This database is meant to integrate electronic tagging datasets from ICCAT and CPCs e-tagging programs. Once relevant datasets are incorporated and compiled, the ETAGS DB will allow performing of joint analyses of broad datasets, which will contribute to improving knowledge on population structure and spatial patterns for all the ICCAT managed species for which e-tagging programs have been implemented, including both BFT stocks..

The outputs from these databases will be directly used to improve the parameterization of assessment models (input data) and therefore the management of BFT stocks as well.

4.2. Fishery independent stock indices (Aerial and Larval Surveys)

ICCAT GBYP Aerial survey on bluefin spawning aggregations (AS) was initially identified by the Commission as one of the three main research objectives of the Programme, to provide fishery-independent trends on the minimum SSB. However, due to different reasons, as budgetary and logistic limitations, and also different opinions about the best sampling strategies between successive SC members, this activity has not been developed regularly and has not followed strictly homogenous methodologies and sampling strategies from the very beginning, even the basic sighting and data analysis methodology has been the same along the whole series, and such methodologies were fully standardized from 2017 onwards.

In 2019, all historical GBYP aerial survey data were re-analysed for all the areas and years in a homogeneous way, correcting some errors that were not detected before and introducing some methodological improvements in the data analysis process, resulting in new more accurate and fully standardised index time series. However, the new index time series exhibited substantial differences in relation to prior time series, and still showed a high interannual variability between and within areas, which raised new concerns about the estimation procedures and the overall efficacy of the survey.

Consequently, the SRCS BFT Group recommended to carry out an in-depth revision by external independent experts. Such revision was performed in 2020 by two recognized experts, including one of the original developers of the analytical methodology used in these surveys, who presented several recommendations for its improvement (see report "Independent Peer Review of the ICCAT GBYP Aerial Survey Design, Implementation and Statistical Analyses (ICCAT GBYP 12/2020), elaborated the Centre for Independent Experts (CIE), available here . One of these recommendations was to explore the feasibility of moving to digital observing and counting systems, to substitute human observers-based system, and another was to extend, if possible, the surveyed areas.

Moreover, having detected some inconsistencies in the computer code, they also recommended to hire another experienced user of the R Distance software, to review and eventually rewrite the code if necessary, as well to apply model-based approaches in addition to the design-based methods.

So, following these recommendations, in 2021 a pilot aerial survey was carried out in the Balearic Sea area, covering both the standard core area and an extended area surrounding it, incorporating digital observing systems in addition to the human based sighting methods, aiming at evaluating the feasibility of using digital systems for the monitoring of BFT spawning aggregations and its accuracy and precision, as compared to the classic human observers-based system.

Finally, to address the recommendations related to data analyses, the Saint Andrews University CREEM team, who are the original developers of the Distance aerial surveys methodology, were hired to perform a global reanalysis of the whole time series, applying both the design-based approach used from the beginning of the GBYP aerial surveys, and a newly developed model-based approach aiming at overcoming the potential impact of interannual environmental variability on BFT spawners distribution and index accuracy.

The field activities showed that the digital systems, couldn't substitute yet the human observers based system at an affordable cost, and that surveying extended areas was not feasible due to budgetary and logistic constraints. Regarding the data analyses, the previously detected inconsistencies were corrected, and it was confirmed that the estimations from the model-based approach fell within the range of estimation from the design-based approach.

Consequently, in Phases 11 and 12 the aerial survey was conducted again in the core areas of the Western and Central Mediterranean Sea following the standard human observers-based methodology. As regards data analyses, CREEM team was selected to continue in charge of these activities, further refining model-based approaches, aiming to provide in a future more accurate index time series for the next BFT MSE cycle, but maintaining the standard design-based methodology for index estimation, in order to update the design-based index time series currently used within the BFT MSE. All the reports related to GBYP aerial surveys, bot to field surveys and data analyses, are available here.

4.2.1. GBYP Aerial survey campaign in 2023

As explained in previous section, despite the promising preliminary results from the pilot survey using digital systems, due to logistic constraints and available budget, the GBYP Steering Committee (SC) decided to resume the aerial survey following the classic human observers-based system. As in 2022, it was decided that the Levantine Sea sub-area (Area G) would not be surveyed given that the results obtained in previous campaigns suggested that one of the basic assumptions to apply this methodology, that is that the BFT spawners are fully available for aerial observations, was not accomplished. Therefore, the three areas which were surveyed in 2023 were the following: Balearic Sea (Area A), Southern Tyrrhenian Sea (Area C) and Central-southern Mediterranean Sea (Area E).

To keep the time series of this aerial index, which is one of the indices used for the evaluation of the eastern BFT stock within the framework of the new management system based on the MSE approach, the surveys strategy and sighting methodologies were the same as in last campaigns. Therefore, the survey was conducted in the period from the end of May to the beginning of July, following the standard protocol and using classical visual observations.

Before the mission, on 31st May 2023 an on-line training course was held, with the participations of all members of the crews (pilot, professional spotters, 2 scientific spotters), in order to provide them with the detailed instructions on the methodology and the way to fill the sighting forms.

The survey in Area A (Balearic Sea) was carried out with a Cessna 337 plane, from 1-26 June 2023. During this period, there were carried out 18 flights, but on two of these days the sighting work was cancelled because of bad visibility. Because bad weather conditions or flight bans due to military activities the team stay in land 8 days. This year the temporal closures of part of the surveyed area due to military exercises obliged the team to adapt the original sampling strategy, covering in some occasions different parts of a given transect of the same replica in different days. Nevertheless, all the 30 initially planned transects, divided into 4 replicas, were flown over. In total, during the time on effort, 36 observations of bluefin were recorded, which summed to more than 27,000 individuals with a total weight of 4,200 t. Most of the observed schools were made up of large individuals (weighting between 150 and 280 kg). The preliminary map (**Figure 1**) shows that most observations were located in the North and North-West of the Ibiza and Majorca islands, as well as in the South-East of Majorca.

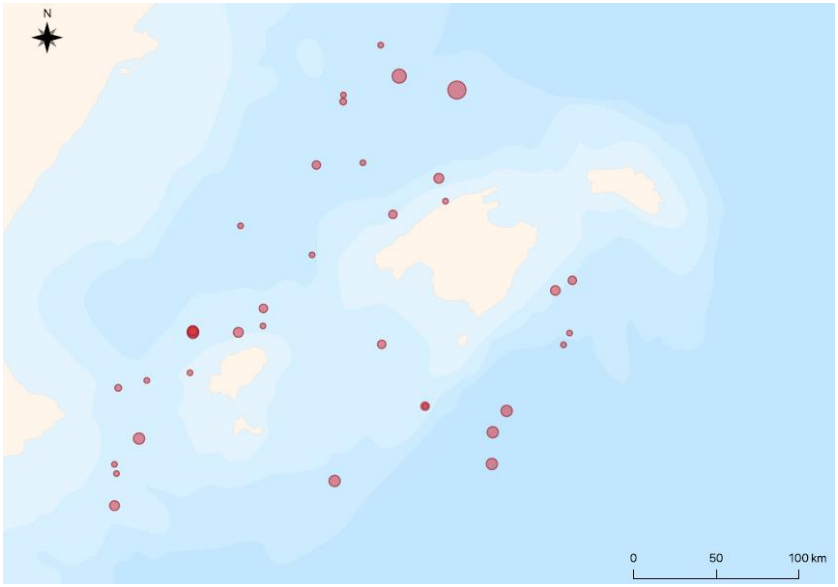

Figure 1. Bluefin tuna observations in the Balearic Sea area

The survey in the Southern-Tyrrhenian Sea (area C) was carried out by a plane Partenavia/Vulcanair P68 B model during the period from 2 to 19 June. There was a total of 13 survey flights. For 5 days, the survey had to be cancelled due to weather conditions or unforeseen events. A total of 5 bluefin sightings were realized, of large schools formed by 500-7000 individuals, which summed up to 11,300 individuals with a total weight of more than 690 t. Although the importance of this area for bluefin spawning could be confirmed once again this year, there were less sightings than in previous years. According to the professional spotters' opinions, part of the BFT schools could be deeper and less visible, probably due to high surface sea temperatures. The distribution of sightings is shown in **Figure 2**.

