BFT CATCH AND SIZE HISTORICAL DATA RECOVERED UNDER THE ATLANTIC-WIDE RESEARCH PROGRAMME FOR BLUEFIN TUNA (ICCAT-GBYP PHASE 1 AND 2). PRELIMINARY ANALYSIS REPORT

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SUMMARY

The Atlantic-wide Research Programme for Bluefin Tuna, conventionally GBYP, among several objectives, has the duty to improve basic data collection, through mining any possible source of data not already included in the ICCAT bluefin tuna data catalogue. The results of the first two years of the data recovery and data mining activity are presented here, along with some basic analyses. The GBYP, in these two first phases, was able to recover a considerable amount of historical and recent data sets, which concerns most of the gears and many fishing grounds. The data related to fishing gears used by vessels cover the years from 1903 to 2010, while the data related to tuna traps constitutes a very long historical series, from the year 1509 to 2009, constituting the largest time series among all RFMOs. Data were also recovered from farmed fish. Most of the data concern Task II (length, weight, effort), but there is also a large amount of catch data. Data on other by-catch species are included in several data sets. The data were all cross-checked against the ICCAT BFT data base, and then individually quality checked, also entering into the details of each record. This preliminary report includes a general overview of the various data sets and the first basic analyses (length/weight relationships and data by sex when available).

RÉSUMÉ

Le Programme de recherche de l'ICCAT sur le thon rouge englobant tout l'Atlantique, conventionnellement dénommé GBYP a pour tâche, parmi plusieurs objectifs, d'améliorer la collecte des données de base, en explorant toutes les sources éventuelles de données qui ne sont pas encore incluses dans le catalogue de données sur le thon rouge de l'ICCAT. Le présent document fournit les résultats des deux premières années de récupération des données et des activités d'exploration des données, ainsi que quelques analyses de base. Dans ces deux premières phases, le GBYP a pu récupérer un volume considérable de jeux de données historiques et récentes qui se rapportent à la plupart des engins et à de nombreuses zones de pêche. Les données relatives aux engins de pêche utilisés par les navires couvrent les années allant de 1903 à 2010, alors que les données relatives aux madragues thonières constituent une série historique très longue, partant de 1509 à 2009, ce qui constitue la plus longue série temporelle de toutes les ORGP. Des données ont également été récupérées sur des poissons élevés. La plupart des données appartiennent à la Tâche II (longueur, poids, effort), mais il existe aussi un grand volume de données de capture. Les données sur d'autres espèces accessoires sont incluses dans plusieurs jeux de données. Les données ont toutes été vérifiées par croisement par rapport à la base de données de l'ICCAT sur le thon rouge et la qualité de chaque donnée a été individuellement vérifiée, les détails de chaque registre étant saisis. Ce rapport préliminaire inclut un aperçu général des divers jeux de données et des premières analyses de base (relations longueur/poids et données par sexe si disponibles).

RESUMEN

El Programa de investigación sobre atún rojo para todo el Atlántico, convencionalmente denominado GBYP, entre varios objetivos tiene la tarea de mejorar la recopilación de datos básicos, utilizando la minería de datos en cualquier posible fuente de datos que no esté ya incluida en el catálogo de datos de atún rojo de ICCAT. Se presentan los resultados de los dos primeros años de actividades de recuperación y minería de datos, junto con algunos análisis básicos. El GBYP, en estas dos primeras fases, pudo recuperar una cantidad considerable de conjuntos de datos históricos y recientes, que afectan a la mayoría de los artes y a muchos caladeros. Los datos relacionados con los artes pesqueros utilizados por los buques cubren los

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años desde 1903 a 2010, mientras que los datos relacionados con las almadrabas constituyen una serie histórica muy larga, desde el año 1509 hasta 2009, lo que constituye la serie temporal más larga de todas las OROP. También se recuperaron datos de peces engordados. La mayoría de los datos se refieren a la Tarea II (talla, peso, esfuerzo) pero también hay una gran cantidad de datos de captura. En varios conjuntos de datos hay incluidos datos sobre otras especies de captura fortuita. Los datos fueron todos verificados con la base de datos de atún rojo de ICCAT y posteriormente se verificó su calidad individualmente, introduciendo también los detalles de cada registro. Este informe preliminar incluye una visión general de los diversos conjuntos de datos y de los primeros análisis básicos (relaciones talla/peso y datos por sexo cuando están disponibles).

KEYWORDS

Bluefin tuna, large pelagic species, ICCAT, data collection, data recovery, data analyses, Mediterranean Sea, Atlantic Ocean

1. Introduction

The Atlantic-wide research programme for bluefin tuna was officially adopted by SCRS and the ICCAT Commission in 2008 after a long process, starting its activities in 2010.

Due to the lack of reliable data sets several times mentioned in various SCRS reports, the first research priority set by the Commission was to improve the basic data collection through mining all available data sources and particularly those related to traps. This priority fits also within the general requirement for GBYP to improve the understanding of bluefin tuna, because the data could possibly include new information about length/weight correlations and other parameters.

2. Objective of data recovery and data mining

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

According to the recommendations set by the GBYP Steering Committee, another objective was to recover the most reliable and detailed sea surface temperature (SST) data, starting from the year 2000, for improving the understanding of any aerial survey data and for specific models to be tested.

3. Data recovery and data mining methodology

Before beginning any data recovery activity, a preliminary work was carried out at the ICCAT Secretariat, setting-up a comprehensive summary table, showing all data sets already present in the ICCAT Bluefin tuna data base which are used for stock assessment purposes. This table was the basis for finding the most relevant gaps in all series and was made publically available, providing it also to SCRS Scientists and National statistical correspondents to help them in detecting the lacking data.

A specific form was prepared by the ICCAT Secretariat for submitting any recovered data according to a common format, with the purpose to have the data “ready-to-use” and which made easier incorporating the recovered data into the ICCAT BFT data base.

SST data (weekly data for the months May, June and July, having 2.5°x2.5°resolution) and the aerial survey data analyses are not included in this report, because these data sets are kept under separate archives, which is anyway available for SCRS purposes. SST data are available on an ICCAT ftp archive, password protected.

Donation of data has been also encouraged and some important data sets were donated to GBYP. Those concerning commercial data are not included in this report, because they should be further examined and then analysed.

3.1 Call for tenders for GBYP data recovery and data mining in Phase 1 and 2

According to ICCAT procedures, several calls for tenders were releases in Phase 1 and Phase 2 of the GBYP, focused on several different gaps in terms of historical series, gear or areas.

Offers were always checked against the detailed ICCAT BFT data base and also with any known official data collection framework or system.

The first call for tenders on this item was issued on April 13, 2010 (ICCAT-GBYP 01/2010), but the only offer submitted was not awarded, after cross-checking it with the ICCAT BFT data base. A second call for tenders was released immediately after, on June 11, 2010 (ICCAT-GBYP 02/2010), receiving five offers that were all awarded.

Targeted calls for tenders were issued in Phase 1 about the collection and supply of satellite SST (Sea Surface Temperature) data sets and maps (call on September 8, 2010) and the first analyses of the data collected by the GBYP aerial survey on bluefin tuna spawning aggregation in correlation with SST data (call on October 20, 2010). In both cases, single offers were received and they were awarded by ICCAT.

The first call for tenders in Phase 2 was issued on January 26, 2011 (ICCAT-GBYP 01/2011), targeting only trap data, receiving three offers that were all awarded. The second call for tenders was issued on January 27, 2011 (ICCAT-GBYP 02/2011), open to all fisheries; six bids were submitted and four offers were awarded. A third call for tenders was released on December 22, 2011 (ICCAT-GBYP 11/2011), targeting the Ottoman Archives, tuna traps and other fisheries; two bids were submitted and only one was partly awarded. The contract for providing SST data was extended to the same company for the year 2011.

3.2 Approaches for data mining and data recovery

The approach in terms of data recovery and data mining included exploring historical archives sitting in several public and private institutions, often by finding the original documents and then detailing all data on the official ICCAT-GBYP form. This approach, which was able to find very important data sets which were never reported to ICCAT or to any other scientific institution, implied a lot of practical difficulties, including the reading of old hand-written documents in various languages reporting common species names difficult to attribute to well-defined species, and sometimes examining the full original set of documents (log-books, registers and selling notes) of some fishermen organisations or traps. More recent data were obtained from on-board observers or comprehensive private landing reports, which, in many cases, included very detailed and unbiased size frequencies, not included in any official data collection system.

3.3 Participating entities

The following entities participated to the ICCAT-GBYP data recovery and data mining activities in the first two years: Direction des Pêches Maritimes (Senegal), Ph.D. Alain Fonteneau (France), Fundación AZTI (Spain), Institut National de Recherche Haulieutique (Morocco), Institute of Marine Research (Norway), Instituto Español de Oceanografía, IEO (Spain), Necton s.c. (Italy), Progetto Blu s.c. (Italy), Ricerca Mare Pesca p.s.c.r.l. (Italy), University of Azores (Portugal). Recent huge sets of commercial data were donated by Mr. Roberto Mielgo Bregazzi (Spain), while historical tuna data were provided by the GBYP coordinator.

The SST data were provided by CLS Collect e Localisation Satellites (France), while the analyses of aerial survey data on bluefin spawning aggregations were conducted by Alnilam Investigación y Conservación S.L. (Spain).

4. GBYP data quality controls

The first part of the work concerned the quality control for incorporating the data in the ICCAT data base and this was done by individually checking all data, at first against the existing data sets in the ICCAT bluefin tuna

data base, for confirming that there was not any potential duplication, and then by an in-depth control, sometimes directly checking some data sets with the contractors. This first part of the work was essential for going on with the regular ICCAT data process, which requires steps by the SCRS Bluefin Tuna Species Group and by Subcomstat.

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

The basic quality controls and the analytical work is essential for including all data recovered so far and those that will be collected in the future in the ICCAT bluefin tuna stock assessment process.

5. Overview of recovered data

It was decided to carry out this preliminary overview by splitting the data sets according to the gear: the data originating from "vessel based" gears (LL, PS, HL, BB, TR, GN, HP) and those originated from tuna trap data sets. For this reason and in order to simplify the presentation of the information, this report was divided in two sections where each of these types of data are described and analyzed. This report includes also a subsection concerning data from tuna cages, obtained at the harvesting.

The full overview of the recovered data, after eliminating any duplicated data set[2], is showed on **Table 1** and summarised on **Table 2**[3].

5.1 Data from "vessel based gears"

Most of the data sets included in the documents obtained by GBYP in these first two years are catch data of bluefin tuna fished by various gears operated by vessel (LL, PS, HL, BB, TR, GN, HP). Data concerns a total of 87834 fishing operations, representing 74% of the historical data recovered so far by GBYP. These data sets are related to Italy, Morocco, Norway, Senegal and Spain, covering both Atlantic and Mediterranean fishing grounds. Data from Norway included only size and/or weight information. Total catches are related to 34,753 bluefin tunas and 119,227 tons.

The files include data of fishing operations carried out from January 1903 to September 2010. **Figure 1** shows the total distribution of the fishing operation by year; it is very clear that the bulk of data are related to the years from 1930 to 1970, because in recent decades several data have been already mostly reported to ICCAT by the CPCs. Peaks are evident in the '50s and the '60s, but also between the last years of the '30s and the beginning of the '40s. Older data are obviously less in number, due to the difficulty of finding reliable data sets. **Figure 2** shows the same data accumulated by decade, fishing ground and gear; in this case, the peak in the '50s is due to the data concerning about 4750 fishing operation in the Bay of Biscay in 1952. Bait boat and trawl data of fishing operations are largely originating from the Bay of Biscay fisheries.

Detailed information was provided for 1046 vessels. Not surprisingly, the largest group of vessels with individual information (around half of the total number) is that of the vessels operating in the Bay of Biscay. The second most numerous set of vessels is the one having about 300 vessels with detailed records of fishing operations in the Strait of Sicily (**Figure 3**).

Detailed catch and effort data have been recovered from the following fishing areas: Mediterranean (Tyrrhenian Sea, Ionian Sea and Strait of Sicily), Atlantic Ocean (West Africa, Bay of Biscay) and Strait of Gibraltar (**Figure 4**). Even in this case, the higher number of data concerns the Bay of Biscay area. Data have been compiled from operations carried out using eight different fishing gears: handline (HL), baitboat (BB), troll (TR), baitboat &

[2] Some duplicated data sets were recovered from different archives and then a set was discarded after choosing the most complete and reliable.

[3] Data sets from 1509 to 1515 were not included in this overview, due to the late arrival of the data that need the usual quality control procedure.

trawl (BB&TR), gillnet (GN), harpoon (HP), longline (LL) and purse seine (PS). **Figure 5** shows the number of fishing operation by gear.

The highest percentage of fishing operations is related to vessels using both hook-and-line and pelagic trawls. **Table 3** shows the distribution of operations corresponding to each gear grouped by vessel flag. Vessel flags match the geographical area of the fishing ground in most cases, except in the case of Senegal, because the vessels reported catching tuna operating in that area were from Spain. The data recovered during these first two Phases usually are related to one single gear by country except for Italy where data recovered cover several fishing gears. **Figure 6** compares the number of fishing operation by gear and fishing area with the number of fish sampled in each fishery, for the years 1903-2010.

The effort types registered in the datasets recovered so far are several: successful days of fishing (SUC. D. FI), number of trips (NO. TRIPS), days of fishing (D.FISH), number of hooks (NO. HOOKS), and number of boats (NO. BOATS). **Figure 7** shows the availability of the different types of effort in the data sets in terms of records. Out of the 87834 vessel operations available, 85213 operation records contain information by category of effort. The two effort types with more data reported are "number of trips" and "number of days fishing".

A more detailed distribution of the operations is showed on **Table 4**, where they are sorted by flag, fishing ground, gear and decade. Even in this case, the highest number of data is related to the Bay of Biscay fisheries. A total of 2621 fishing operations were recorded without identifying any specific type of effort in the effort columns of the form submitted to ICCAT; as a matter of fact, even for these fishing operations, effort data (usually D.FISH) could be detected from other parts of the form and this detailed analytical work will be fully completed before submitting all data sets for the official incorporation in the ICCAT BFT data base. **Figure 8** shows the number of fishing operations recovered for each effort/time strata.

Another important aspect of the data recovery is related to the presence of details concerning other species, caught as by catch during the various bluefin fishery activities. These data can be useful for future studies on the variability of by-catch components over the years. **Table 5** shows the distribution of data sets including other species by flag, fishing area, gear, time/strata and decade, while **Figure 9** shows the number of fishing operations having by-catch components by species. Fishing operations with albacore catch data are numerous (about 40,000 records) scattered between 1930 and 2008; most of them are related to the Bay of Biscay, although some data are related to Italian vessels fishing in the Mediterranean Sea. Swordfish catch data are included only in the Italian records after the '90s, but the total number of fishing operations with these additional catches is comparative low (640). Records belonging to other species are also presents in the data sets.

5.1.1 Individual fish data

Task II data recovered during Phase 1 and 2 by GBYP included also several size samples, sometimes available by sex. Out of 87,834 fishing operations recovered, 3,929 sets included size and/or weight data, with a total of 79,204 bluefin tunas sampled. As a preliminary discriminate, wild-caught bluefin tunas were separated from farmed specimens, due to the different growing factors. Tuna size data are reported over the last 60 years, but data having sex information are limited to the 2000 decade.

Size frequencies recovered from Norway were treated separately because no information is available about the fishing operations during which the specimens were collected. This dataset contains detailed task II data for a total of 15,728 individuals for the period 1950-1954 and the years 1979 and 1984. Then, including all sample data (data from Norway, other wild-caught fish and farmed individuals), the total recovered is 94,932 tunas.

Most of the size and weight data recovered are related to wild-caught specimens and this is a very positive point, because these data could possibly reduce the number of substitutions in the assessment procedures. There are a total of 82,807 wild fish samples recovered so far. The following analyses show information for only 67,079 samples because the 15,728 individual dataset provided by Norway need extra preparatory work and then they were not included in the analyses of wild-caught fish. The greatest number of wild bluefin tuna specimens sampled is from the Bay of Biscay, followed by the Tyrrhenian Sea and the Strait of Sicily (**Figure 10**). The distribution of the same samples by fishing area and decade or by year is shown on **Figure 11** and **Figure 12** respectively.

The distribution of samples by fishing gear is on **Figure 13**. The number of fish sampled has a different distribution from the number of fishing operation by gear, even if there is a similar peak from baitboats in the Bay of Biscay. Table 8 displays a more detailed summary of the bluefin tuna samples distribution by vessel flag, gear and fishing area where the corresponding fishing operation took place. **Table 6** provides a more detailed summary of the bluefin tuna samples distribution by vessel flag, gear and fishing area where the corresponding fishing operation took place.

Figure 14 shows the distribution over the years of fish sampled by gear and fishing ground, without any numerical abundance. The color codes in the legend represent the data source (contractors). For this reason, samples from harpoon fishery show here the longest series. **Figure 15** shows the same information sorted first by fishing area and then by gear type.

The fish samples related to the data recovered from Norway (15728 bluefin tunas), without details about the fishing operations, are still to be analysed in detail. **Figure 16** shows the total number of bluefin tunas sampled by year. Individual data were provided for the years 1950 to 1954, and then for 1979 and 1984.

5.1.2 Length/weight correlation

After the preliminary verification of all data sets recovered by GBYP from all fisheries, it was possible to identify the best available data for correlating length and weight from wild-caught bluefin tunas. For this type of preliminary analyses only data sets having both parameters were used, discarding data when one of the parameter was missing.

A very first overview is provided by **Figure 17**, showing an overall length/weight correlation including all samples from all areas and fisheries. The axis histogram shows one clear mode for weights between 10 and 20 kg. The main mode for length is between 80 and 90 cm, although there are two other modes for the ranges between 120 to 130 and 230 to 240 cm. The number of fish sampled in each area is different and this fact obviously affects this first analysis, but we are aware that this overview is just a very preliminary approach, which needs many further refinements.

The weight versus length correlation is displayed in separate plots corresponding to each fishing ground in **Figure 18** and condensed into an overlay plot in **Figure 19**, where major differences can be noted for medium-giant fish.

Only a fraction of the datasets of recovered samples of bluefin tuna includes information on sex. Out of the total 67079 wild-caught fish samples, only 2125 are differentiated by sex. The number of fish samples by sex, which include 1076 males and 1049 females all from fisheries active in the southern Tyrrhenian Sea, is well balanced, making these data suitable for further analyses.

Figure 20 shows the length/weight correlation by sex. Both male and female specimens show similar distribution, although if it is possible pointing out that there is a significant difference between their respective average weights, being the male specimens slightly heavier than the female ones in these sets. Furthermore, male specimen records show bigger sizes too. The length distribution (10 cm classes) by sex of the same set of data is showed in **Figure 21**. Peaks are both between 240 to 250 cm.

5.1.3 Length frequencies

A first analysis of length frequencies recovered by GBYP for the various fishing gears (independently from the fishing area) was performed, with the only purpose of providing general information about the range of sizes available in the various data sets. Of course, further and more detailed analyses will be carried out, with the objective of providing detailed data sets for improving the system. From this very preliminary analysis, based on a total of 67,079 samples) it is very evident that these data are unbiased and they provide information also for some length frequencies which are not usually included in previous data sets available on the ICCAT bluefin tuna data base (**Figure 22**). These data will be possibly very useful for improving substitutions.

5.2 Farmed bluefin tuna samples

A total of 12,125 bluefin tuna farmed fish were sampled in 126 harvesting days (which, in the ICCAT data base, are always coded as “fishing operations”, but obviously with the full information about the real nature of the “operation”). **Table 7** shows the distribution of these samples by area (in this case, fishing ground means the

location of the cages[4]), gear and catch time period (even in this case, catch time means the harvesting). All samples were obtained at the harvesting and the real location of the catches was unknown (catches from different locations in the same cage were usual at that time). Samples are almost equally distributed between cages located in the Strait of Sicily (n=5897) and those located in the southern Tyrrhenian Sea (n=6228). Data with sex code area available only from the Strait of Sicily (n=3340) and only for some of the samples recovered in two consecutive years (2005: n=1400; 2006: n=1940). Males were more numerous than females in these samples, with a more balanced situation in 2006 (**Figure 23**).

5.2.1 Weight/length correlation

Weight-length correlations from farmed tunas are affected by several factors, among which the most relevant are the initial weight of each individual, the time in cage before harvesting, the feeding rate and the type/quality of food. **Figure 24** clearly shows the great difference in the length/weight correlation between length and weight between farmed samples and wild-caught fish (as previously showed on Figure 17). This graph clearly demonstrates the effects of fattening on bluefin tuna, with an exponential length/weight correlation curve, even if the fattening time of each fish is unknown. According to these samples, there is one weight mode, which corresponds with the range between 50 and 60 kg; and two length modes for sizes between 230-240 cm and 140-150 cm. **Figure 25** and **Figure 26** show the same plot by the two cage locations; length/weight correlations have more dispersed plots for the samples recovered from the cages in the Straits of Sicily, possibly due to remarkable differences in caging time, while those from the Tyrrhenian Sea are much more condensed close to the average.

It was possible also to have more detailed data by sex for some of those specimens sampled in cages, as previously mentioned in the first part of this chapter. **Figure 27** provides the bivariate fit of weight by length for both males and females, showing a very similar distribution and average weight.

5.2.2 Length frequencies

A first analysis of length frequencies recovered by GBYP for the various cages (independently from their location and the fishing area, the latter remaining unknown) was performed, with the only purpose of providing additional information about the size ranges available in the various data sets. Even in this case, further and more detailed analyses should be necessary. **Figure 28** clearly shows that, in these years, the catch composition of the purse-seine fleet included also a small portion of small size tunas, which can be easily detected even after the unknown period of farming and fattening. This is a very useful information, able to improve our understanding of the purse-seine fishery during a period where sampling at catch or landing became impossible or extremely marginal, due to the transfer of almost all catches in cages. The three main modes are at 90 cm, 140 cm and 230 cm, after fattening. It is reasonable that growth in length was higher for lower size fish and much lower for larger size fish. **Figure 29** shows the length distribution of the samples taken in cages by sex (10 cm classes), for those having this type of additional information. The mode for males was at 160 cm and at 180 cm for females.

5.3 Tuna traps data

A specific target of the GBYP data recovery and data mining activity is the tuna trap fishery, because it is the most ancient industrial fishing activity in the world and its origins are in the Mediterranean Sea. The extreme importance of this fishery is well described by a full ICCAT volume recently published (2012), which contains the reports and the scientific papers of the "ICCAT-GBYP Symposium on Trap Fisheries for Bluefin Tuna". Furthermore, data on this fishery exits in many archives and only a part of them has been already recovered by GBYP, after an intense cooperative work carried out by several scientists and institutions. Many other data could be possibly recovered.

Data from a total of 187 different traps in 6 countries have been recovered and this is a very important data set, even from an historical point of view. Most of the trap data were recovered from European traps, but there are also several data from North African countries: 74 traps from Italy, 51 from Spain, 23 from Portugal, 18 from Libya, 13 from Morocco and 8 from Tunisia; the full list is reported on **Table 8**.

This relevant data mining activity, conducted by various scientists who explored and investigated several historical archives in many places, concerned a total catch of 619,151 tons and 23,191,100 bluefin tunas, which

[4] During the years when sampling in cages were carried out, it was still not mandatory distinguishing the origin of farmed fish in each cage according to the ICCAT rules at that time and then the same cage might include at the same time fish originating from several fishing operations and even from different fishing grounds, making then impossible to have any information about the time in cage and the origin of the samples.

constitutes a very important improvement of data for the ICCAT data base. **Table 9** provides the details of data recovered in the various steps of the first two phases of ICCAT-GBYP..

GBYP recovered a total of 30717 tuna traps operations during the first two years of activity, which represent 26% of the historical data retrieved so far. The datasets contain data from operations carried out between January 1525 and December 2009. Additional data sets concerning trap information on a yearly basis from 1509 to 1516, received after 2011, are still to be incorporated in the ICCAT data base and therefore are not included in this report.

The distribution of the tuna trap operations (identified as "matanza"[5]) by year is shown on **Figure 30**. The 19th century, starting early in 1800 and then the first part of the 20th century, is a period of time during which an important number of catch operations has been recovered, with the highest peaks in 1878, 1898 and 1925. **Figure 31** shows the number of fishing operations by decade and fishing ground, for the years 1520-2000. The highest number of data is related to fishing operations carried out in Algarve (PT), Cadiz (SP) and Sicily (IT). In more recent years, most of the data are related to the few areas where this activity is still carried out, mainly Cadiz (SP) and Atlantic Morocco.

The number of traps set in each fishing ground (or area) is presented in **Figure 32**. The fishing grounds by countries are the followings: Italy: Ligurian Sea, Sardinia, Tyrrhenian Sea, Strait of Sicily, Ionian Sea; Spain: Cádiz, Eastern Spain, Strait of Gibraltar; Portugal: Algarve, Madeira; Morocco: Atlantic Morocco; Libya and Tunisia: Southern Mediterranean Sea. According to this graph, the Tyrrhenian Sea is the fishing area where most traps were active, followed by Cádiz, Algarve and the area of Eastern Spain. According to what it was observed in vessels datasets, fishing grounds with the highest reported number of operations ("Matanzas") do not exactly match those with the highest number of traps, because the amount of fishing operations recovered for each individual trap is different. **Figure 33** shows the number of fishing operations ("matanzas") by fishing ground.

The fishing effort of a tuna trap can be considered under various options: the number of fishing operations (2matanzas" in the same fishing season, single fishing operations, the total number of days at sea of the trap (since the beginning of the deployment to the last day of the rectrival), the total number of days between one fishing operation and the other; the number of day on which the trap was fishing and even the number of traps (this type of data sets were used for historical times, when more than one trap was owned by the same owner and then the catch data were joined). Each type of effort can be used for various purposes and some are used only for economic purposes. In the case of the trap data recovered by GBYP, out of the 30717 data sets recovered, only 27838 provided useful information about the effort. The four types of efforts identified are: number of days at sea (D. AT SEA), number of trap *matanzas* (NO. TP MAT), number of traps (NO. TRAPS) and number of trap days (TRAP D). As shown on **Figure 34**, the fishing effort expressed in terms of number of trap matanzas is the most common. Hence, about 56% of the whole trap data sets provide effort by matanzas (representing about 62% of the sets providing effort data).

A more detailed overview of the effort type data distribution is given on **Table 10**, where the number of operations is sorted by fishing ground, catch time period and effort type. The fishing areas with the highest detailed number of fishing operations (matanzas) are those of Cádiz and the Tyrrhenian Sea, both recorded on a daily basis, followed by Sardinia, Strait of Sicily, Ionian Sea, Southern Mediterranean (Tunisia + Libya) and Atlantic Morocco.

Another important set of data is the one from Algarve fishing area, where effort data were provided in number of traps. When comparing the Catch Time Scale in which data are provided (**Figure 35**) it is evident that 73% of information is given by day, which means that an important effort has been made while mining and recovering these data from the archives. The remaining data are provided either on a monthly basis (8%) or on yearly basis (19%).

The distribution of catch data by fishing ground over the extremely long time frame covered by the data mining conducted by GBYP is showed on **table 11**, with details on the type catch time period available. This table allows the identification of time gaps in the various series, providing the necessary information for future data mining activities and, at the same times, the existing limitations.

[5] Slaughtering bluefin tunas in the last part of the trap (called "death chamber") is called "matanza" in Spanish and "mattanza" in Italian.

The data mining conducted by GBYP in Phase 1 and 2 allowed also the recovery of by-catch data in some data sets. The data are related to albacore (ALB), swordfish (SWO), Atlantic bonito (BON), marlins (BIL), bullet tuna (BLT) and Atlantic black skipjack tuna (LTA), as well as other fish species not better identified in the datasets[6].

Figure 36 shows the fishing areas and the time periods for which by-catch data were recovered. Several data sets includes total catch data for two species (BFT and BON) together and these data sets require additional efforts for possibly separate these two species, because at the moment it is impossible to separate bluefin tuna from Atlantic bonito. The effect of these additional catches of bluefin tuna on the total catches of these traps should be assessed, at least as a sensitivity analyses.

Figure 37 shows the different abundance of by-catch data sets by species; albacore, bullet tuna and bonito are the most common species, while the case of a mixed name "BFT and BON" should be possibly clarified in the future. This is a very particular case, where both species were recorded together in the original registers, possibly because fish of similar sizes had the same value on the market. Due to the fact that these old registers were used both for recording the quantity of the catches and their value, in the owner's interest and for owner's purposes, this particular situation will require additional work, trying to find all possible sources of information at that time for having the possibility to attribute these catches separately to the two species.

5.3.1 Individual fish data

Out of the total of 30,717 operations reported, only 81 operations include both size and weight data for individual bluefin tunas, with a total of 7,610 specimens sampled in the decades 1910, 1920, 1990 and 2000. These data are very reliable and they are important for improving the existing Task II data sets. **Table 12** shows the distribution of these samples over the decades and the fishing areas from where they were collected. The number of samples in each fishing ground is shown on **Figure 38**, confirming that most of the samples are from the Strait of Sicily, followed by samples from Sardinia. **Figure 39** shows the distribution of the samples by year and fishing area.

5.3.2 Weight/length correlation

A very preliminary weight/length correlation analyses was conducted over the 7,610 individual specimens reported in the previous chapter. As a matter of fact, it will be necessary to fully process all tuna trap data, even those received in the very last periods, before finalizing the analyses. This first essay provides a general overview of the weight/length correlations. **Figure 40** shows a bivariate fit of weight (kg) by length (cm) and **Figure 41** shows the same overlay plot with all fishing grounds. **Figure 42** shows the same correlation by each fishing ground.

Accumulated length frequencies of these fish by 10 cm classes are shown on **Figure 43**.

A total of 212 of these samples have a sex code; 8 specimens are from Sardinia, 102 from the Strait of Sicily and 102 from the Southern Mediterranean Sea. **Figure 44** shows the distribution by sex, having a majority of males. The bivariate fit of weight by length of these sub-samples by sex is showed in **Figure 45**, while the length frequencies concerned are shown in **Figure 46**.

5.3.3 Additional recovered data from tuna traps

In the very last part of GBYP Phase 2, it was possible to recover some additional data sets, from various documental sources. This data recovery was done directly by the GBYP coordination. These data have been regularly included in the GBYP data base, even if they will require some additional analytical work to be done in Phase 3. **Table 13** shows the summary of these data. As it was mentioned at the beginning, it was possible also to recover some other additional data from 1509 and for a small series of years, but these have to be incorporated in the data base.

[6] In some cases, it was impossible so far to attribute some old local common names to well-identified species and this actually still true for three names included in the original archives. For the other species, sometimes the identification required a difficult historical investigation, for attributing the right species name to old common names.

6. Data Recovery Products

During GBYP Phase 1 and 2 several reports were produced, mostly for grant contract obligations with the ICCAT-GBYP co-funders. The full list is provided under the Bibliography chapter of this paper and includes 4 general reports issued as deliverables (Anonymous, 2011a, 2011e, 2012c, 2012e), 3 general reports issued as scientific SCRS or SCI papers (Anonymous, 2012d; Di Natale, 2011; Di Natale & Idrissi, in press), 3 detailed reports on the data collected issued as deliverables (Anonymous, 2011c, 2011d, 2012a), 1 detailed report on data collected issued as scientific paper (Ortiz et al., 2012), 2 scientific papers on some aspects of the data recovered by GBYP (Di Natale & Idrissi, 2012; Fontaneau & Pereira, 2012) and one ICCAT special volume entirely dedicated to tuna trap fishery (Anonymous, 2012d).

In addition to these papers, another deliverable concerned the SST data and the elaboration of aerial survey data (Anonymous, 2012b).

Most of the procuts are available on the ICCAT-GBYP web section: http://www.iccat.int/GBYP/en/Products.htm .

7. Conclusions

This first summary of the data recovered by GBYP in Phase 1 and 2, along with the very preliminary analyses, provide a general overview of the type and amount of data which are now available for the ICCAT data base on bluefin tuna. In some cases it was possible to cover some gaps, in other cases it was possible to extend back in time some already existing data series. At the moment, the historical series available make ICCAT data base on bluefin tuna the most extended amor all RFMOs, covering more than five centuries.

As we mentioned several times in this text, further analyses are necessary for better exploring the data, while all necessary steps within the ICCAT data system for duly incorporating them in the data base are also necessary. Further data recovery and data mining activities, which area now more difficult after the first trials, may help in filling old end new gaps.

8. Acknowledgments

We would like to warmly acknowledge the very supporting efforts made by all the colleagues of the ICCAT Secretariat staff to allow the Atlantic-Wide Research Programme for Bluefin Tuna to stay on schedule, besides of the short time available to carry out all the necessary duties, sometimes under a very short notice. A particular thank is to be given to Dr. Mauricio Ortiz and Dr. Carlos Palma who spend efforts and time for organizing the proper input of data according to the ICCAT data base.

The Coordinator also acknowledges the strong collaboration of the GBYP Steering Committee members, who cooperated in setting-up the various targets during these first two years of activities.

Another particular thank is to be given to the ICCAT Executive Secretary, Mr. Driss Meski, for the continuous support, the time availability and the dedication in professionally helping to solve many practical problems.

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Table 1. Full overview of the various types of data recovered by GBYP in Phase 1 and 2. Data are grouped by century for the period 1500 to 1800, while they are by decade for the period 1900 to 2010. The "blank" column includes some data sets where exact dates should be better clarified.