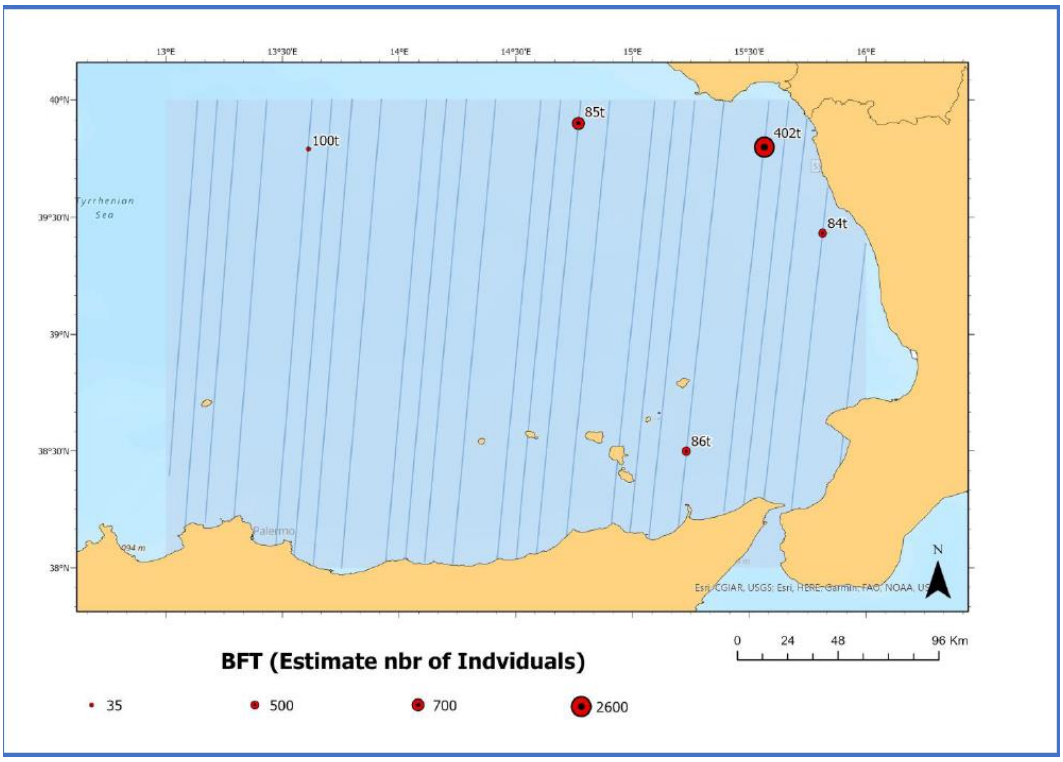

Figure 2. Bluefin tuna observations in the Southern Tyrrhenian Sea area

The survey in Area E: Central-Southern Mediterranean Sea (Sicily Channel) was carried out from 20 June to 5 July. Unfortunately, it was impossible to cover the Easternmost part of the study area (around 1/3 of the total), specifically the transects that should be covered from Malta airport, because this year, contrastingly to previous ones and also the criteria followed by Italian and Spanish authorities in the other areas, the Maltese aerial authorities considered that the scientific observers were merely passengers, and hence the contracted aerial company should present different type of certificate. It must be highlighted that the documentation presented by the contracted company was exactly the same than in previous years, in which the authorizations were given without any problem. Therefore, the presentation of a formal protest to Maltese authorities could be considered. As a result of these administrative problems, the four foreseen replicas could only be done in the Western/central part of the study area, having as base port Pantelleria airport. The survey was carried out by two planes, both of model Partenavia/Vulcanair P68 B, through 13 survey flights along a 9-day period. In total, 11 bluefin tuna schools were recorded, which represents a similar number as in previous years. However, there was a larger percentage of medium and large fish compared to 2022. In total, there were 10,650 individuals observed with a total weight of 1,270 t. The distribution of sightings is shown in **Figure 3**.

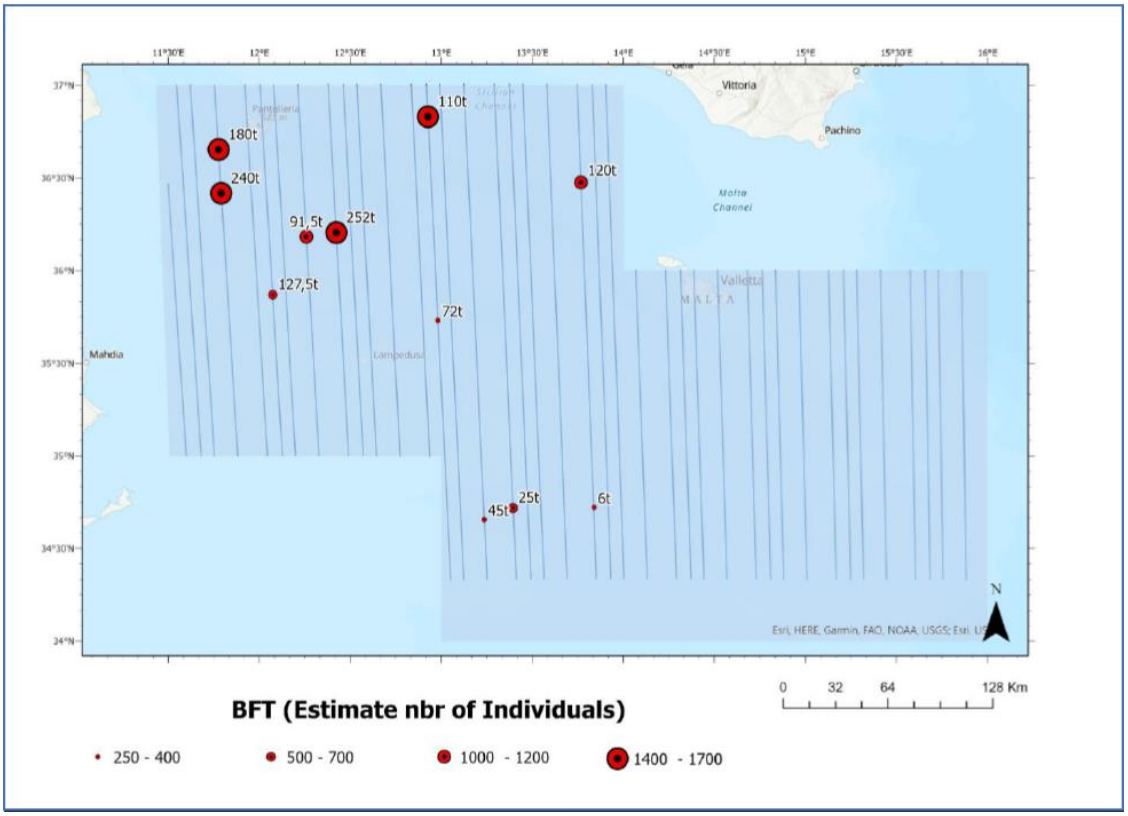

Figure 3. Bluefin tuna observations in the Central-Southern Mediterranean Sea

4.2.2. 2023 Aerial survey data analysis

The contract for aerial survey data analysis was provided to the University of St. Andrews (CREEM). This work comprised the analysis of the visual aerial survey data from 2023 and updating the estimates from the previous surveys conducted in 2017-2023. Abundance and biomass in the surveyed blocks were estimated using line transect distance sampling methods. The tuna indices are updated in two ways: actualisation (Task 1), and strict update (Task 2). To provide a strict update, the detection function from last year was used i.e. the same variables and same parameters.

Table 2 summarises the sightings for the 2023 survey. Like previous years, most sightings in 2023 were observed in block A. For the distance sampling analysis, only on-effort sightings and sightings of non-juveniles' schools were used. Sightings described as 100% small (individuals <25 kg) have, therefore, been excluded, however, the remaining sightings may still include some schools that contain small individuals amongst larger fish. The school sizes observed in 2023 were, on average, larger than in the previous years. This was also reflected in the larger average observed biomass, second only to year 2021.

Table 2. Summaries of BFT sightings in 2023. The Final number indicates the number of sightings which are on-effort and represent adult schools. In brackets are given numbers after truncation to 1,500 m.

Year	Block	All sightings	On effort	Non juveniles	Final number
2023	A	24	22	22	21 (14)
	C	5	5	4	4 (3)
	E	11	11	8	8 (8)

The largest search effort per block was conducted in block A and lowest in block C. Apart from block E, which was only surveyed partially, the effort and area covered in each block was comparable to these in

the previous years. Most sightings were made in block A, resulting in the highest estimated encounter rates and with lowest CVs. Encounter rate estimates were lowest in block C with highest CVs.

Indices actualization (Task 1)

The biomass estimates are presented in **Table 3** and **Figure 4**. The estimates for the previous years based on the newest detection function are comparable with the estimates from the previous reports. There is no increase in biomass in block A in 2023 despite the increase in abundance from 2022. There is a sharp decrease in biomass in block E and a sharp increase in block C following these trends in abundance.

Table 3. Estimated biomass (B, in tonnes) per block (block and year) with standard errors (SE) and lower (LCL) and upper (UCL) confidence levels. Coefficient of variation (CV) is also provided for the results from this analysis. The orange values apply to estimates reported last year (2023), and the grey values from the year before (2022). All estimates are based on sightings from all blocks: A, C, E and G.

Label	B	SE	CV	LCI	UCI	N	CV	LCI	UCI	N	CV	LCI	UCI
	This report					Paxton et al. 2023				Chudzinska et al. 2022			
A-2017	8726	3817	0.44	3774	20177	7949	0.44	3426	18444	8001	0.45	3436	18634
A-2018	14603	4480	0.31	8034	26544	13251	0.31	7225	24304	13345	0.31	7352	24222
A-2019	12948	5139	0.40	6015	27871	11808	0.40	5469	25495	11548	0.38	5619	23734
A-2021	5183	2747	0.53	1905	14105	4955	0.53	1831	13410	4714	0.53	1750	12696
A-2022	10640	4849	0.46	4441	25493	9433	0.49	3723	23899				
A-2023	10970	5364	0.49	4289	28056								
C-2017	6994	2824	0.40	3167	15442	6715	0.40	3060	14733	6749	0.43	2981	15280
C-2018	5238	3032	0.58	1740	15767	5042	0.58	1680	15129	5069	0.54	1846	13920
C-2019	3186	1857	0.58	1047	9696	3057	0.58	1008	9275	3072	0.62	977	9652
C-2022	10770	4610	0.43	4677	24804	9965	0.44	4237	23436				
C-2023	4054	2764	0.68	1140	14412								
E-2017	6393	3726	0.58	2147	19040	5822	0.58	1951	17372	5884	0.6	1981	17483
E-2018	3865	2205	0.57	1335	11189	3702	0.57	1283	10682	3735	0.47	1538	9067
E-2019	2096	994	0.47	848	5176	1956	0.46	804	4760	2023	0.5	797	5188
E-2022	2110	1599	0.76	537	8284	2092	0.77	528	8293				
E-2023	14954	6592	0.44	6299	35500								

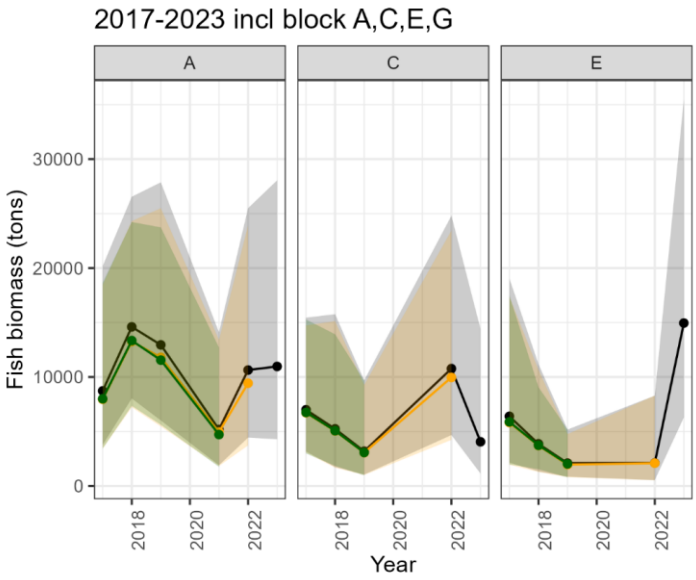

Figure 4. Estimated biomass (in tonnes) of BFT for surveyed years and blocks. Black colours show estimates from this study: dots show mean values and ribbon show upper and lower confidence limits of the 95% confidence interval. Orange colour shows estimates from the last year (2023) and green the year before (2022).