		1500	1600	1700	1800	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010	Blank
# Records	OG					9	10	96	11519	15623	29984	17964	6211	1791	1181	3210	236	
	TP	181	170	211	6039	2983	4335	6671	2301	1021	1040	2032	184	777	1221	1548		3
BFT (n)	OG												107	70	9937	21559	3080	
	TP	3931863	1292782	425335	4472749	1606782	1880732	2971129	2013583	1787209	1566956	614611	51510	178743	204806	186199		6111
BFT (t)	OG					44	163	813	2952	6288	29443	16054	25012	18992	17559	1704	203	
	TP				23097	35646	69376	75341	83592	86204	111417	71842	11981	8755	19568	22332		
# Fish sampled	OG										18614	18548	9053	804	18569	28000	1344	
	TP						153	170							2225	5062		

Table 2. General summary of the data recovered by GBYP, divided by tuna trap and all other gears.

TOTAL PHASE 1 + PHASE 2		Total	Total OG+TP
# Records	**OG**	87834	118551
	TP	30717	
BFT (n)	**OG**	34753	23225853
	TP	23191100	
BFT (t)	**OG**	119227	738378
	TP	619151	
# Fish Sampled	**OG**	94932	102542
	TP	7610	

Table 3. Overview of the number of fishing operations by vessel flag, gear and fishing ground.

FlagVess	Gear	FishingGroundg	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
MAR	HL	Gibraltar Strait										341	1551	
EU.ESP	BB	Bay of Biscay					17	23224	12022	4473	653	305		
		Senegal												3
	BB&TR	Bay of Biscay				11364	15466	6760	5942	1716	1100			
	TR	Bay of Biscay	9	10	96	155	140							
EU.ITA	GN	Tyrrhenian Sea										119	409	
	HL	Tyrrhenian Sea										66	24	
	HP	Tyrrhenian Sea								22	38	76	44	
	LL	Ionian sea											3	
		Strait of Sicily										204	998	233
		Tyrrhenian Sea										2	7	
	PS	Strait of Sicily											55	
		Tyrrhenian Sea										68	119	

Table 4. Details of the various types of effort records available by flag, fishing area, gear and decade. The table does not include the 2621 records of fishing operations where the type of effort was not specifically identified by the contractors, which will be analysed separately and individually, because in most of the cases the effort could be detected.

Flag	FGg	Gear	CTPeriod	EffortType	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
MAR	Gibraltar Strait	HL	dd	SUC.D.FI										341	1551	
EU.ESP	Bay of Biscay	BB	dd	D.FISH						23052	11582	4071	199			
		BB&TR	dd	NO.TRIPS				11364	15466	6760	5942	1716	1100			
EU.ITA	Ionian sea	LL	dd	NO.HOOKS											3	
	Strait of Sicily	LL	dd	NO.HOOKS										102	998	233
		PS	dd	D.FISH											15	
	Tyrrhenian Sea	GN	dd	D.FISH										119	409	
		HL	dd	D.FISH										66	24	
		LL	dd	NO.HOOKS										2	7	
		PS	dd	D.FISH										67	23	
				NO.BOATS										1		

Table 5. Presence of fishing operations including by-catch data among the data recovered from various fisheries, showed by flag, fishing area, gear type, time/strata and decade.

Flag	FishingGround	Gear	CatchTPeriod	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
MAR	Gibraltar Strait	HL	dd												
EU.ESP	Bay of Biscay	BB	dd												
			mm												
			yy												
		BB&TR	dd												
		TR	mm												
			yy												
	Senegal	BB	dd												
EU.ITA	Ionian sea	LL	dd												
	Strait of Sicily	LL	dd												
			(blank)												
		PS	dd												
			qq												
	Tyrrhenian Sea	GN	dd												
		HL	dd												
		HP	dd												
		LL	dd												
		PS	dd												
			qq												

ALB	
SWO	
OTF	

Table 6. Distribution of individual size and/or weight data by flag, gear, fishing area and decade.

Flag	Gear	FishingGroundg	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
MAR	HL	Gibraltar Strait									341	1465	
EU.ESP	BB	Bay of Biscay					3775	18548	8791				
		Senegal											17
	BB&TR	Bay of Biscay											
	TR	Bay of Biscay											
EU.ITA	GN	Tyrrhenian Sea									309	4384	
	HL	Tyrrhenian Sea									998	49	
	HP	Tyrrhenian Sea							107	70	96	56	
	LL	Ionian sea										173	
		Strait of Sicily									9403	4946	1327
		Tyrrhenian Sea									2	7	
	PS	Strait of Sicily										199	
		Tyrrhenian Sea									7420	4596	

Table 7. Distribution of farmed fish samples by area (location of the cages), gear, time strata (harvesting) and year.

FishingGround (cage location)	Gear	CatchTPeriod (harvesting time strata)	2003	2004	2005	2006	2007	Total
Strait of Sicily	PS	dd	482	1686	198	2131		4497
		qq			1400			1400
Tyrrhenian Sea	PS	dd	101	189	2197	1748	195	4430
		qq				903		903
		(blank)					895	895
		Total	583	1875	3795	4782	1090	12125

partly with SexCode

Table 8. Full list of tuna traps by country from which data have been recovered by GBYP.

GBYP DATA MINING - LIST OF TUNA TRAPS FROM WHERE DATA HAVE BEEN RECOVERED IN PHASE 1 AND PHASE 2

FlagTrap		TrapName
LYB	1	Marsa Marrecan
LYB	2	Marsa Zuaga
LYB	3	Marsa Sabratha
LYB	4	Marsa Soman
LYB	5	Marsa Dila
LYB	6	Gebbana Sidi Mahfud o Sidi Bilal
LYB	7	Sidi Abdul Gelil o Zanzur
LYB	8	Ras Lahmar o Gargaresch
LYB	9	Mellaha Ras Tagiura o Sidi Azus
LYB	10	Sidi Sbeh Lahman
LYB	11	Marsa al Hamra o Marsa Beltan
LYB	12	Punta Lebdi
LYB	13	Zliten o Sidi Burgheira
LYB	14	Ras Urih
LYB	15	Sidi Bu Mefta o Sidi Bu Fatma
LYB	16	Dzeira
LYB	17	Ras el Msel o Ras el Mouen
LYB	18	Mongar el Chebir - Cirenaica
MOR	1	Cap Spartel
MOR	2	Garifa
MOR	3	Cuevas
MOR	4	Cenizosos
MOR	5	Es Sahel
MOR	6	Punta Negra
MOR	7	Jolot
MOR	8	Kenitra 1
MOR	9	Kenitra 2
MOR	10	Kenitra 3
MOR	11	Capo negro
MOR	12	Tahadart
MOR	13	Principe
TUN	1	Sidi Daoud
TUN	2	Ras el Ahmar
TUN	3	El Aouaria
TUN	4	Cap Zebib
TUN	5	Bordj Kadidja
TUN	6	Conigliera
TUN	7	Monastir
TUN	8	Kuriat
FlagTrap		**TrapName**
UE.PRT	1	Vau
UE.PRT	2	Torre da Barra
UE.PRT	3	Torre Altinha
UE.PRT	4	Torre Alta
UE.PRT	5	Sul do Cabo Carvoeiro
UE.PRT	6	Sul da Ponta do Zavial
UE.PRT	7	Sul da Ponta Baleeira
UE.PRT	8	Senhora da Rocha
UE.PRT	9	Pedra da Galé
UE.PRT	10	Olhos d'Água
UE.PRT	11	Medo das Cascas
UE.PRT	12	Medo Branco (Ramalhete)
UE.PRT	13	Srª do Livramento
UE.PRT	14	Forte Novo
UE.PRT	15	Farol
UE.PRT	16	Cabo de Santa Maria
UE.PRT	17	Cabeço
UE.PRT	18	Burgau
UE.PRT	19	Bias
UE.PRT	20	Beliche
UE.PRT	21	Barril (3 Irmãos)
UE.PRT	22	Abóbora
UE.PRT	23	Penedo do Sono

UE.ESP	1	Reina Regente
UE.ESP	2	Las Cabezas
UE.ESP	3	Punta Umbria
UE.ESP	4	El terron
UE.ESP	5	Nuestra Senora de la Cinta
UE.ESP	6	Las Torres
UE.ESP	7	La Higuera
UE.ESP	8	Arroyo Hondo
UE.ESP	9	Rota
UE.ESP	10	Torre Gorda
UE.ESP	11	Punta de la Isla
UE.ESP	12	Torre del Puerco
UE.ESP	13	Torre Atalaya
UE.ESP	14	Conil de la Frontera (up tp 1914)
UE.ESP	15	Barbate
UE.ESP	16	Zahara
UE.ESP	17	Lances de Tarifa
UE.ESP	18	Carbonera
UE.ESP	19	La Barrosa
UE.ESP	20	La Tuta
UE.ESP	21	Conilejo
UE.ESP	22	San Sebastian
UE.ESP	23	La Mojarra
UE.ESP	24	El Portil
UE.ESP	25	Lentiscar
UE.ESP	26	Aguas de Ceuta
UE.ESP	27	La Atunara/ La Linea
UE.ESP	28	Estepona
UE.ESP	29	San Miguel
UE.ESP	30	Ancon de Cabo de Gata
UE.ESP	31	Agua Amarga
UE.ESP	32	La Azohia
UE.ESP	33	Calabardina de Cope
UE.ESP	34	Escombreras
UE.ESP	35	Isla de Tabarca
UE.ESP	36	Cala Punta
UE.ESP	37	Cala del Charco
UE.ESP	38	Rio Torres
UE.ESP	39	Benidorm
UE.ESP	40	La Caleta
UE.ESP	41	Calpe
UE.ESP	42	Moraira
UE.ESP	43	Granadella
UE.ESP	44	Nuestra Señora del Carmen
UE.ESP	45	Formentera
UE.ESP	46	Suratlantica
UE.ESP	47	Surmediterránea
UE.ESP	47	Levante
UE.ESP	49	Tramontana
UE.ESP	50	Baleares
UE.ESP	51	La Espada
UE.ITA	1	Capo Altano
UE.ITA	2	Camogli
UE.ITA	3	Bagno di Marciana
UE.ITA	4	Enfola (Capo d'Enfola)
UE.ITA	5	Bivona
UE.ITA	6	Langhione
UE.ITA	7	Angitola (from 1924 Mezzapraia)
UE.ITA	8	Pizzo
UE.ITA	9	Torre di Pizzo
UE.ITA	10	Gallipoli
UE.ITA	11	S. Caterina
UE.ITA	12	Torre Sant'Isidoro
UE.ITA	13	Torre Squillace

UE.ITA	14	Porto Paglia
UE.ITA	15	Porto Scuso
UE.ITA	16	Isola Piana
UE.ITA	17	Saline
UE.ITA	18	Trabucato
UE.ITA	19	del Tono
UE.ITA	20	S. Giorgio
UE.ITA	21	Oliveri
UE.ITA	22	Salicà
UE.ITA	23	S. Antonino
UE.ITA	24	La Punta
UE.ITA	25	Brucoli
UE.ITA	26	S. Panagia
UE.ITA	27	Terrauzza
UE.ITA	28	Fontane Bianche
UE.ITA	29	Avola
UE.ITA	30	Fiume di Noto
UE.ITA	31	Bafuto o Vindicari
UE.ITA	32	Marzamemi
UE.ITA	33	Capo Passero grande
UE.ITA	34	Capo Passero piccolo
UE.ITA	35	S. Giuseppe
UE.ITA	36	Portopalo
UE.ITA	37	Pozzallo
UE.ITA	38	Palma di Montechiaro
UE.ITA	39	Sciacca - Lo Tono
UE.ITA	40	Siculiana
UE.ITA	41	del Pepe o Capo Bianco
UE.ITA	42	Capo Feto
UE.ITA	43	S. Giuliano
UE.ITA	44	Asinelli(S. Cusumano)
UE.ITA	45	Bonagia
UE.ITA	46	Curto
UE.ITA	47	S. Vito lo Capo / Capo S. Vito
UE.ITA	48	Secco (Monte S. Giuliano)
UE.ITA	49	Sibiliana
UE.ITA	50	Magazzinazzi
UE.ITA	51	Scopello
UE.ITA	52	Castellammare del Golfo
UE.ITA	53	Cala Pozzillo
UE.ITA	54	Isola delle Femmine
UE.ITA	55	Vergine Maria
UE.ITA	56	Arenella
UE.ITA	57	S. Elia
UE.ITA	58	Solanto
UE.ITA	59	S. Nicolò o Nicola
UE.ITA	60	Trabia
UE.ITA	61	Cefalù
UE.ITA	62	Torre Caldura
UE.ITA	63	Detta
UE.ITA	64	Dell'Orsa
UE.ITA	65	Santa Lucia
UE.ITA	66	Puntanera
UE.ITA	67	Vaccarella
UE.ITA	68	Calavinagra
UE.ITA	69	Columbargia
UE.ITA	70	Flumentorgiu
UE.ITA	71	Peloso
UE.ITA	72	Mondello
UE.ITA	73	Favignana
UE.ITA	74	Formica

TOTAL: 187 traps

Table 9. Detail of the tuna trap data recovered under the several Calls for tenders issued by ICCAT-GBYP in the first two Phases.

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

Table 10. Number of catch data records by fishing ground, catch period and effort type (n=30717).

FishingGround	CatchTPeriod	EffortType	N TP Operations
Algarve	dd	D.AT SEA	1214
		NO.TP.MAT	245
		NO.TRAPS	3754
	mm	NO.TRAPS	2470
	yy	NO.TRAPS	2103
		(blank)	241
Atlantic Morocco	dd	NO.TP.MAT	926
	yy	TRAP D	34
		(blank)	68
Cádiz	dd	NO.TP.MAT	5537
		(blank)	3
	yy	TRAP D	65
		(blank)	1236
Eastern Spain	yy	(blank)	243
Gibraltar Strait	yy	TRAP D	4
		(blank)	154
Ionian Sea	dd	NO.TP.MAT	1732
		TRAP D	10
	yy	TRAP D	53
		(blank)	136
Ligurian sea	dd	NO.TP.MAT	48
	yy	TRAP D	4
		(blank)	10
Madeira	yy	NO.TRAPS	2
Sardinia	dd	NO.TP.MAT	2453
		NO.TRAPS	27
	yy	TRAP D	179
		(blank)	208
Southern Mediterranean Sea	dd	NO.TP.MAT	1060
	yy	TRAP D	100
		(blank)	43
Strait of Sicily	dd	D.AT SEA	2
		NO.TP.MAT	2298
		TRAP D	27
	yy	TRAP D	305
		(blank)	149
Tyrrhenian Sea	dd	NO.TP.MAT	2951
	yy	TRAP D	235
		(blank)	388

Table 11. Distribution of tuna trap catch data by fishing ground, catch time period and decade.

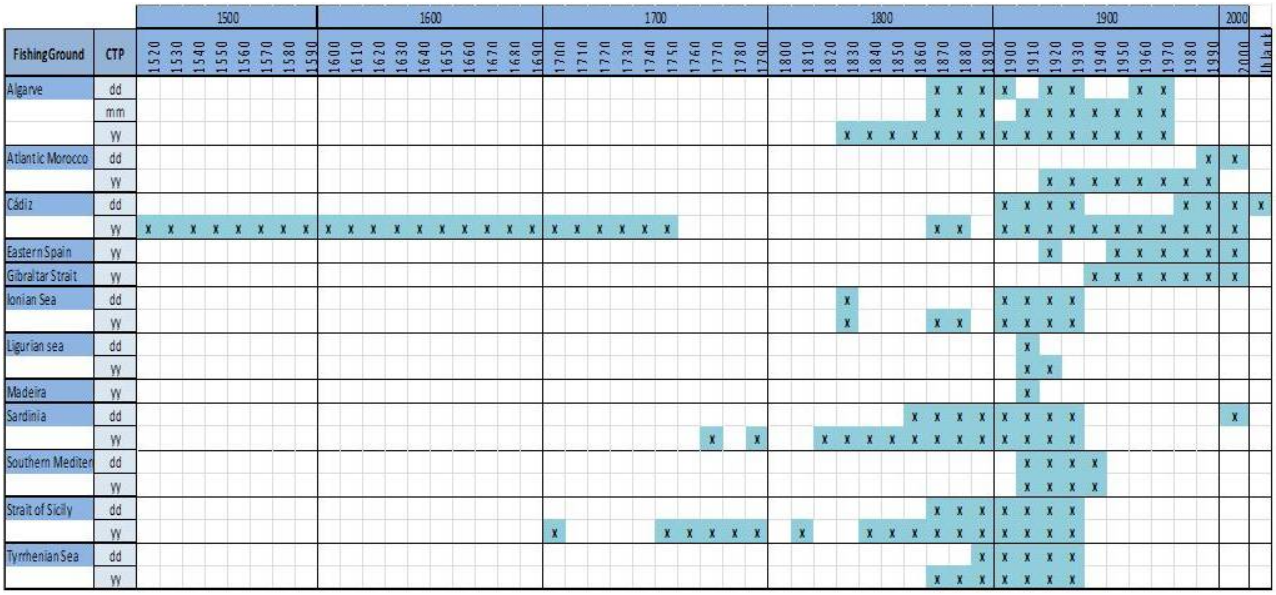

Table 12. Distribution of complete (length+weight) bluefin tuna individual data in the various strata for tuna traps.

FishingGround	CatchTPeriod	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Algarve	dd											
	mm											
	yy											
Atlantic Morocco	dd											
	yy											
Cádiz	dd											
	yy											
Eastern Spain	dd											
	yy											
Gibraltar Strait	yy											
Ionian Sea	dd											
	yy											
Ligurian sea	dd											
	yy											
Madeira	yy											
Sardinia	dd			xx								x
	yy											
Southern Mediter	dd			xx								
	yy											
Strait of Sicily	dd										x	xx
	yy											
Tyrrhenian Sea	dd		x									
	yy											

xx	SexCode
x	No SexCode

Table 13. Summary of the additional tuna trap data recovered in the last part of Phase 2, to be analysed in Phase 3.

# traps	*Flag*	*Gear Type*	*Start-Date*	*End-Date*	*# Records*
UND	SPA,POR, TUR	TP	01/01/1512	28/02/1916	**127**

BFT (# and/or kg)		ALB (# and/or kg)		SWO (# and/or kg)	
Number	*Catch*	*Number*	*Catch*	*Number*	*Catch*
46.224	120.058.663	-	-	-	474.677

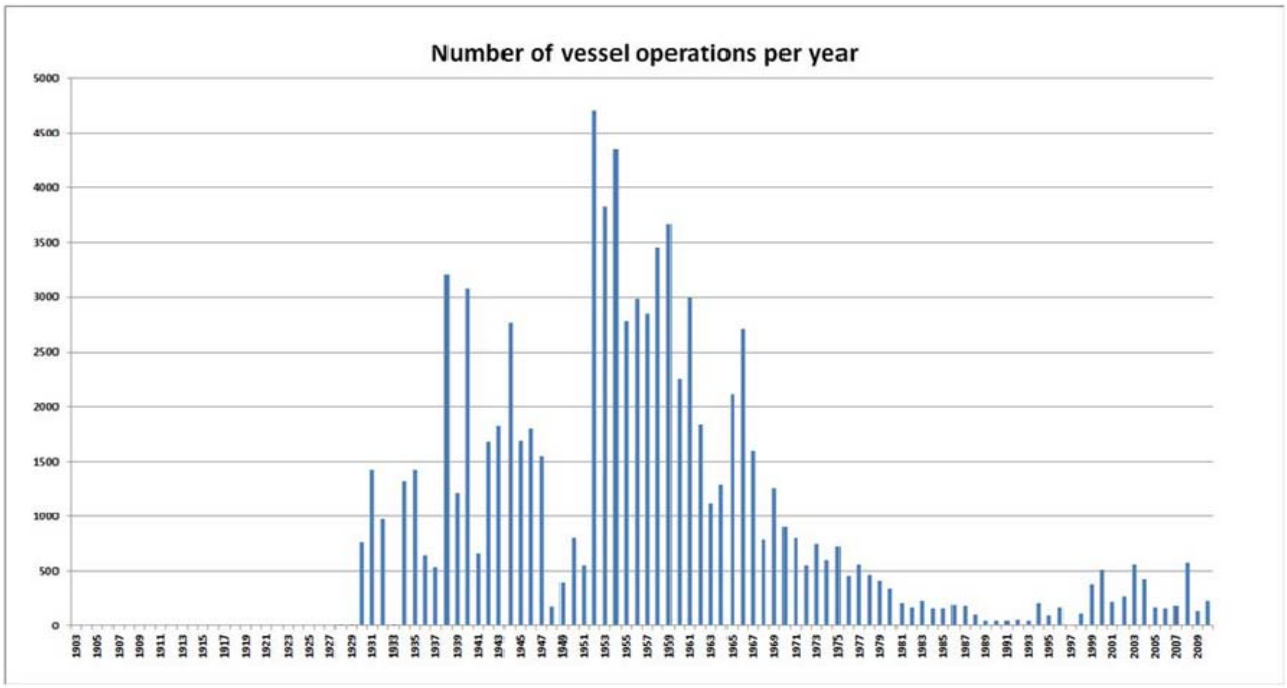

Figure 1. Distribution by year of the recovered data related to the fishing operations concerning all gears (except traps).

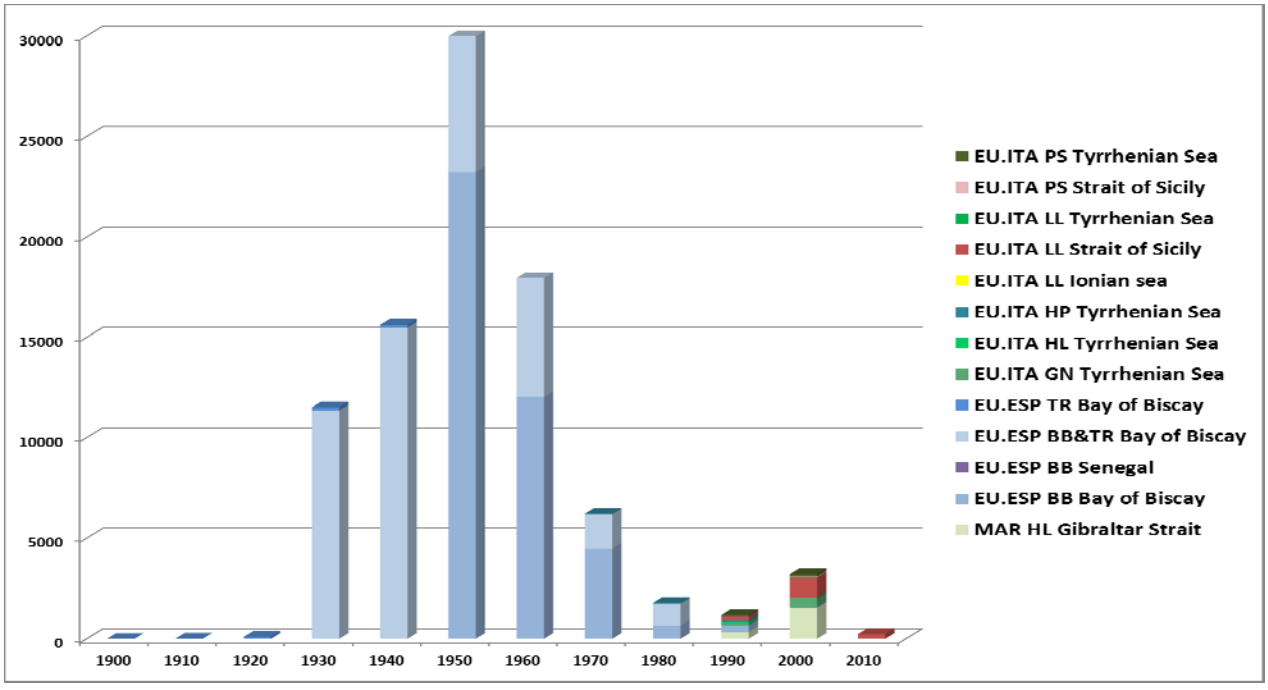

Figure 2. Distribution by decade of the recovered data related to the fishing operations concerning all gears (except traps) and in the various fishing grounds. All bars in blue tones represent data from the Bay of Biscay, while red or green tones bars are related to the Strait of Sicily and the Tyrrhenian Sea areas, respectively.

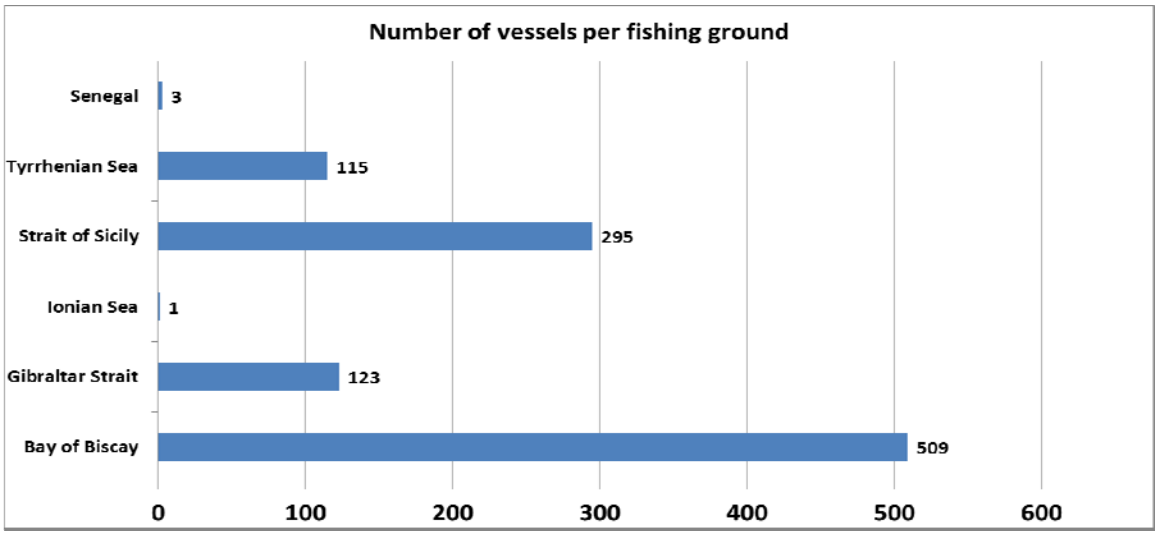

Figure 3. Number of vessel recorded in each fishing area.

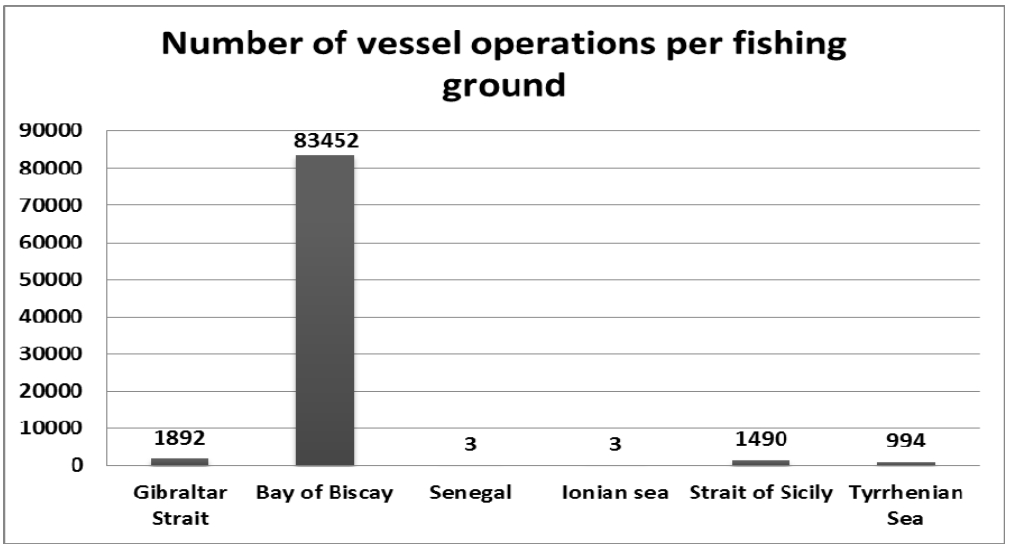

Figure 4. Number of vessel operations data available for each fishing area.

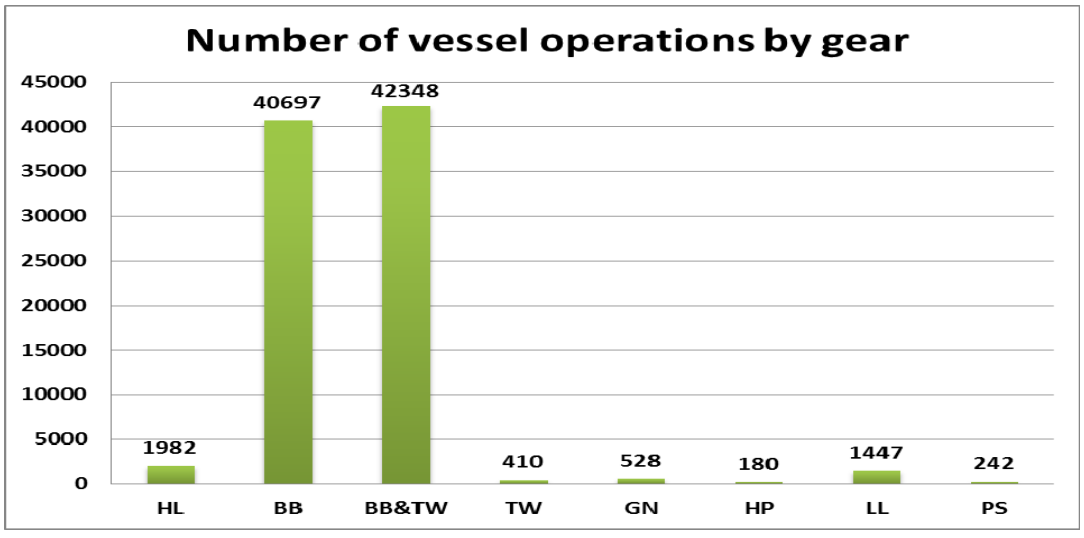

Figure 5. Number of vessel operations data available for each type of "vessel-based gear".

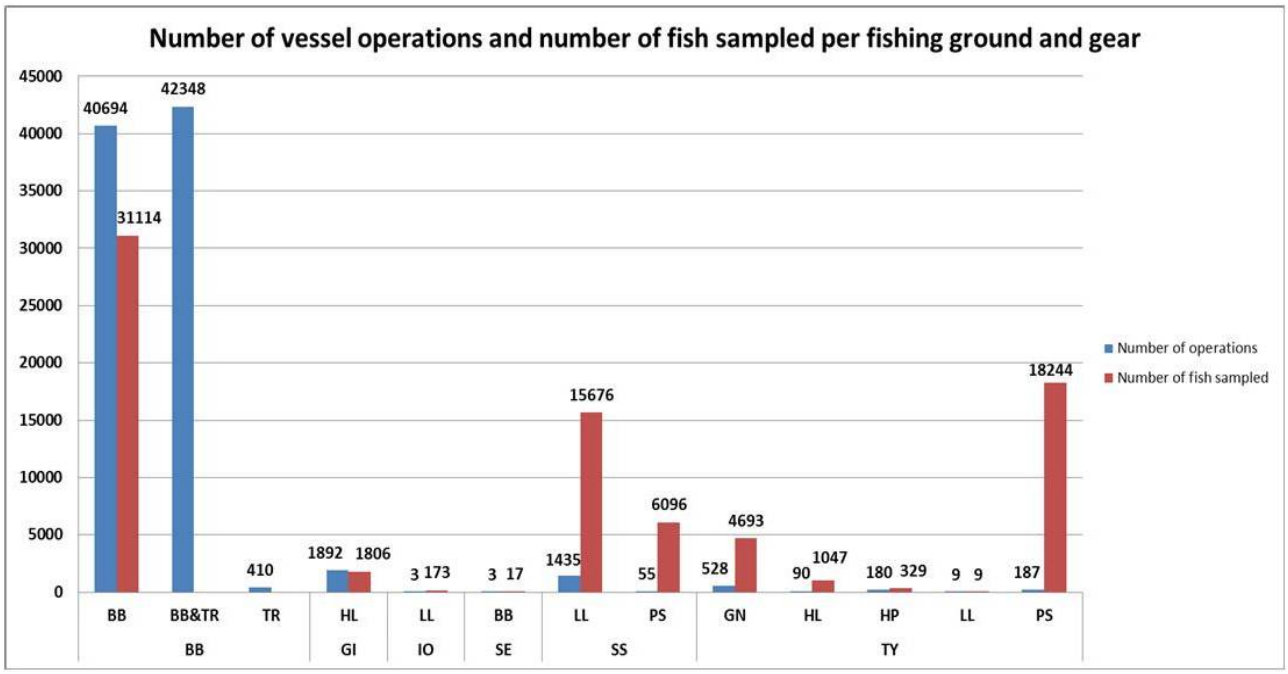

Figure 6. Number of fishing operations and number of fish sampled by fishing area (BB: Bay of Biscay; GI: Strait of Gibraltar; IO: Ionian Sea; SE: Senegal; SS: Starit of Sicily; TY: Tyrrhenian Sea) and gear, for the tears 1903-2010).