Strict update of indices (Task 2)

The biomass results, detailed in **Table 4** and **Figure 5**, are very similar to the pattern in the abundance estimates for all three blocks and to estimates from Task 1A. The largest discrepancies in the estimates between Task 1A and 2 are for blocks A and E but both well within the confidence intervals.

Table 4. Estimated biomass (B, in tonnes) per block (block and year) with standard errors (SE) and lower (LCL) and upper (UCL) confidence levels based on the parameter estimates from analysis up to the 2022 data inclusive. Coefficient of variation (CV) is also provided for the results from this analysis. All estimates are based on sightings from all blocks: A, C, E and G.

Label	B	SE	CV	LCI	UCI
A-2023	7513.3	5624.2	0.75	2007.3	28122.5
C-2023	3793.5	2601	0.69	1063.5	13531.4
E-2023	14026.2	6352	0.45	5810	33861.1

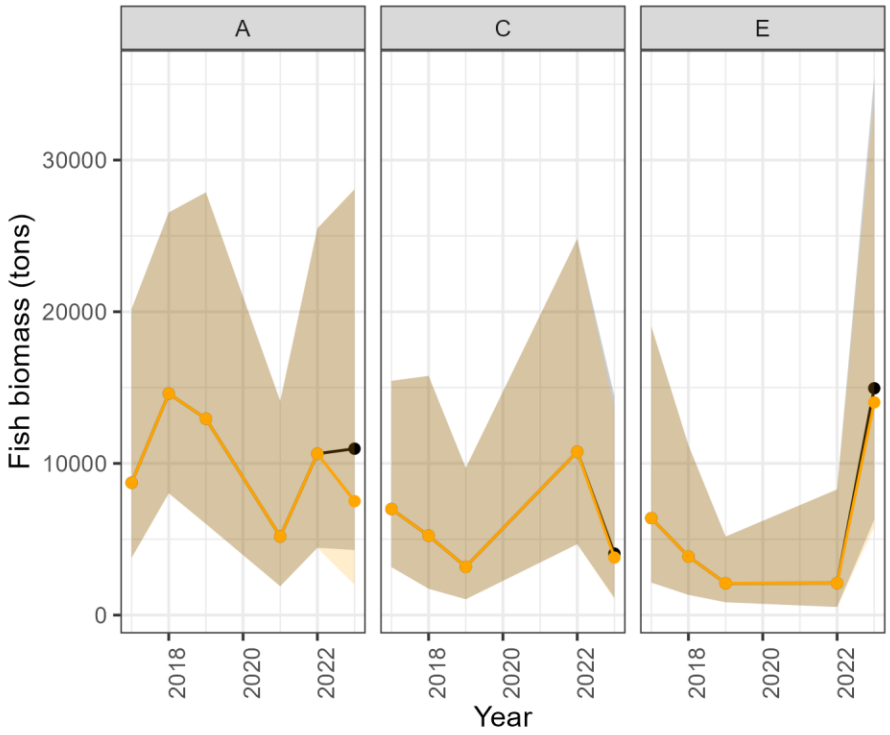

Figure 5. Estimated biomass (in tonnes) of BFT for surveyed years and blocks. Black colours show estimates based on all four blocks (A, C, E and G) for Task 1A: dots show mean values and ribbon show upper and lower confidence limits of the 95% confidence interval. Orange colour shows estimates based in Task 2.

The analysis presented in Task 1 revealed that there is little difference between the abundance and biomass estimates between analysis based on all four blocks (A, C, E and G) and just three blocks (A, C, E) and both estimates are well within the confidence intervals of each other. One would expect the uncertainties around the estimate probability of detection to decrease the larger the number of detections. There was, however, no change in the estimated uncertainties. Keeping the detection function based on all four blocks is, however, consistent with the biomass and abundance estimates of the ICCAT GBYP program and useful in case block G is surveyed again in the future.

The actualization of the tuna indices for 2023 showed an increase in BFT abundance in blocks A and E and decrease in block C. The estimates for block E are associated with large confidence intervals most likely since only part of the block was surveyed. This resulted in a lower number of sightings in this block in comparison to previous years. The expected school size in this block is also much higher in 2023 than in 2022, hence increase in abundance and larger uncertainties. The encounter rate in block A was higher in 2023 than 2022 but lower in 2023 than 2022 in the two other blocks, which is reflected in the above-mentioned trend in abundance.

The probability of detection in block A in 2023 was much lower than in the previous surveyed year, 2022 (0.32 and 0.60 respectively), but comparable in the remaining two blocks (0.35 and 0.40 in block C and 0.38 and 0.28 in block E respectively) between the last two years (2022 and 2023).

While adding new data (here, new surveyed year) and calculating a new detection function based on updated data, standard error and confidence intervals for the previous years can be updated and, frequently, reduced. The approach used in Task 2 does not allow for such updates as the calculation is based on detection function on a reduced data set (i.e. not including sightings from 2023). CREEM recommended to continue using the approach from Task 1 including 4 survey blocks instead of Task 2, especially that the best detection function contains the same covariates (here company) each year of the analysis.

4.3. Tagging

This line of research has faced two important problems from the beginning of the program, which have prevented or limited the fully achievement of these initial objectives. One is the very low recovery rate of conventional tags, which impede the use of these data to estimate reliable mortality rates. Because of that GBYP SC decided to cancel in Phase 4, the direct investments in conventional tagging campaigns which had been initiated in Phase 2 besides the tag awareness and recovery programme. However, it was agreed to maintain an indirect support to conventional tagging programs developed by third parties by providing tags and tagging equipment to different institutions or organizations which requests such support. Moreover, GBYP has also maintained the awareness and rewards campaigns and the update of the data base integrating all the results from recovered tags, as it was considered that there were cost effective activities. The second major problem has been the relatively short time of the electronic pop-up tags retention on the fish, which limits the usefulness of the recorded data to achieve the stated objectives. The premature releases have been attributable to different factors, as technological problems of the tags, fishing activities, death of the fish after tagging and, in general, probably the use of equipment and tagging methodologies not fully adequate for BFT. These potential problems have been addressed through different ways, as the use a new reinforced model of MiniPAT satellite tag designed to minimize “pin broke” problems, selection of tagging areas with lower fishing pressure and exploring and applying whenever possible improved tagging methodologies. In Phase 9 further methodological improvements were introduced in GBYP tagging operations, as the use of a new type of reinforced tether with titanium darts and the use of a retention loop with a second anchor. In addition, an ad hoc workshop on satellite tags deployment methodologies was held for instructing the taggers, including practical sessions. Consequently, the time on fish of the tags deployed in the last years has improved a lot, with increasingly higher proportion of tags remaining on fish the whole programmed year, for the first time in GBYP tagging campaigns. Unfortunately, an additional technical problem affecting the performance of the satellite tags used within GBYP program, which has resulted in bad or null data transmission of tags deployed along the last years, mainly in those campaigns developed in warm waters. An intensive work has been done, in close collaboration with the affected e-tags manufacturing company, to identify the causes of these potential problems, and within Phase 13 several measures to minimize its negative effects, as design and application of stricter tags maintenance and testing protocols, have been implemented, besides tagware improvements carried out by the manufacturer.

4.3.1. Tagging campaigns

As recommended by the Steering Committee, the tagging activities carried out under contract or collaboration agreements in the Phase 13 were limited again to the deployment of electronic tags, keeping the deployment of conventional tags only as a complementary activity. As in the previous season,

the specific objectives of the 2023-2024 campaign were to improve the estimations of the degree of mixing of western and eastern Atlantic bluefin tuna stocks in the different statistical areas over the year cycle, specifically considering the current needs of the MSE modelling process, with the immediate objective to improve the knowledge of the bluefin spatial patterns.

Likewise in 2021-2022 and 2022-2023, the GBYP tagging program in 2023-2024 was carried out along with electronic tagging programs developed at national level. This allowed to strengthen collaboration, taking advantage of the synergies between the different tagging programs and increase the efficiency of each, with the final goal of providing better scientific advice. With this aim, a Call for expressions of interest was published in July 2023 (ICCAT Circular #G- G-0869/2023), for deployment of a total of 75 pop-up satellite tags by experienced tagging teams in the Mediterranean and/or North Atlantic Ocean, targeting eastern stock individuals.

As a response to the Call, several expressions of interest were received, describing their work-plan for the deployment of the tags, both those owned by each institution and those that could be awarded by GBYP. These were carefully evaluated by an evaluation panel composed by GBYP Steering Committee and Secretariat staff representatives, in order to select the most adequate ones to fulfil SCRS research needs. Consequently, memorandums of understanding were signed between ICCAT and the awarded research teams, to formalize the cooperation. In these MoUs it was stated that GBYP would provide the agreed number of electronic tags and would cover the costs of PSATs satellite transmission, while national teams should the human resources, including experienced scientific personnel in deployment of electronic tags in bluefin tuna and infrastructure required to successfully conduct such tagging operations. In these MoUs it was also agreed that the GBYP tags data would be shared by both parties, and that the national teams would provide after the campaigns not only activity reports describing the field operations, but also detailed metadata about all the tags deployed within these surveys, both those owned by the teams and those awarded by GBYP, using the standard ICCAT TG forms. Moreover, in the MoUs it was stated that in a near future, once the deployed tags transmit the data, the scientific results achieved under the MOU, from both GBYP and national teams owned tags, should be presented to ICCAT SCRS meetings at the first opportunity, and will be available for publication following the ICCAT GBYP publication rules.

The following national teams were awarded in 2023:

- Acadia University, in collaboration with DFO (Fisheries and Ocean Canada) and Stanford University - 8 PSAT tags to be deployed in Canadian waters
- Fundación AZTI - 6 PSAT tags to be deployed in the Bay of Biscay
- Technical University of Denmark (DTU) - 8 PSAT tags to be deployed in North Eastern Atlantic water (Eastern North Sea, Skagerrak, Kattegat and Øresund)
- University of Exeter in collaboration with Cefas and the Government of Jersey - 4 PSAT tags to be deployed in Jersey territorial waters
- University of Exeter -4 PSAT tags to be deployed in southwest England
- Institute of Marine Research (IMR) of Norway - 8 PSAT tags to be deployed in Norwegian waters
- The Marine Institute - 8 PSAT tags to be deployed in the coastal waters off Ireland
- Swedish University of Agricultural Sciences - 8 PSAT tags to be deployed in Skagerrak, Kattegat and Öresund
- Stanford University in collaboration with Barcelona ZOO and AZTI - 8 PSAT tags to be deployed off Canary Islands
- Stanford University - 8 PSAT tags to be deployed in the waters off North Carolina
- University of Genova - 5 PSAT tags to be deployed in the Ligurian Sea

In addition, in the first semester of 2024, thanks to the extension of GBYP Phase 13 until July 2024, two national teams were awarded for tags deployment:

- Ifremer – 10 PSAT tags to be deployed in the Western and Central Mediterranean
- Stanford University, in collaboration with Mediterranean Fisheries Research, Production and Training Institute (MEDFRI), Akua Group Fisheries, General Directorate of Fisheries and Aquaculture (GDFA) - Republic of Türkiye and Cukurova University – 13 PSAT tags to be deployed in the Levantine Sea

Stanford University and Acadia University have been electronically tagging Atlantic bluefin tuna (ABT) in the Gulf of St. Lawrence (GSL), Canada, over the past two decades. All 8 of awarded tags were deployed in the GSL in fall 2023 on large bluefin tuna (268-290 cm CFL).

Technical University of Denmark (DTU) deployed, within the framework of the Swedish and Danish collaboration "Scandinavian Bluefin Marathon", a variety of electronic and conventional tags on 134 ABFT (CFL ranging between 217 to 290 cm) in Skagerrak, Kattegat and Øresund over the course of 17 tagging days between 19 August and 1 October 2023. All the individuals were tagged with a conventional tag, and most were also tagged with an acoustic tag (Thelma Biotel). 23 ABFT were also tagged with PSATs, of which 8 were provided by ICCAT GBYP and 6 were tagged with biologgers. Given the ongoing deployment of acoustic infrastructure in the Strait of Gibraltar and Danish Straits (under the guise of the EU-funded STRAITS project) the data from the deployed acoustic tags will contribute greatly to the broader understanding of bluefin tuna movements and population dynamics.

The Marine Institute Satellite successfully carried out tagging of bluefin tuna in Donegal Bay (North-West Ireland) over two consecutive days, between the 30 September-1 October 2023 with all 8 individuals tagged and released with GBYP owned PSATs and numbered floy tags. The Marine Institute tagged a further 9 tuna in the period 1-17 October 2023 in Donegal Bay (N.W. Ireland) with Wildlife Computers PSATs. All 9 individuals were also tagged with ICCAT issued floy tags.

The Institute of Marine Research continued its tagging program of BFT along the coast of Norway between the 6 September and 22 October 2023. Tagging was performed on-board a specially designed tagging vessel with an aluminum ramp to pull the fish on board. In total, eleven BFT ranging from 231 - 292 cm CFL were tagged with PSATs and conventional tags, and genetic samples were collected. 9 BFT were caught from research vessels, and 2 individuals were transferred from collaborating recreational fishing boats to the tagging vessel. All fish were caught using rod-and-line and spreader bars as lures. The results of this project contribute to the understanding of the behavior, migration and ecology of this highly migratory species at its historical feeding grounds far north in the northeast Atlantic Ocean.

In North Carolina, Stanford University successfully deployed 4 GBYP PSATs over the period 19 February-1 March 2024. The other 4 awarded tags failed battery transmission tests and were returned to Wildlife Computers for warranty replacement. The tags were deployed on bluefin tuna ranging 190-234 cm CFL.

Swedish University of Agricultural Sciences (SLU) deployed a variety of electronic and conventional tags on 41 large (> 229 cm CFL) bluefin tuna captured by volunteer rod-reel anglers in Skagerrak between 19 August and 3 September, and in Öresund between 23-27 September 2023, 20 PSATs were deployed, out of which 8 of which were provided by ICCAT. Additionally, sampling fin clippings was done for each tagged individual for genetic analysis and muscle biopsy to explore the physiological status as well as the level of contaminants in the fish.

The University of Exeter, in collaboration with Cefas and the Government of Jersey deployed 28 PSATs on bluefin tuna ranging 136-230cm CFL off southwest England and the Channel Islands in September and November 2023. 8 of these tags were provided by ICCAT. A total of 6 accelerometers, 5 PATs and 19 acoustic tags were deployed as well.

In Levantine Sea tagging was performed by Turkish team (MEDFRI, T.R. GDFA, Akua Group Fisheries and Çukurova University) and Stanford University on 8 June 2024. One Stanford University Expert was contracted to assist in tagging deployment, while a second one was provided in kind by the same institution. In addition to providing expertise, Stanford University also provided additional tags to be deployed. The Akua Group Fisheries Company captured bluefin tuna during five purse seine operations conducted between 2-4 June in Antalya Bay. Following each operation, the fish were transferred into tow pens. The tagging procedure was conducted inside one of the pens, before being towed for transport to farming area, in the offshore waters of Alanya-Antalya. After tagging, the fish were released back into the open sea at a depth of 1,000 meters. A total of 32 fish were caught and released during this campaign. Of these, 17 with a pop-up tag only, 13 were tagged with an acoustic tag only, and two were double tagged. One fish died during the operation and was assigned the GBYP Research Mortality Allowance. The CFL of ABT individuals ranged from 120 to 273 cm.

IFREMER carried out tagging operations in the Central and Western Mediterranean, specifically in Malta, SE Spanish coasts and Balearic Sea, aiming mainly at assessing the fidelity to the different spawning grounds. This diversification of tagging operations allowed to spread the risks and to ensure that objectives are met, but also to cover the two most important areas. Unfortunately, the tagging ooperation on board purse seiners south of Malta should be cancelled After 3 weeks onboard the PS, the boats still hadn't caught any tuna. It was therefore decided to move away from this operation so that effort could be put on the other operations. The second operation was developed in Santa Pola (SE Spanish coasts), taking advantage of a sport fishing event. It was very successful, allowing the deployment of 6 GBYP tags. Finally, the third operation was developed on board French longliners operating in the Balearic Sea after the purse seine fishing season. It was difficult, since it was plagued with a week-long period of low catch, but allowed to deploy the two last GBYP tags available. Summing up, a total of 14 pop-up tags, including the 8 GBYP tags, were deployed on fish between 156cm and 275cm (CFL).

Stanford University tagging team, in collaboration with the Barcelona Zoo and AZTI, deployed GBYP pop up tags in the Canary islands targeting giant tuna, to refine the information from previous tagging surveys and genetic studies that show the presence in this area of fishes from the different Atlantic BFT stocks. The initial plan was to deploy a total of 9 GBYP tags around La Gomera and south Tenerife, but due to rough weather, a minimum of force 4 winds in Beaufort scale along the whole survey, developed between the 28th of April to the 5th of May 2024, the survey was moved to Lanzarote, looking for better conditions. Thanks to that and to the use of a larger than usual sport fishing vessel, 7 large fish, between 247 and 272 cm CFL, could be tagged. Two remaining tags were reassigned to the tagging survey in the Levantine Sea.

Six GBYP miniPAT tags were awarded to AZTI to tag and sample medium-large sized ABFT in the Bay of Biscay, aiming at exploring the detailed migration routes used by ABFT that move to the Bay during winter and spring, identifying the drivers that affect their distribution along the Bay interannually, determine the population of origin of the tagged ABFT and to investigate long-term and larger-scale movements, and how these might be overlapped with the mackerel fishery during winter. Four of those tags were successfully deployed in Atlantic bluefin tuna ranging from 156 to 250 cm CFL, during spring and summer in fish, both tagging from sportfishing vessels and professional fishing vessels. Due to logistic limitations to handle the fish on board in some of the vessels, it was developed a tagging procedure to tag large fish inside the water with two anchors, without having to lift them onboard when no big boats are available to do so). Four tags could be successfully deployed, and the two remaining ones, which could not be deployed due to the lack of fish, even after having tried to do it within extra surveys in summer 2024, will be reused, after testing, in the fall 2024 campaigns.

In addition, for the first time within GBYP program, direct support was provided to develop an acoustic tagging campaign in a Portuguese trap located in the southern coast of Algarve, targeting fishes migrating from the Atlantic to Mediterranean for spawning aiming, primarily at testing the efficiency of the new acoustic receivers array recently deployed within the framework of the EU project STRAITS, which has significantly reinforced in recent years the European Tracking Network (ETN). A total of 18 acoustic tags provided by IFAPA (EU-Spain) were deployed by ICCAT Secretariat staff with the logistic support from IPMA (EU-Portugal) and the TUNIPEX tuna trap (EU-Portugal).