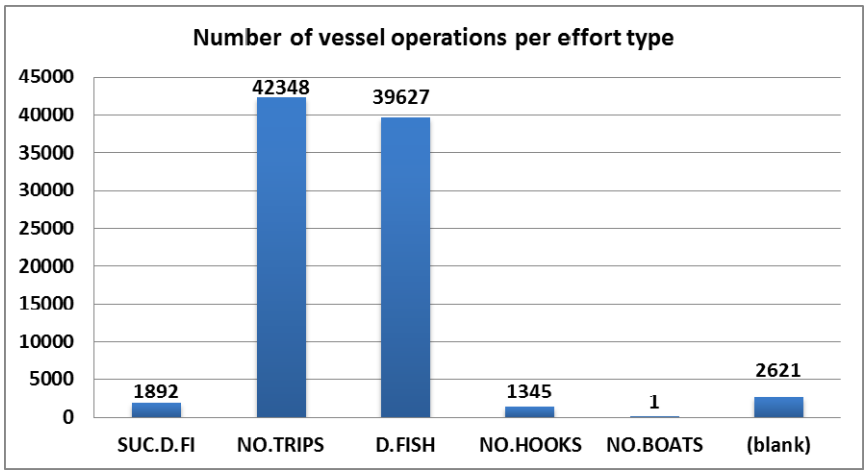

Figure 7. Number of vessel operations having data about the effort. The records listed as "blank" had no specific indications of any fishing effort in the original form submitted to ICCAT, but effort data (usually D.FISH) could be possibly obtained from most of the individual records and this analysis will be completed before officially incorporating the data in the ICCAT BFT data base.

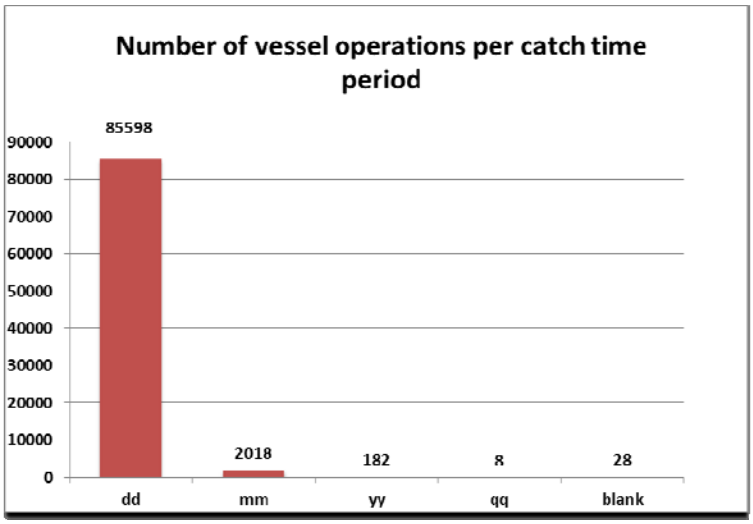

Figure 8. Details of the different effort/time strata existing for each record of vessel operations. Blank concerns data to be further analysed.

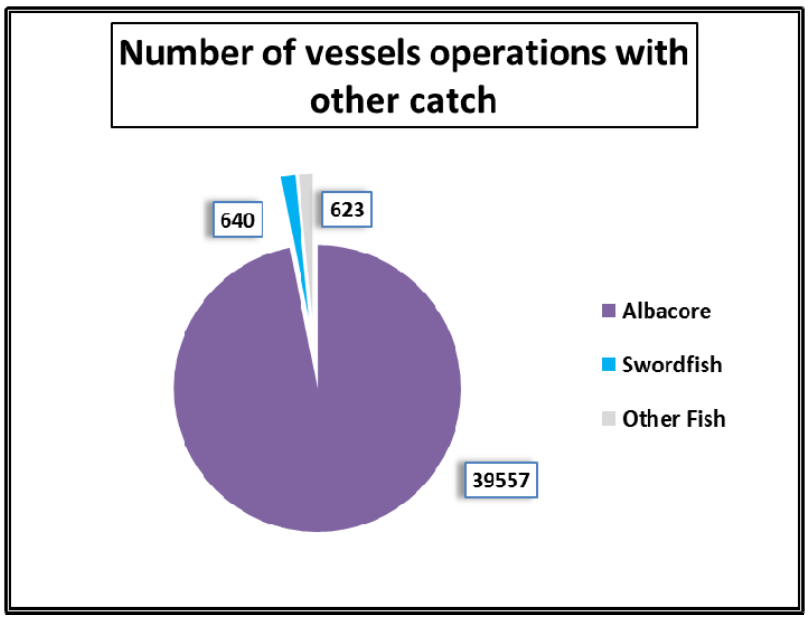

Figure 9. Distribution by major species of by-catch data included in the fishing operations records recovered by GBYP.

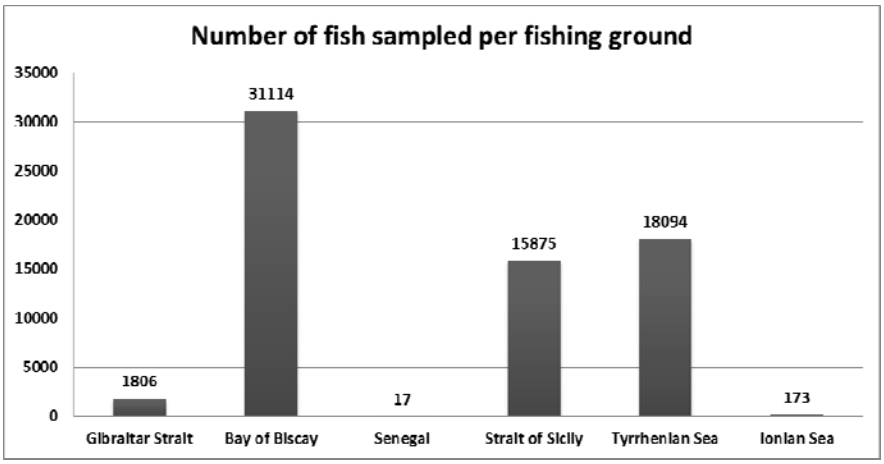

Figure 10. Distribution by fishing area of weight and/or size data samples related to wild-caught bluefin tuna, recovered by GBYP in Phase 1 and 2.

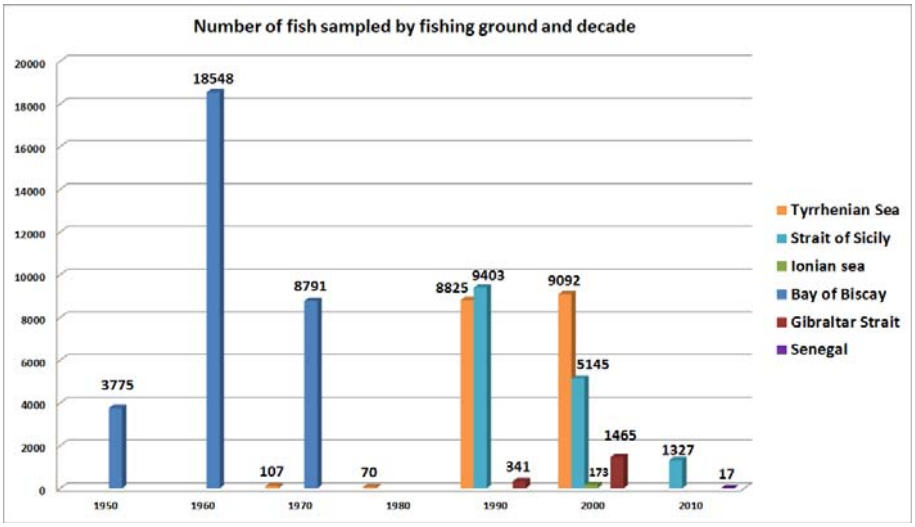

Figure 11. Distribution by decade and fishing area of weight and/or size data samples related to wild-caught bluefin tuna, recovered by GBYP in Phase 1 and 2.

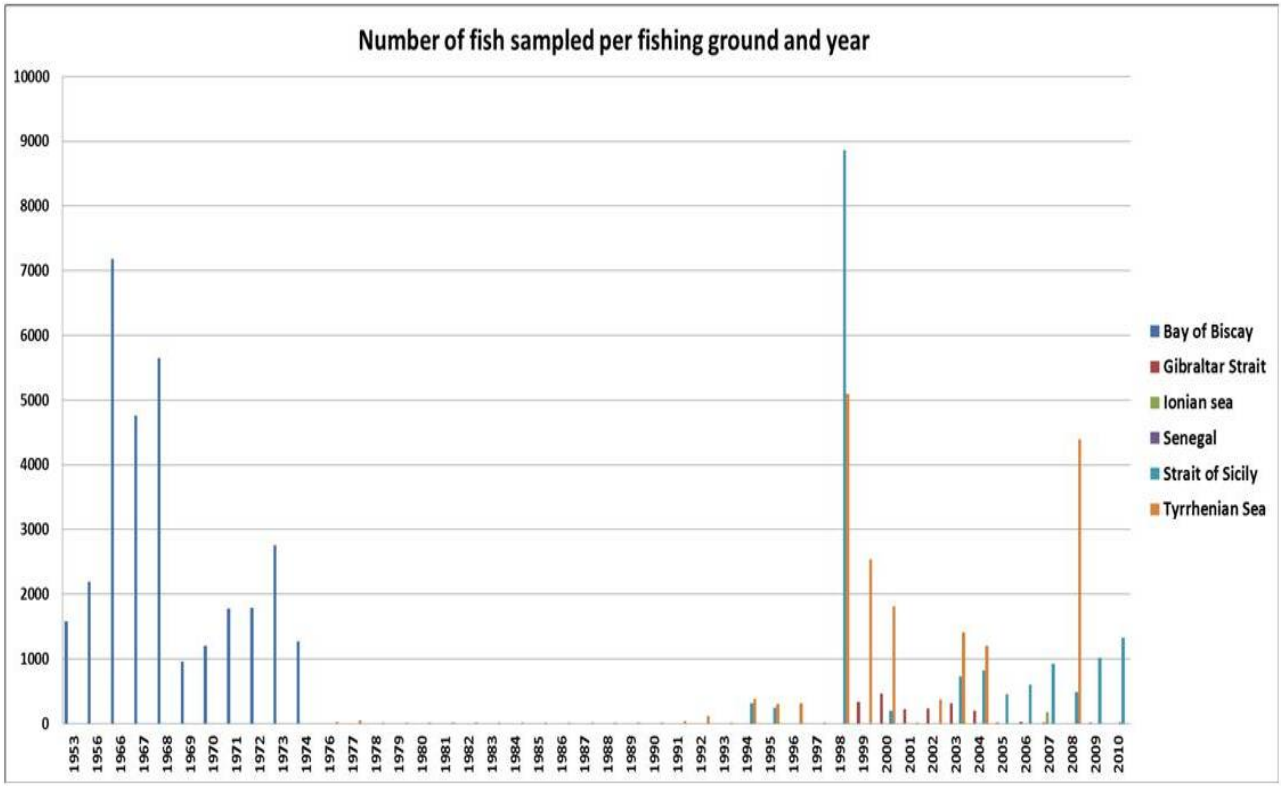

Figure 12. Distribution by year and fishing area of weight and/or size data samples related to wild-caught bluefin tuna, recovered by GBYP in Phase 1 and 2.

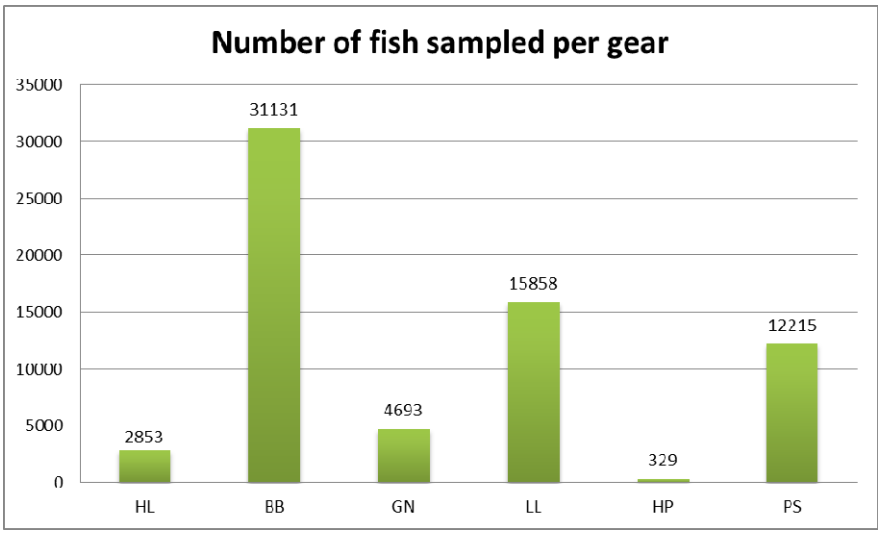

Figure 13. Distribution by gear of individual weight and/or size data samples related to wild-caught bluefin tuna, recovered by GBYP in Phase 1 and 2.

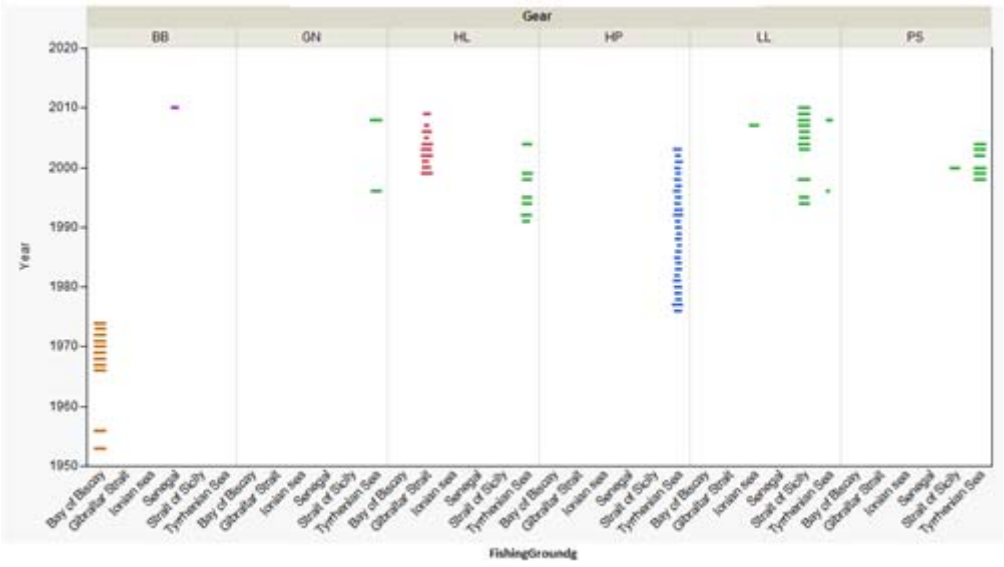

Figure 14. Sample distribution by gear, fishing area and year. Different colours indicate only the various data sources.

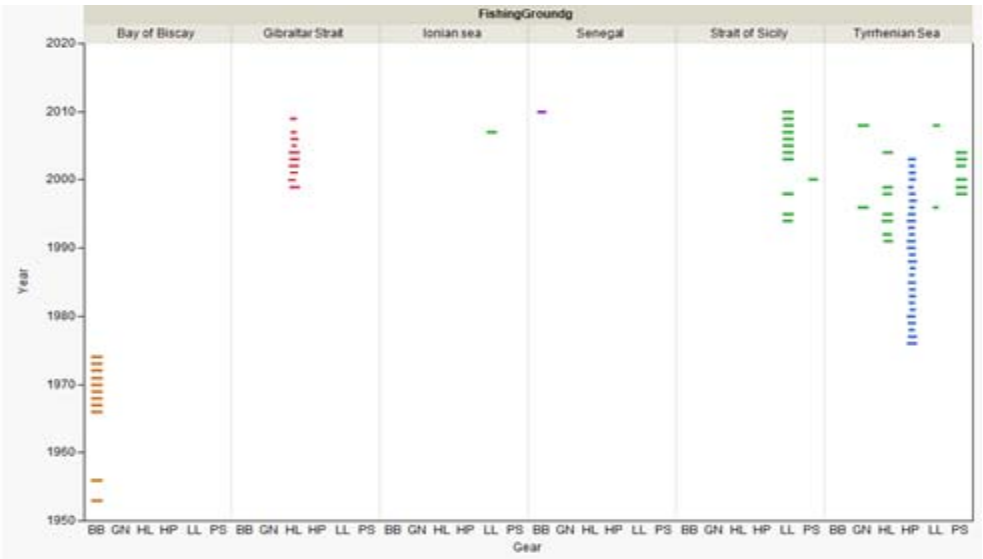

Figure 15. Sample distribution by fishing area, year and gear. Different colours indicate only the various data sources.