Currently available electronic tag tracks from the tags deployed by GBYP from 2011 are shown on **Figure 6.** In addition to these tags, GBYP also acquired numerous e-tags datasets from other tagging programs through its data recovery activity. Namely, these include tags deployed by Stanford University (Hopkins Marine Station, Block Lab), Large Pelagics Research Centre and WWF. The complete tracks currently available in the GBYP repository are shown on **Figure 7**. The electronic tags datasets are being used in MSE for determination of BFT stocks mixing rates.

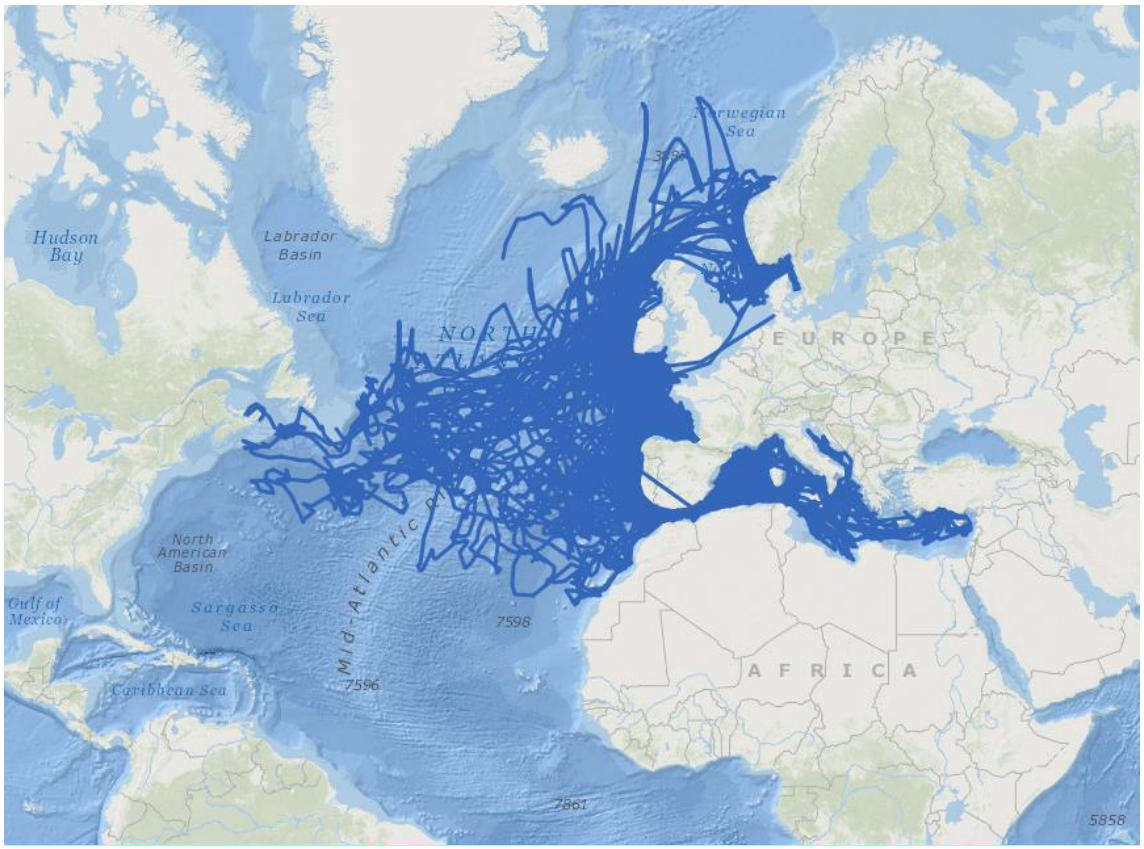

Figure 6. Currently available electronic tag tracks, for tags deployed by GBYP up to 2023.

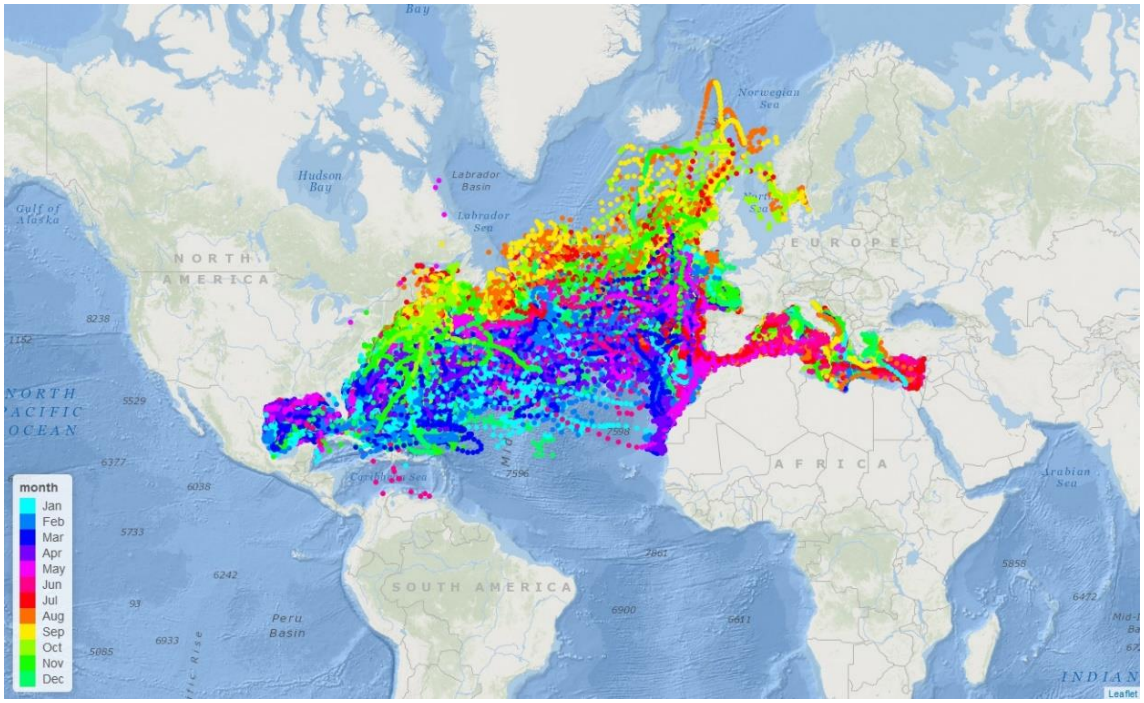

Figure 7. Currently available electronic tags tracks, for tags deployed by GBYP and acquired through data recovery activity from other programs. Daily positions are colored by month.

Besides the activities carried out under formal GBYP contracts or agreements, GBYP has supported e-tagging activities carried out independently by other institutions, by allowing the use of GBYP RMA in case of BFT casualties during tagging operations.

As regards conventional tags, within the reporting period associated to Phase 13, 1750 “spaghetti” tags, along with applicators and the tagging protocols and forms to report tagging operations, were delivered to various institutions (**Table 5**). To provide this logistic support to CPCs it is requested that an official institution commit itself to provide all the metadata associated to tagging operations through the standards ICCAT forms (TG forms), and that the tagging operations be supervised by scientific teams, as stated in the BFT management plan.

Table 5. Number of conventional tags sent to different collaborators in Phase 13 (from March 2023 until March 2024)

Country	Institution	Conventional tags (number)
Canada	St. Andrews Biological Station	1000
United Kingdom	Centre for Environment Fisheries and Aquaculture Science	500
Italy	Federazione Italiana Pesca Sportiva e Attività Subacquee	50
Sweden	Swedish University of Agricultural Sciences. Department of Aquatic Resources (SLU Aqua)	100
Denmark	Technical University of Denmark	100

During this reporting period, a total of 630 fish were tagged (**Table 6**).

Table 6. Number of fish tagged during Phase 13 (from March 2023 until March 2024) by region of deployment.

Deployment region	ALL FISH TAGGED	FISH SINGLE TAGGED			FISH DOUBLE TAGGED		
		FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Double Tags - Conventional	Mini-PATS + Conv.	Mini-PATS + 2Conv.
Canada	8	0	0	0	0	8	0
West Med.	8	0	0	8	0	0	0
North and Celtic Seas	574	0	534	0	0	40	0
Bay of Biscay	4	0	0	0	0	4	0
Canary Islands	0	0	0	7	0	0	0
Northwest Atlantic	4	0	0	4	0	0	0
East Med.	32	0	20	0	0	12	0
GRAND TOTAL	**630**	0	554	19	0	64	0
		SUBTOTAL = 573			**SUBTOTAL = 64**		

Table 6 bis. Number of fish tagged during Phase 13 (from March 2023 until March 2024) by CPC (detailing EU countries).

		FISH SINGLE TAGGED			FISH DOUBLE TAGGED		
	ALL FISH TAGGED	FT-1-94	FIM-96 or BFIM-96	Mini-PATs	Double Tags - Conventional	Mini-PATS + Conv.	Mini-PATS + 2Conv.
Canada	8	0	0	0	0	8	0
EU.France	8	0	0	8	0	0	0
EU.Denmark	134	0	126	0	0	8	0
EU.Sweden	41	0	33	0	0	8	0
United Kingdom	16	0	8	0	0	8	0
EU.Ireland	365	0	357	0	0	8	0
Norway	18	0	10	0	0	8	0
USA	4	0	0	4	0	0	0
Türkiye	32	0	20	0	0	12	0
EU.España	11	0	0	7	0	4	0
TOTAL	637	0	554	19	0	64	0

In total, from the beginning of the Programme up to 1 March 2023, more than 25 thousand bluefin tuna individuals have been tagged, using more than 33 thousand tags of different types (**Table 7**).

Table 7. Number of fish tagged since the beginning of GBYP (up to 1 March 2024)

	ALL FISH	FISH SINGLE TAGGED					FISH DOUBLE TAGGED						
	TAGGED	FT-1-94	FIM-96 or	Mini-PATs	Archivals	Acoustic	Double Tags -	Mini-PATS + Conv.	Mini-PATS + 2Conv.	MiniPAT+Acoustic+Conv.	Archivals	Archivals	Acoustic + Conv.
Canada	2170	0	2139	0	0	0	0	31	0	0	0	0	0
Bay of Biscay	7728	4179	15	3	0	0	3493	22	0	0	16	0	0
Morocco	365	129	48	45	0	0	121	14	0	7	0	0	1
Portugal	347	53	39	94	0	0	154	7	0	0	0	0	0
Strait of Gibraltar	5561	2254	43	0	0	0	3212	22	5	0	23	2	0
West Med.	1929	1154	377	41	0	0	352	5	0	0	0	0	0
Central Med.	3509	1264	1707	32	0	0	479	15	0	0	12	0	0
East Med.	154	59	20	50	0	0	0	25	0	0	0	0	0
North and Celtic Seas	4366	524	3520	16	0	0	130	129	42	0	5	0	0
Canary Islands	18	0	0	7	0	0	0	10	0	0	1	0	0
Northwest Atlantic	22	5	0	12	0	0	0	3	0	0	2	0	0
		9621	7908	300	0	0	7941	283	47	7	59	2	1
GRAND TOTAL	26169	SUBTOTAL = 17829					SUBTOTAL = 8340						

4.3.2. Tag recoveries

a) Tag awareness and reward policy

This activity is considered essential for improving the low tag reporting rate existing so far in the Eastern Atlantic and the Mediterranean Sea. The tag awareness material was produced in 12 languages, considering the major languages in the ICCAT convention area and those of the most important fleets fishing in the area: Arabic, Croatian, English, French, Greek, Italian, Japanese, Mandarin, Portuguese, Russian, Spanish and Turkish. Several thousands of posters of various sizes (A1, A3 and A4) and stickers were produced so far and distributed to all major stakeholders, such as Government Agencies, scientific institutions, tuna scientists, tuna industries, fishers, sport fishery federations and associations in the area. In addition, in 2016 two short propaganda videos on ICCAT GBYP tagging activities were produced, which are available in 8 languages through YouTube.

The ICCAT GBYP tag reward policy has been considerably improved since the beginning of the program, with the purpose of increasing the tag recovery rate. The current strategy includes the following rewards: 50€/ or a T-shirt for each spaghetti tag; 1000 € for each electronic tag; annual ICCAT GBYP lottery (September): 1000 € for the first tag drawn and 500 € each for the 2nd and 3rd tag drawn. According to the recovery data, this policy (along with the strong tag awareness activity) was very useful for improving the tag reporting rate.

For further improving the results, meetings with ICCAT ROPs have been organized periodically, further informing them about the ICCAT GBYP tag recovery activity and asking them to pay the maximum attention to tags when observing harvesting in cages or any fishing activity at sea, which have resulted in an increase of recoveries by ICCAT observers in farms.

b) Tag recovery and reporting

The important tag reporting improvement registered after the beginning of the tagging and tag awareness activities by ICCAT GBYP is impressive. So, the average ICCAT recoveries for the period before 2010 were much lower than during GBYP, as shown in the **Figure 8**. The first significant increase in the rate of the tag recoveries was recorded from 2012. Such a success should probably be attributed not only to the recent tagging activities, but to the settled tag awareness campaign as well. In the year 2023, a total of 201 tags were recovered. It should be stressed that, in last years, for the first time in ICCAT bluefin tuna tagging activities, the number of tags recovered and reported from the Mediterranean Sea has been higher than any other area. Considering that reported tags from the Mediterranean were almost nil before GBYP, this is the clear evidence that GBYP tag awareness campaign is producing positive effects.

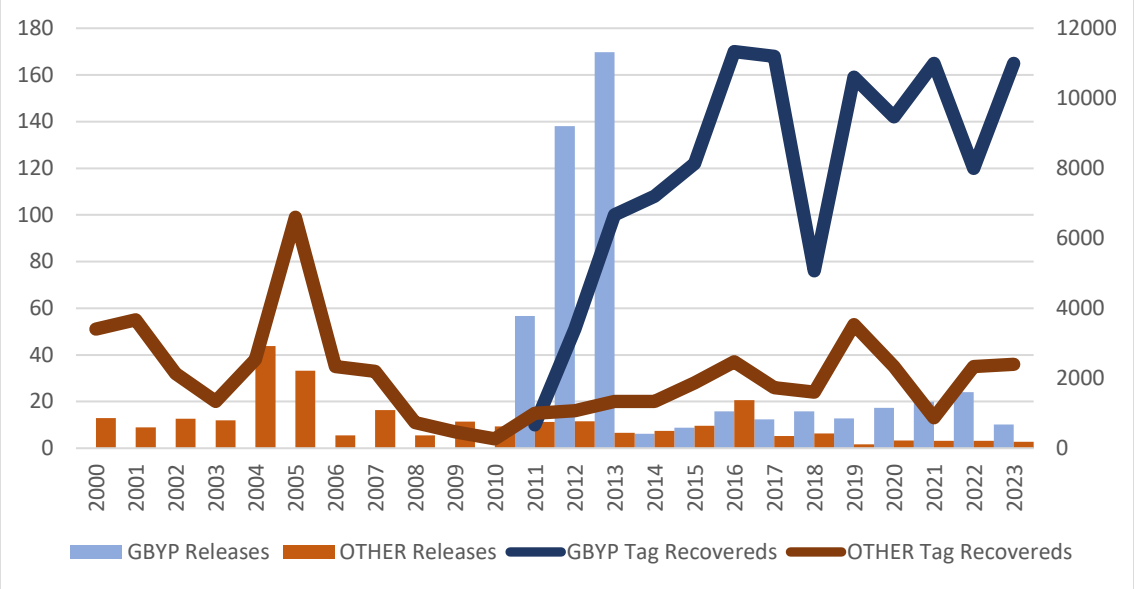

Figure 8. Annual trend of bluefin tuna tag recoveries reported to ICCAT since 2002 (up to 1 March 2024).

4.4. Biological studies

The main specific activities carried out in relation to biological sampling and analysis of biological samples and their more relevant results are summarized below:

4.4.1. Biological sampling and analyses

As done in previous GBYP phases, a call for tenders was issued for maintenance and management of ICCAT GBYP Tissue Bank, collecting tissue samples and otoliths and performing analyses – both microchemistry analyses of otoliths and genetic analyses of tissue samples. A contract was provided to the Consortium headed by AZTI.

During Phase 13, the Consortium sampled a total of 573 Atlantic bluefin tuna (135 YOY, 1 juvenile fish, 24 medium sized fish and 413 large fish) from different regions (148 from the Balearic Sea, 30 from Canary Islands, 85 from the Bay of Biscay, 131 from the Norwegian Sea and 149 from the Central Atlantic). In total, 986 biological samples (286 otolith samples, 127 fin spines and 573 genetic samples) were collected by the Consortium and incorporated into the tissue bank. The Consortium also received samples apart from those agreed in the contract. In total, the Consortium handled 1384 biological samples (405 otolith samples, 256 fin spines and 723 genetic samples) from 732 individuals (**Table 8**). All these samples have been catalogued and stored together within the biological tissue bank. Part of these samples were later used to develop the genetic analyses planned within Phase 13, and the rest were stored to carry out in a future, according to the research needs identified by the SCRS and funds availability, any analyses required to cover such research needs.

Table 8. Total number of otoliths, dorsal fin spines and muscle/fin tissue samples collected in Phase 13, per area.

ICCAT MSE Region	Area	Tissue sampled			Total
		otoliths	spine	muscle/fin	
MED	Balearic Sea	12	12	166	**190**
	Strait of Sicily		5		**5**
	Tyrrhenian Sea	118	124	122	**364**
	Adriatic Sea			40	**40**
SATL	Gibraltar Strait			30	**0**
	Canary Islands	30		30	**60**
EATL	Bay of Biscay			31	**31**
				54	**54**
NATL	Norway	95	115	131	**341**
	Skagerrak	1			**1**
WATL	Central and North Atlantic	149		149	**298**
TOTAL		**405**	**256**	**723**	**1384**

Following the Commitment to the EU to increase dissemination of the data, the Consortium developed a detailed and updated catalogue of samples stored in the GBYP Tissue Bank. The catalogue is available through a link to a persistent and reliable public web repository. This user-friendly interface has been developed within a Shiny app (**Figure 9**) and offers an integrated and interactive data visualization tool. This tool enables compiling data from multiple databases and data sources providing a superior overview. Results are visualized with maps, graphs and diagrams.

Figure 9. BioTuna Shiny application developed by the Consortium including the filter selector and corresponding geographic distribution of data.

Another activity included sorting and identifying ABFT larvae from surveys conducted in the Balearic Sea spawning ground for potential close-kin analyses. In total, 2923 individuals from 25 samples collected during 2023 were identified. Bluefin tuna larvae were found in 21 out of the 25 samples analysed. The sorted individuals were preserved in 100% ethanol in different 4 ml jars and kept in the freezer for a perfect conservation.

On the genetic analysis, based on whole genome sequencing analysis a set of candidate gene variants were identified, potentially affecting Atlantic bluefin tuna fitness originated from a past introgression event from the albacore tuna, which was confirmed to have occurred in the Mediterranean Sea. The observed introgression signal in ABFT, stronger from Mediterranean albacore than from Atlantic albacore, confirms that the introgression of albacore alleles into ABFT originated from individuals of both species co-occurring in the Mediterranean. The confirmed origin of albacore alleles introgressing into Atlantic bluefin tuna from the Mediterranean, along with the observed introgression among Slope Sea larvae and young-of-the-year (YOY), validates the connectivity between the Mediterranean and Slope Sea spawning areas. Regarding the adaptive potential of albacore origin, it was found that the preservation of specific genomic regions with strong signal of introgression in the genome and the location of protein coding genes within them suggests that a past introgression event of albacore tuna alleles could confer adaptive potential to the Atlantic bluefin tuna.