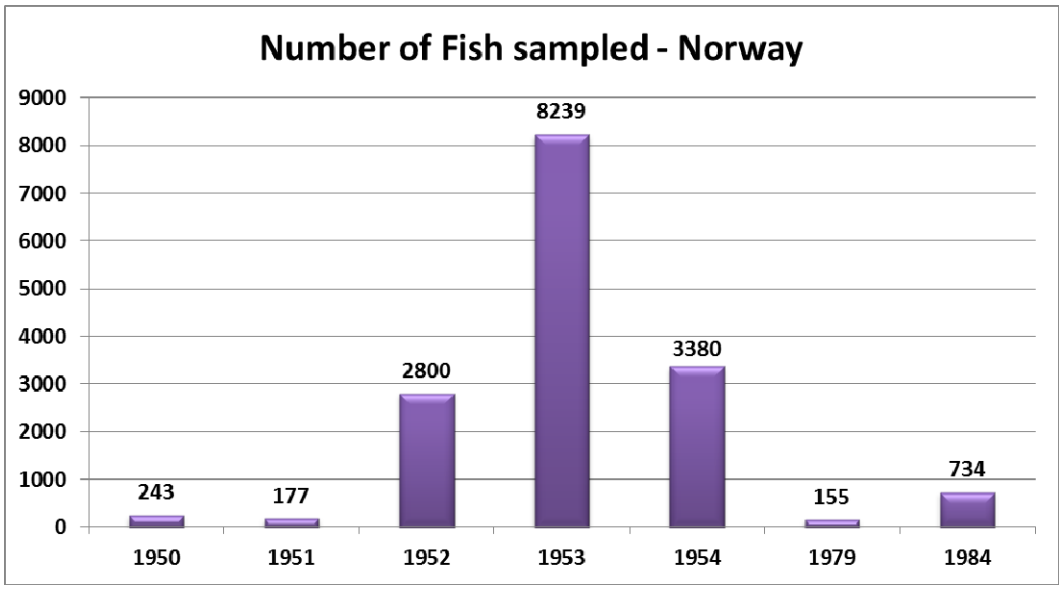

Figure 16. Distribution by year of the individual bluefin tuna samples included in the data sets recovered from Norway.

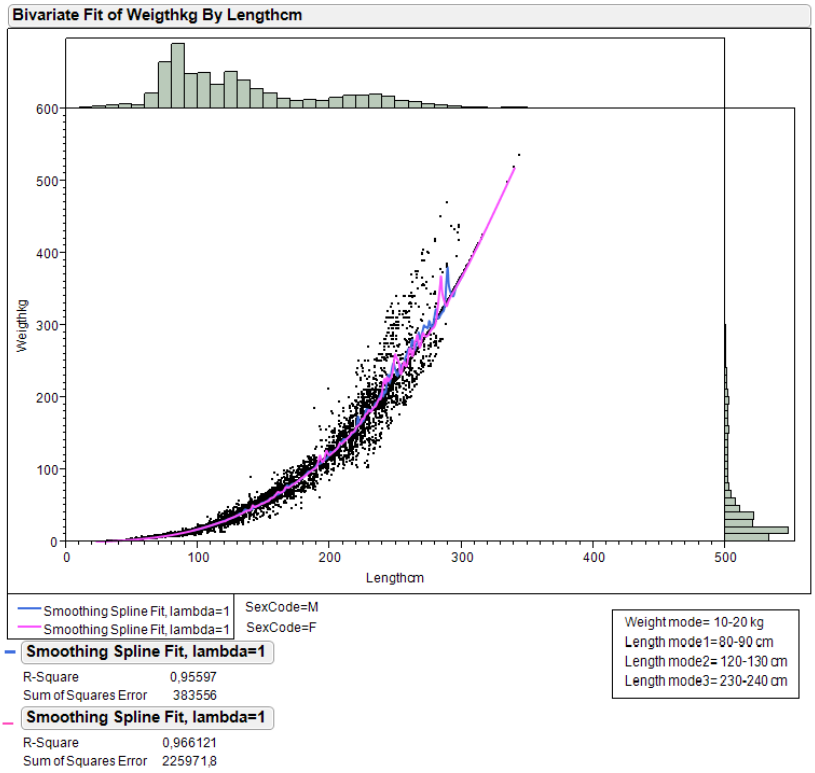

Figure 17. Bivariate fit of weight (kg) by length (cm) (n=67079; t=1953-2010). Weight mode: t=1953-2010; length mode 1: t=1953-2008; length mode 2: t=1953-2010; length mode 3: t01973-2010.

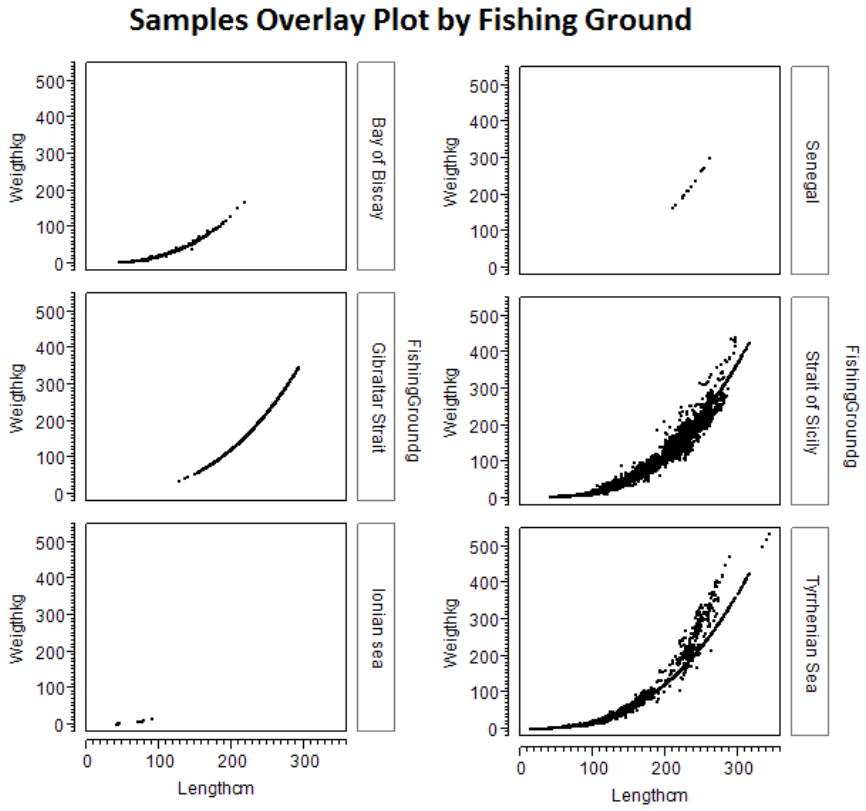

Figure 18. Overlay plots of bluefin tuna samples weight/length correlations by fishing area. Bay of Biscay: n=31114, t=1953-1974; Strait of Gibraltar: n= 1806, t= 1999-2009; Ionian Sea: n= 173, t= 2007; Senegal: n= 17, t= 2010; Strait of Sicily: n= 15875, t= 1994-2010; Tyrrhenian Sea: n= 18094, t= 1976-2008.

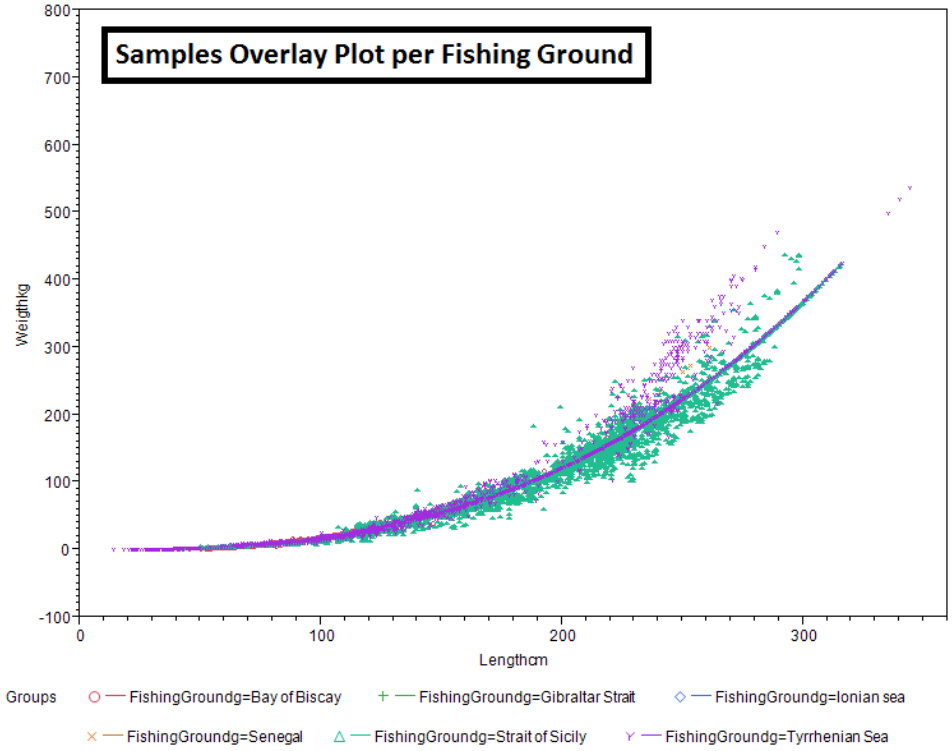

Figure 19. Overlay plot of bluefin tuna length/weight data by fishing area (n=67079, t=1953-2010).

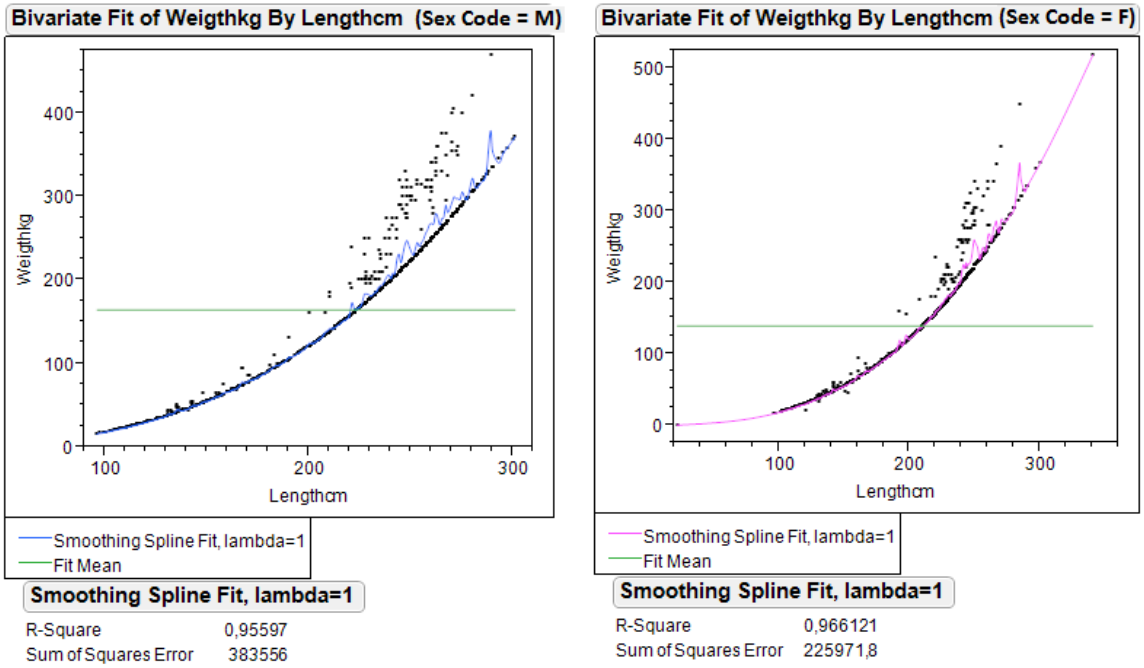

Figure 20. Bivariate fit weight (kg) by length (cm) by sex. Males: n=1076, t=1998-2002, mean=164.92 kg; Females: n=1049, t=1998-2002, mean=139.58 kg.

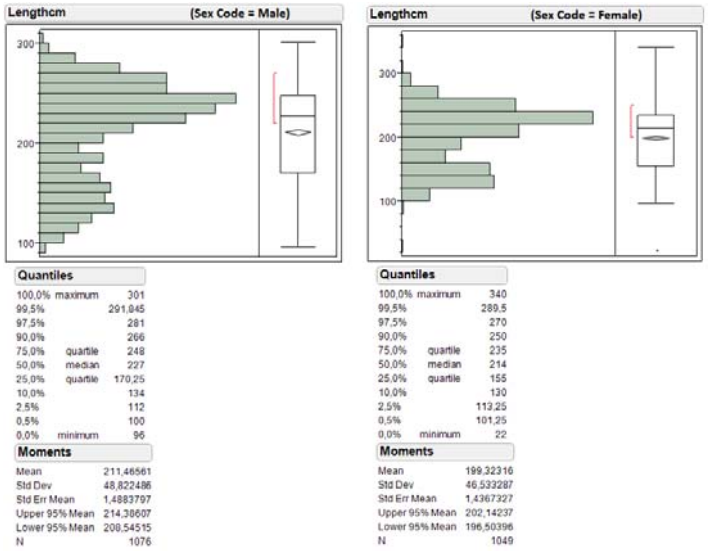

Figure 21. Length distribution of bluefin tuna recovered samples by sex. Males: n=1076, t=1998-2002, mean=164.92 kg; Females: n=1049, t=1998-2002, mean=139.58 kg.

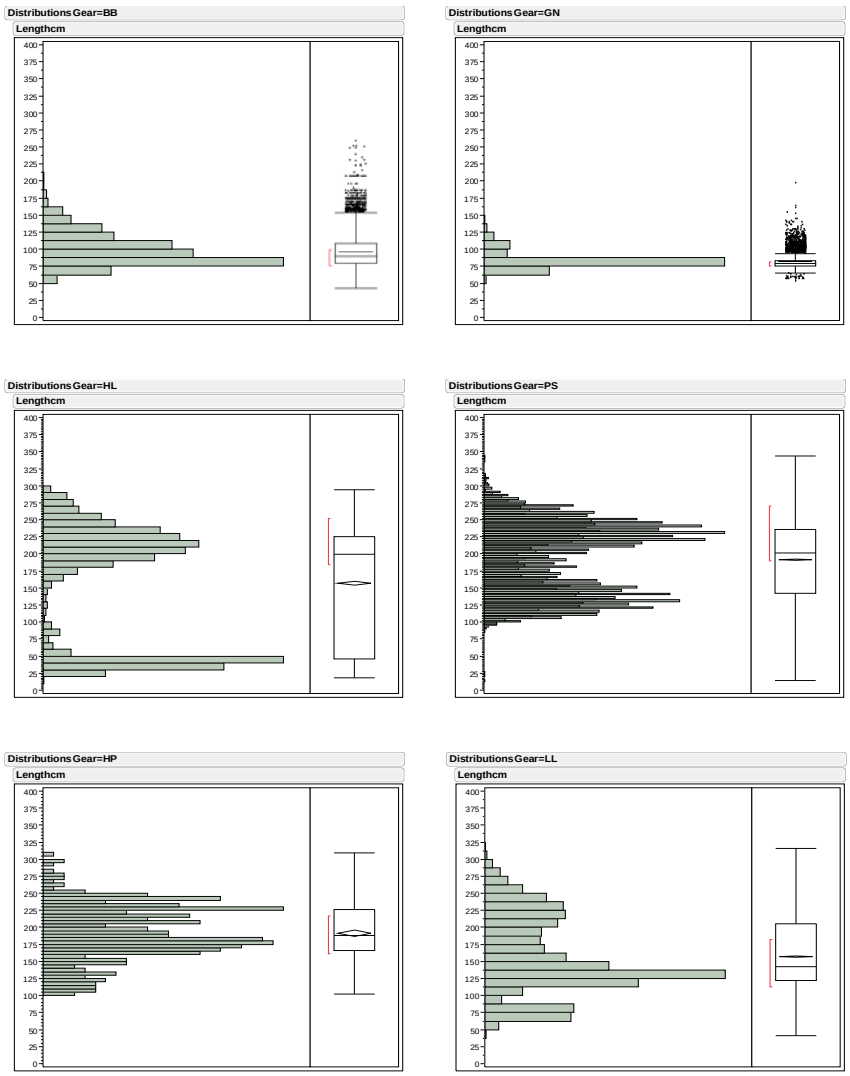

Figure 22. Length frequencies obtained from all data sets including wild-caught bluefin tuna (n=67079) recovered by GBYP, by gear type (BB: n=31131; GN: n=4693; HL: n=2853; PS: N=12215; HP: n=329; LL: n=15858).

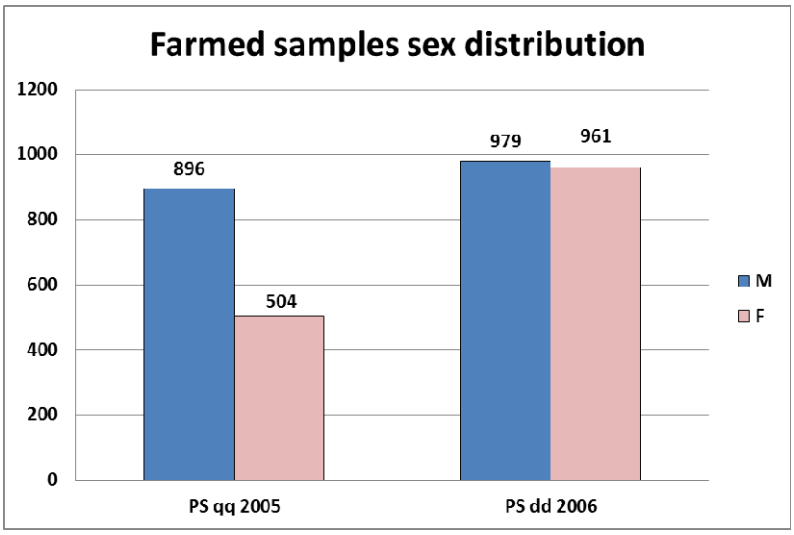

Figure 23. Distribution of samples by sex in farmed bluefin tuna in 2005 and 2006.

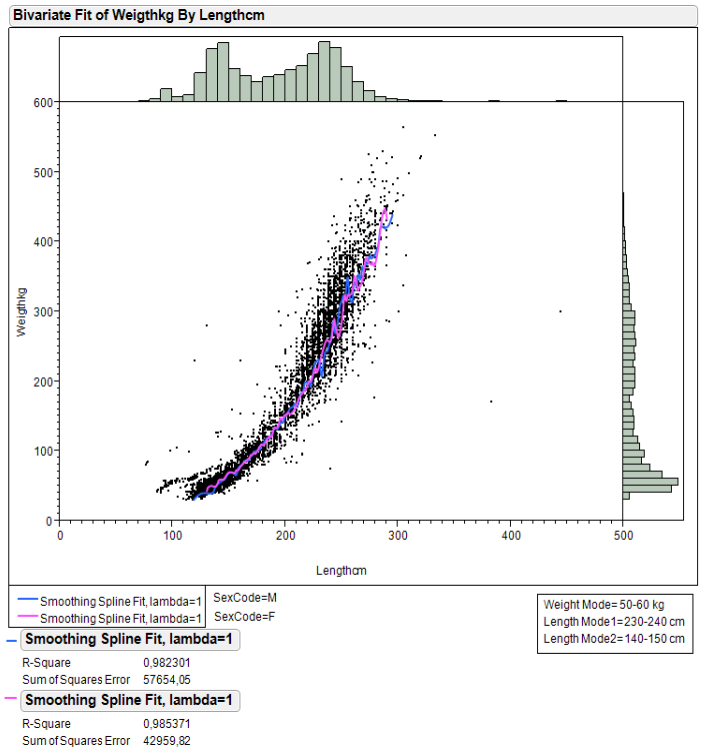

Figure 24. Bivariate fit of weight (kg) by length (cm) in bluefin tuna farmed samples (n = 12125; t = 2003-2007). Weight mode: n= 1302; t= 2003-2007; Length mode 1: n= 858; t= 2003-2007; Length mode 2: n= 847; t= 2003-2007.

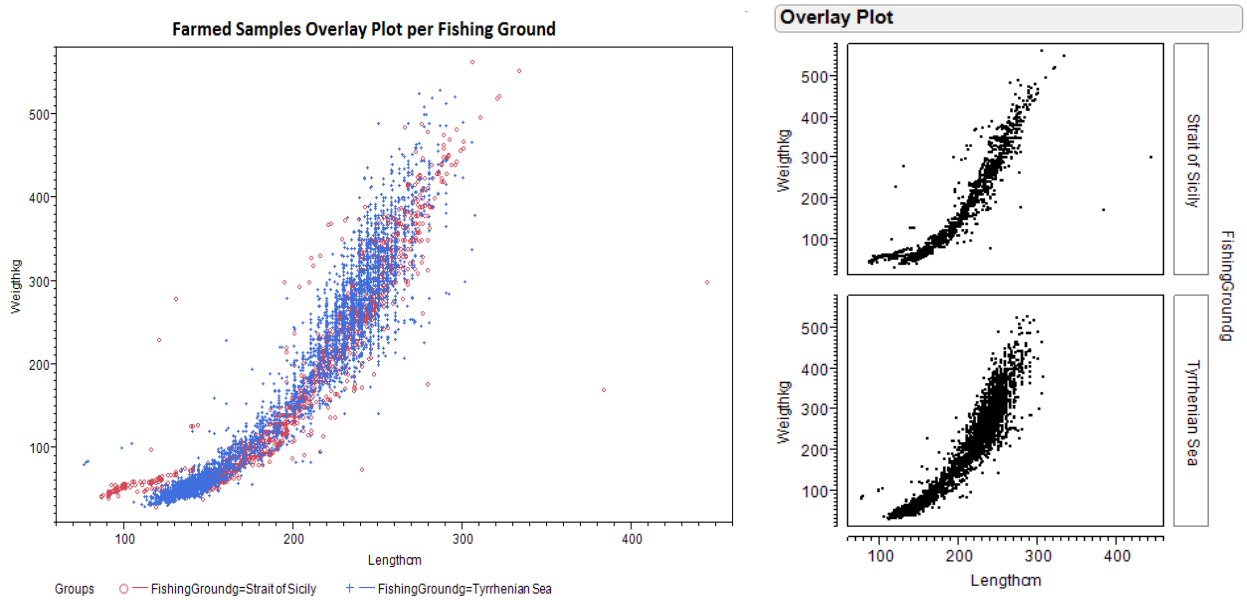

Figure 25 (right). Overlay of length/weight plots for farmed tunas from the two areas (n=12125; t=2003-2007).

Figure 26 (left). Length/weight correlation by farm location. Strait of Sicily: n=5897, t=2003-2006; Tyrrhenian Sea: n=6228, t=2003-2007.

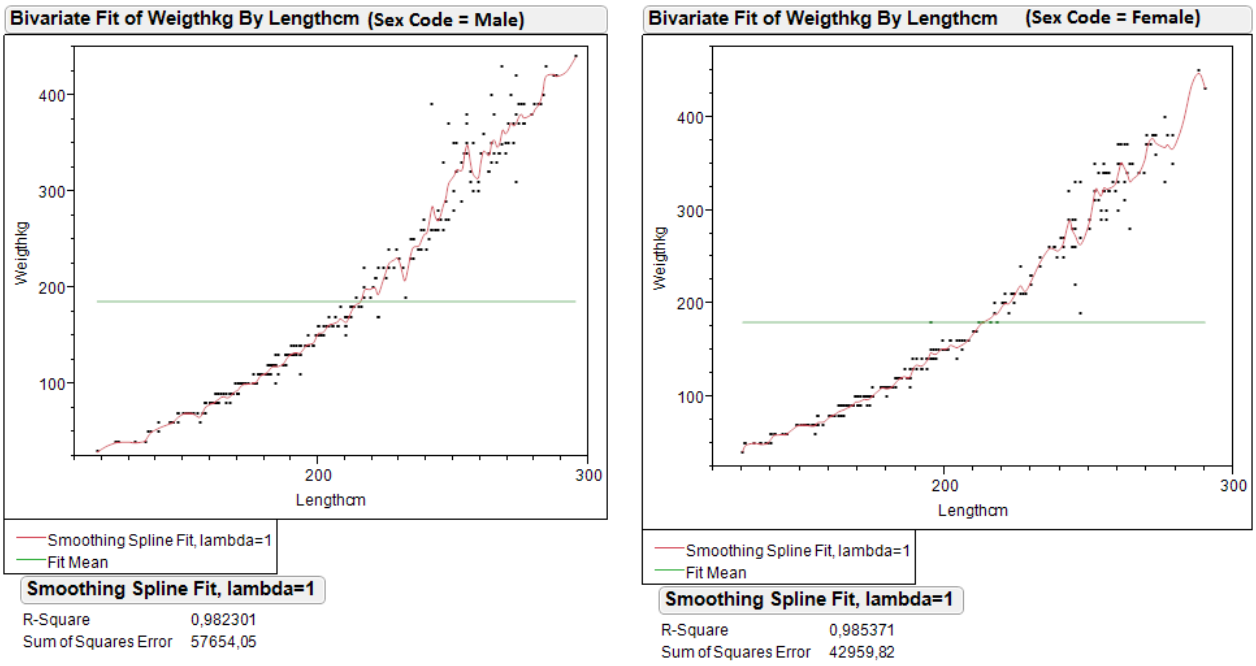

Figure 27. Bivariate fit of weight (kg) by length (cm) for both males (right) and females (left) farmed samples. Males: n=1875, t=2005-2006, mean RW: 186,47 kg; Females: n=1465, t=2005-2006; mean RW: 180,42 kg.

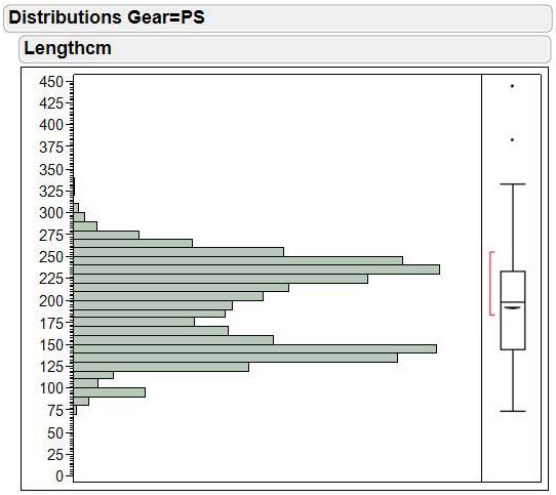

Figure 28. Length classes of farmed bluefin tuna samples at the harvesting in 2005 and 2006 (years and sex combined).

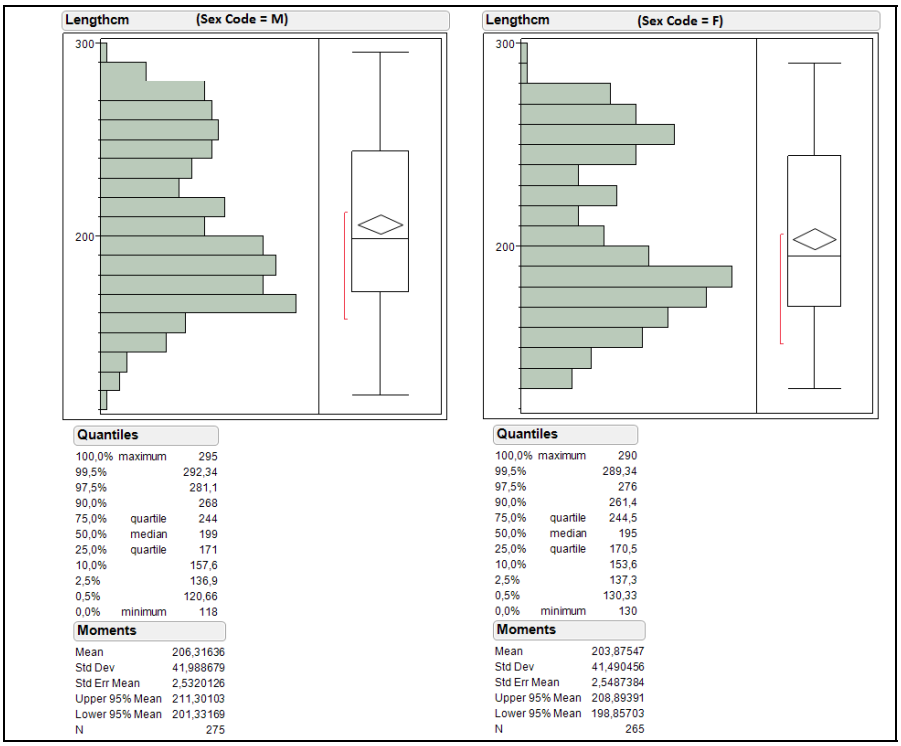

Figure 29. Length classes by sex of farmed bluefin tuna samples at the harvesting in 2005 and 2006 (years combined). Males: n=1875; Females: n=1465.

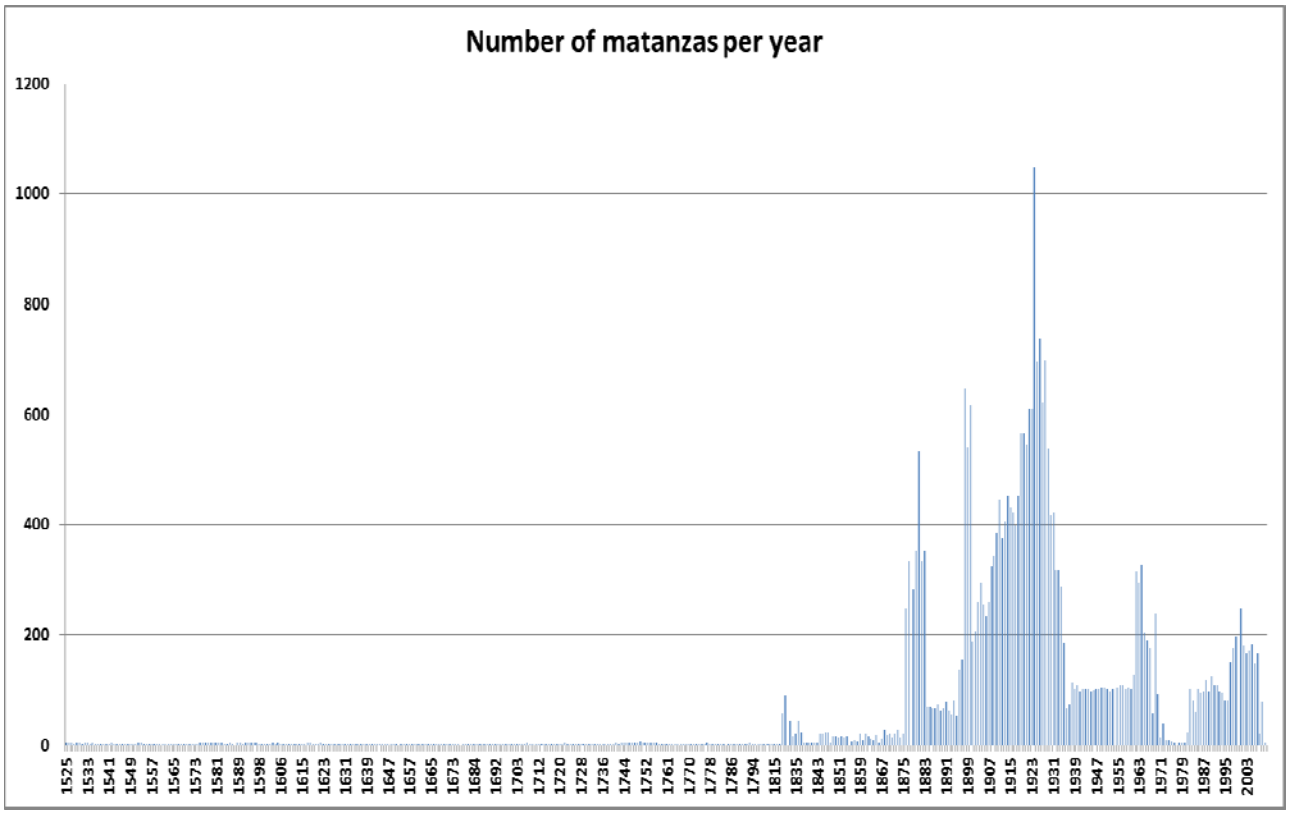

Figure 30. Distribution of tuna trap operations by year, over the period 1525-2009 (n=30717).

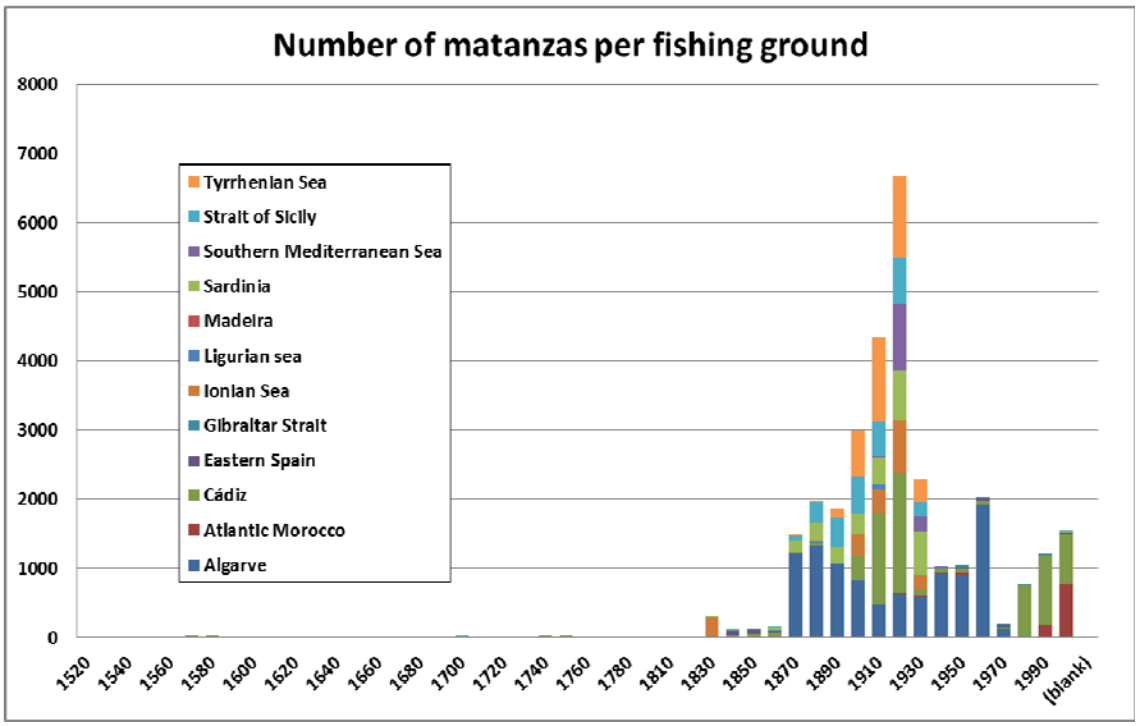

Figure 31. Distribution of tuna trap operations by decade, with details about the fishing groud (n=30717).