Genetic variants affecting fitness at earliest life stages of Atlantic bluefin tuna was also studied. The filtered genotype table contained 624 larvae (n=490) and YOY (n=134) captured in the Mediterranean Sea during the years 2018 to 2023 and 5975 neutral SNPs. The PCA showed weak genetic differentiation between larvae and YOY based on these 63 SNPs (**Figure 10**). The finding of candidate genomic variants for affecting survivorship during the earliest life-stages of the Atlantic bluefin tuna in the Mediterranean Sea means an advance on the understanding of the genomic basis of adaptive capacity of the species to changing environmental conditions.

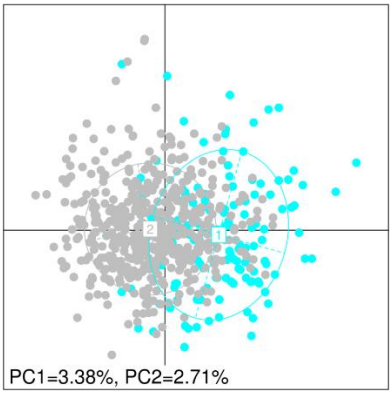

Figure 10. Principal component Analysis performed based on the 63 candidate SNPs affecting fitness in the earliest life-stages of Mediterranean Atlantic bluefin tuna. The analysis included larvae (grey) and YOY (blue) captured in the Mediterranean Sea during the years 2018 to 2023.

The Consortium also carried out a first study to determine the suitability of the larvae available from Balearic sea Tunibal survey supported by the EU DCF, by applying the R package *kinference* to the genotype table obtained from the analyses of 490 larvae belonging to 5 different cohorts, for kinship analysis required for CKMR model implementation in the Eastern Atlantic bluefin tuna. This allowed to detect a total of 8 kin pairs, 1 full sibling 6 half siblings in larvae captured at the same station and year, and a possible half sibling between larvae from two different stations sampled in the same year, which confirmed that the 7000 SNP array developed within GBYP program by the AZTI lead Consortium can be used for the implementation of a CKMR study, and that the larvae are suitable as source of “juvenile” population fraction samples.

The obtained results suggest that adult individuals may spawn at different locations in the Westen Mediterranean during the same spawning season. Spatial and temporal connectivity between spawning sites in the Mediterranean Sea needs further study and increased sampling size to determine Atlantic bluefin tuna spawning site fidelity. Moreover, kinship analysis can be used to explore spawning site fidelity at a fine scale within the Mediterranean Sea.

The genetic origin of previously unassigned individuals was also explored, in order to understand the mixing patterns and monitor the migratory behavior with the aim to anticipate potential changes in stock

distribution. It was found that the genetic origin assignments based on the 96 SNP panel could overestimate the proportion of Gulf of Mexico individuals and the mixing of both components at both sides of the North Atlantic Ocean, highlighting the need for a more comprehensive and powerful tool, such as the ABFT SNP Array, for Atlantic bluefin tuna monitoring to provide with more accurate information about the genetic origin of Atlantic bluefin tuna, mixing dynamics and behavior. **Figure 11** shows the difference in genetic assignments between the two methods. In conclusion, using ABFT SNP Array tool, the Consortium identified a set of candidate genomic variants potentially affecting survivorship during earliest life-stages that require further analysis, and performed kinship analysis which suggested the participation of the same individual in multiple spawning events at different locations within the same spawning season, expanding our knowledge on the demographic connectivity of the species.

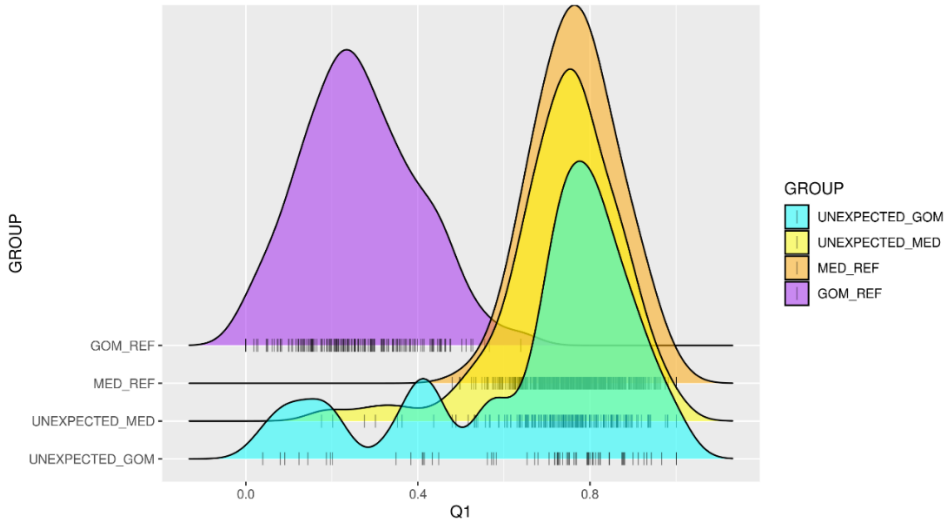

Figure 11. Distributions of individual ancestry proportion (Q1) of the ancestral population which corresponds to the Mediterranean Sea of the reference individuals from the Gulf of Mexico (GOM_REF, in purple) and the Mediterranean Sea (MED_REF, in orange) and individuals that were unexpectedly assigned to the Gulf of Mexico (UNEXPECTED_GOM, in blue) or to the Mediterranean Sea (UNEXPECTED_MED, in yellow) based on results obtained with the 96 SNP panel. Individual ancestry proportions were estimated based on the genotypes at > 6000 neutral SNPs obtained with the ABFT SNP Array.

The study on the genetic profile of bluefin tuna captured in the Bay of Biscay in different season showed that individuals of Mediterranean and Gulf of Mexico origin can be found in the Bay of Biscay at different proportions across different years, seasons and age classes, suggesting dynamic migratory behavior of the species. Unusual high catches of Atlantic bluefin tuna in the Bay of Biscay during the winter over the last three years are composed by individuals of Mediterranean origin, although higher samples sizes are needed to infer more robust conclusions.

Another activity included evaluating the sex assignment power of genetic markers included in the SNP array with the objective to pose hypothesis of sex-biased migration. The results showed an assignment rate of the 92.6%. In conclusion, the correct sex assignation of the ABFT samples using the genetic markers for sex determination included in the ABFT SNP array will allow the reliable automated sex identification of ABFT individuals genotyped using the ABFT SNP array required for kinship analysis needed for the implementation of CKMR models without increasing costs.

4.4.2. Investigating Adaptive Divergence in Atlantic Bluefin Tuna using Whole Genome Sequencing

In Phase 13 a specific study has been performed using the whole genome sequencing of Atlantic bluefin tuna DNA with the objective to allow better characterization of the population structure and mechanisms driving evolutionary divergence between bluefin tuna spawning populations. Due to the long duration of the procedures to agree on all the terms of the contract between Stanford University and ICCAT, it was

signed in February 2024, much later than expected considering that the work had been awarded in August 2023. Therefore, the effective analytical work started also later than planned. Moreover, the initial attempts to extract DNA from larvae sampled between 2010 and 2016 in the Central Mediterranean shown that it was challenging to get high enough quality DNA for full genomic sequencing, and hence it was necessary to use analytical approach different to those initially planned, which has caused a further delay in the development of the study. Because of that it was agreed that the complete set of analytical results will be presented within the SCRS BFT Group meeting in September 2024. The first WGS results, based on 331 samples representing Atlantic bluefin tuna populations in the western, eastern Atlantic, and Mediterranean Sea, are summarized below.

The mean percentage of reads mapped to the Atlantic bluefin tuna reference genome was 99.44% and the mean genome coverage across the 92 retained individuals was 10.24x. After filtering, we obtained 13,241,151 single nucleotide polymorphisms (SNPs) for subsequent analyses.

Principal component analysis (PCA) revealed subtle, but significant genome-wide differentiation between GOM and Med samples for both the full and neutral dataset (**Figure 12**). Results from ADMIXTURE on the neutral dataset supported K=1 as the best supported cluster by cross-validation errors, and we did not see any population structuring in the visualization of ancestry proportions for higher values of K. There were no differences in heterozygosity between GOM (mean ± SD = 0.21± 0.03) and Med (0.20 ± 0.03).

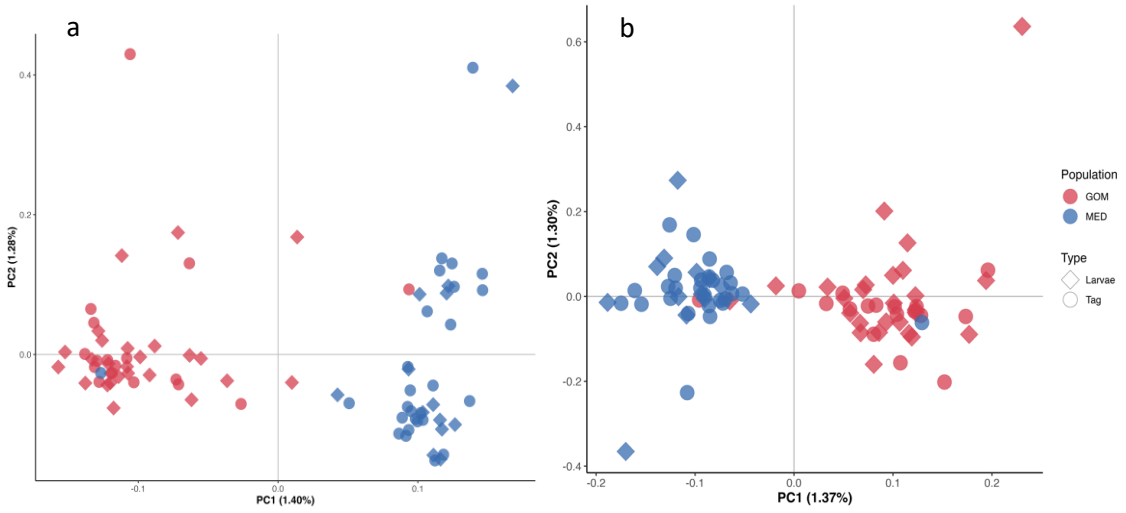

Figure 12. Principal component analysis (PCA) using the full dataset (a) and neutral dataset (b). Points are coloured by population, GOM (red) and Med (blue), and shaped by sample type, either larvae (diamonds) or tagged adults (circles).

Genome-wide FST estimates between GOM and Med suggest moderate levels of divergence (mean FST = 0.0032), with 158 SNPs having elevated FST values greater than four standard deviations above the mean (Figure 3). The 158 outlier SNPs overlapped with 468 elevated windows, which mapped to 305 unique gene IDs. Several of these had functions related to development of the vasculature (angiogenesis) and calcium signalling in ion channels (**Table 9**).

Table 9. Selection of candidate genes and their putative roles from FST outlier peak on Chromosome 21.

Chrom	Gene name	Description
21	a2ml	Liver development
21	plekhg5 b	Angiogenesis, blood vessel endothelial cell migration
21	rcbtb1	Retinal vasculature and blood vessel development
21	MLNR	Calcium-mediated signaling
21	pgr	Ovulation; LH signaling
21	trpc6a	Calcium channel activity

Summing up, GOM – Med whole genome comparisons performed up to now describe subtle, but significant, genomic variation using both adaptive and neutral markers. The most differentiating markers across the entire genome that may aid future efforts in assigning individuals of unknown origin to the western or eastern stock have been identified (see more details at https://www.iccat.int/GBYP/DOCS/Biological_Studies_Phase_13_Stanford.pdf). The analysis of the additional Med larvae from different sites, as well as the adults tagged in Norway, will allow to investigate the possibility of population structure within the Mediterranean Sea. The addition of Slope Sea spawners will help to better understand their origin and contribution to overall bluefin tuna biodiversity.

4.5. Modelling

The modelling programme addresses the GBYP general objective 3, which is to "Improve assessment models and provision of scientific advice on stock status through improved modelling of key biological processes, 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".

Along previous GBYP Phases, modelling tasks were mostly focused on the development of MSE related models. Given that the BFT Management strategy evaluation (MSE) modelling tasks have already been completed within Phase 12, in this phase 13 GBYP modelling efforts focused on CKMR issues.

So, regarding MSE, within Phase 13 GBYP provided only indirect support to further development and implementation of the process. New MSE modelling related tasks related to MSE OM reconditioning will be addressed again in GBYP Phase 14. In addition, GBYP continued providing its support to BFT MSE Technical Group by covering the travel expenses, whenever needed, for participating in MSE related meetings of the members of the previous MSE Core Modelling Group. In Phase 13 GBYP supported the travel of the MSE Coordinator (Dr Doug Butterworth) and the MSE modelling expert (Dr Tom Carruthers) to BFT Species Group meeting in September 2023. Modelling tasks related to CKMR development are detailed below.

4.5.1 Close-Kin Mark-Recapture modelling

Due to the new SCRS research priorities identified during the course of the Phase 13, additional tasks related to the CKMR development were carried out, which were not initially envisaged when Phase 13 planning was made. That was one of the motives for amending the EU Grant Agreement. In particular, there was a need for developing mathematical and statistical modelling to assess the probabilities of BFT population dynamics parameters required for CKMR analysis and creating potential alternative sampling designs. Therefore, a first contract was awarded to experienced modellers to produce an initial model to

be presented and discussed within the SCRS BFT group intersessional meeting held in April 2024. Specifically, this model consisted in a spatially-explicit Close-Kin Mark-Recapture (CKMR) model suitable for Eastern Bluefin Tuna (EBFT), which was used to investigate some sampling options (e.g., sample sizes by fishery, number of years, whether to preferentially subsample bigger or smaller fish, etc), to check what kind of precision might be achievable for quantities-of-interest (mainly, total abundance of adult EBFT) and by when. This contract was extended until July 2024 once GBYP Phase 13 amendment was approved, to explore alternative options for potential sampling designs suitable for EBFT CKMR, as recommended by the SCRS BFT Group during April 2024 meeting. So, seven designs were considered, that differed in terms of total sample size and in the breakdown of samples across fisheries. The effect of using genetic samples collected in the Atlantic and Mediterranean in recent years, was also investigated.

It was agreed that the results from this modelling work would be presented in detail as SCRC papers withing the September 2024 SCRS BFT group meeting.

The main conclusion of this modelling work was that given sampling levels that seem quite feasible logistically, from a small number of selected fisheries (and a larval survey), then by 2030 it could be expected a very good precision on adult abundance (~10% CVs) and on Z (in effect on M) – under reasonable working assumptions about spatial structure and current abundance. There should also be enough kin-pairs of particular types to check assumptions about spatial structure, e.g. extent of spawning site fidelity. Useful CVs on aggregate abundance might even be achieved in time for SCRS 2027, but there will not be enough kin-pairs to check most spatial structure assumptions.

This work directly supported by GBYP, besides other pilot studies carried out within Phase 13 (e.g. kinship analyses described in the section 4.4) and in previous Phases, as the development of a epigenetic clock for ageing Atlantic BFT, has contributed to the elaboration of the feasibility study for the implementation of the CKMR approach to the Atlantic BFT Eastern stock (Rodriguez-Marín et al., SCRS/150/2024).

Annex 1. GBYP Contracts and MOUs issued in Phase 13

COORDINATION

ACTIVITY	RETAINED PROPOSAL	working schedule		COST
		initial date	final date	
S1.1	GBYP Steering Committee external member – Dr. Ana Parma (Argentina)	14/09/2023	30/04/2024	15.000,00 €
S1.7	External advice to Steering Committee on CKMR genetic issues – Dr. Daniel Ruzzante (Canada)	02/04/2024	30/07/2024	18.000,00 €

AERIAL SURVEY

ACTIVITY	RETAINED PROPOSAL	working schedule		COST
		initial date	final date	
S2.2	Aerial survey campaign 2023 in zone A - Air Perigord (France)	29/05/2023	31/07/2023	138.310,00 €
S2.2	Aerial survey campaign 2023 in zones C and E - Unimar and Aerial Banners (Italy)	29/05/2023	31/07/2023	210.914,00 €
S2.2	Aerial survey 2023 Data Analysis - University of St Andrews (UK)	14/03/2024	30/04/2024	10420,50 GBP

TAGGING PROGRAMME

ACTIVITY	RETAINED PROPOSAL	working schedule		COST
		initial date	final date	
MoU	Tagging in North Eastern Atlantic waters - DTU Technical University of Denmark	24/10/2023	31/07/2024	30000 USD *
MoU	Tagging off Norway - IMR Institute of Marine Research (Norway)	24/10/2023	31/07/2024	30000 USD *
MoU	Tagging in Celtic Sea - MI Marine Institute (Ireland)	29/08/2023	31/07/2024	30000 USD *
MoU	Tagging in North Eastern Atlantic waters - SLU Swedish University of Agricultural Sciences	31/08/2023	31/07/2024	30000 USD *
MoU	Tagging in Canada –Acadia University (Canada), Stanford University (USA) and DFO (Canada)	15/09/2023	31/07/2024	30000 USD *
MoU	Tagging in USA North Carolina – Stanford University (USA)	07/11/2023	31/07/2024	30000 USD *
MoU	Tagging in Canary Islands–Stanford University (USA), AZTI, Barcelona Zoo (Spain)	07/11/2023	31/07/2024	30000 USD *
MoU	Tagging om the English Channel – Government of Jersey and Thunnus UK (UK)	29/08/2023	31/07/2024	15000 USD *
MoU	Tagging off Jersey – University of Exeter, Cefas, Government of Jersey (UK)	20/09/2023	31/07/2024	-15000 USD *
MoU	Tagging in the Bay of Biscay - AZTI Fundación (Spain)	05/09/2023	31/07/2024	-22500 USD *
MoU	Tagging in the Ligurian Sea – University of Genova	6/02/2024	31/07/2024	-18750 USD *
MoU	Tagging in the Levantine Sea – Stanford University (USA), Cukrova University (Turkiye)	20/05/2024	31/07/2024	-48750 USD *

MoU	Tagging in the Mediterranean - Ifremer	5/06/2024	31/07/2024	37000 USD
S2.3	Expert for tag deployment in Levantine Sea – Ocean Foundation	29/05/2024	05/06/2024	9856,10 USD
BIOLOGICAL SAMPLING AND ANALYSES				
ACTIVITY	**RETAINED PROPOSAL**	**working schedule**		**COST**
		initial date	**final date**	
S2.4	Biological studies – The consortium led by AZTI Fundación (Spain)	13/09/2023	31/05/2024	161.829,00 €
S2.4	Biological studies – University of Stanford (USA)	29/01/2024	20/04/2024	27600 USD
S2.4	Model based sampling design for E-BFT Close-Kin Mark-Recapture - IEO Instituto Español de Oceanografia (Spain) and Estimark Research (Australia)	18/03/2024	31/07/2024	13,382.60 € and 28,500 AU$

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- Costs associated to MOUs represent the value of the awarded tags, but not costs charged to Phase 13, since the tags awarded in this Phase were provided for free by Wildlife computers as compensation for the failures of tags purchased within GBYP Phases 11 and 12.