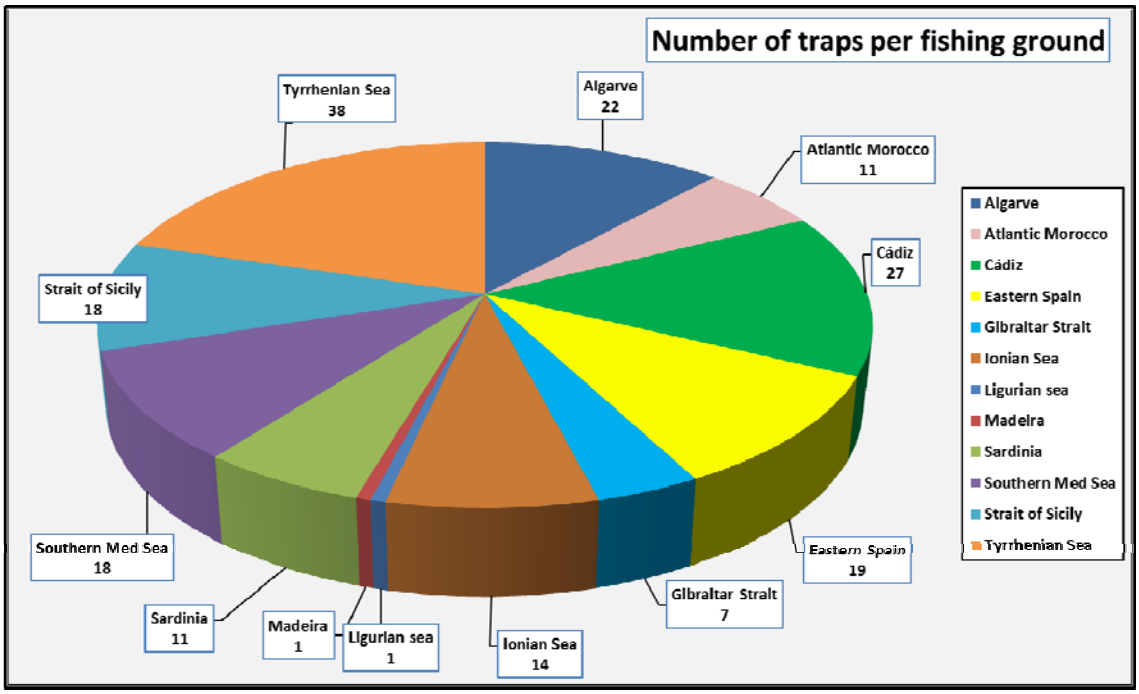

Figure 32. Distribution of the total number of tuna traps by fishing ground (n=187).

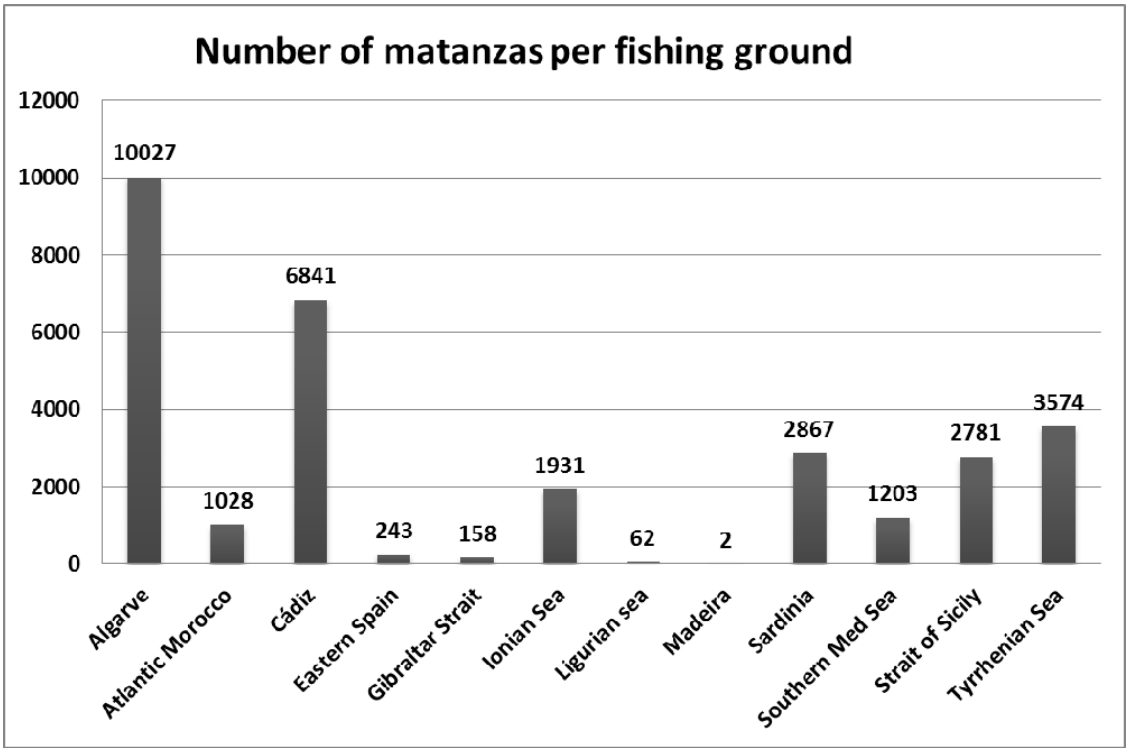

Figure 33. Total number of tuna trap fishing operations ("Matanzas") by fishing ground (n=30717).

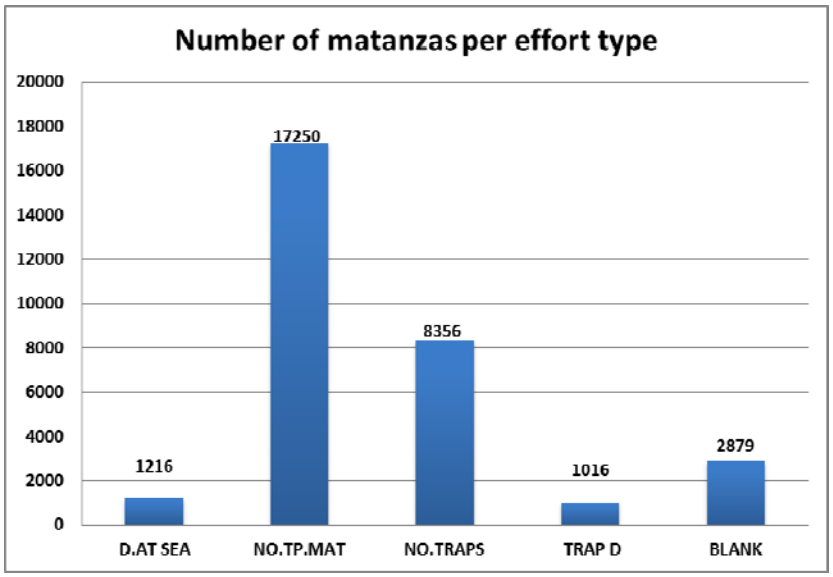

Figure 34. Number of trap matanzas by fishing effort category. Blank shows data sets where effort data are not available (n=30717).

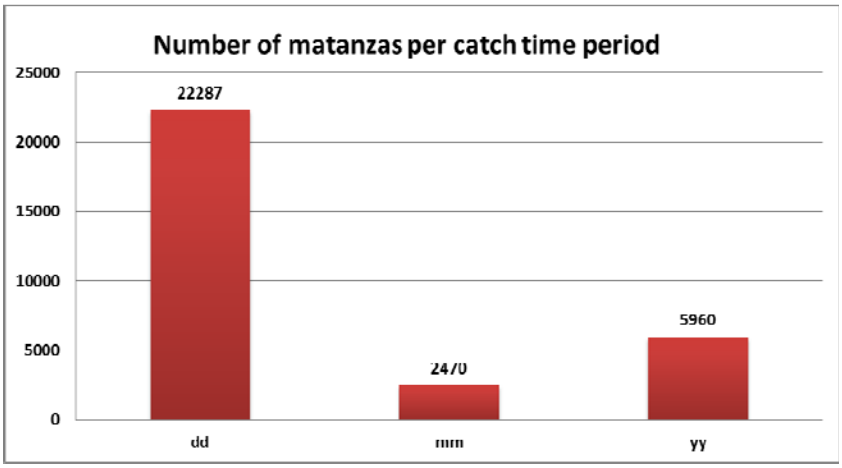

Figure 35. Number of trap matanzas by reported catch time period (n=30717).

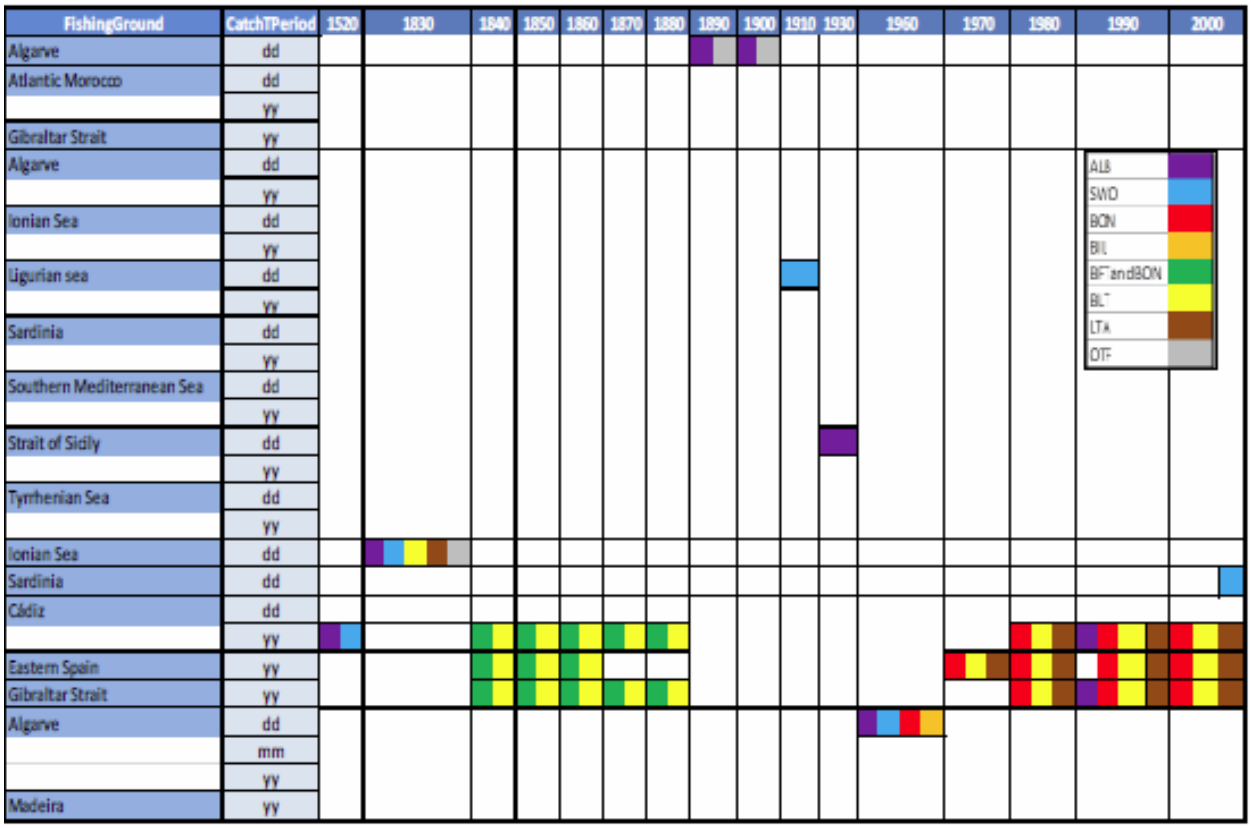

Figure 36. Presence of various species in the by-catch by fishing ground, catch period and decade.

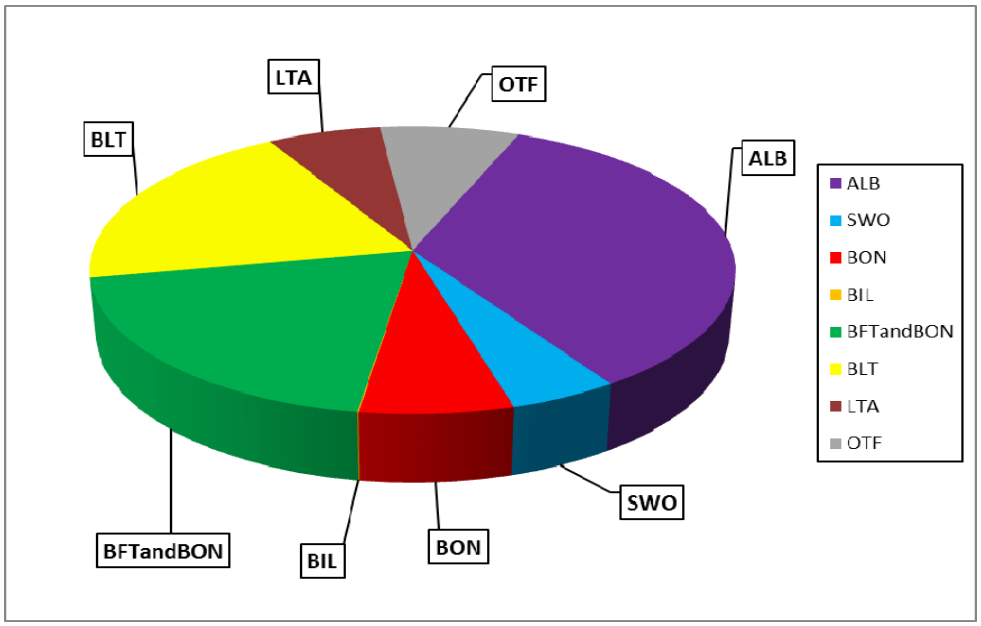

Figure 37. Proportional abundance of by-catch data sets by species in the data recovered from tuna traps.

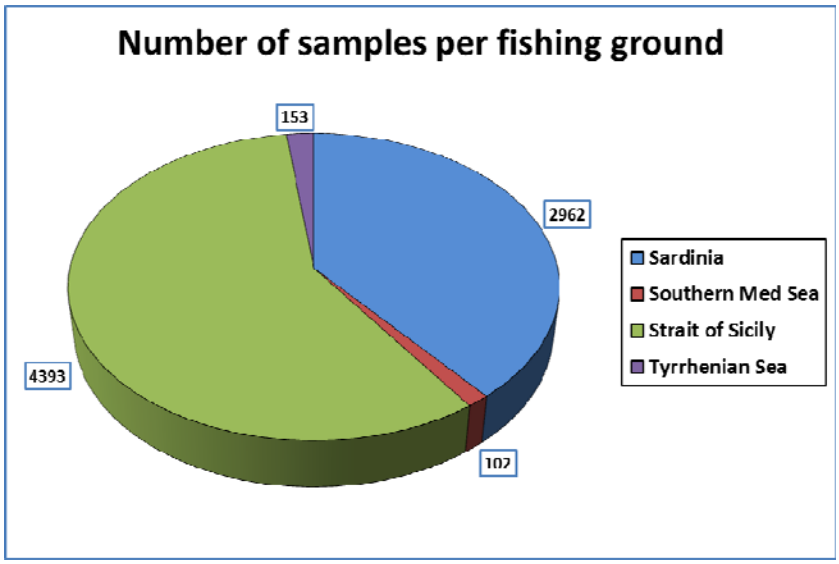

Figure 38. Number of samples including both length and weight data from the various fishing grounds (n=7610).

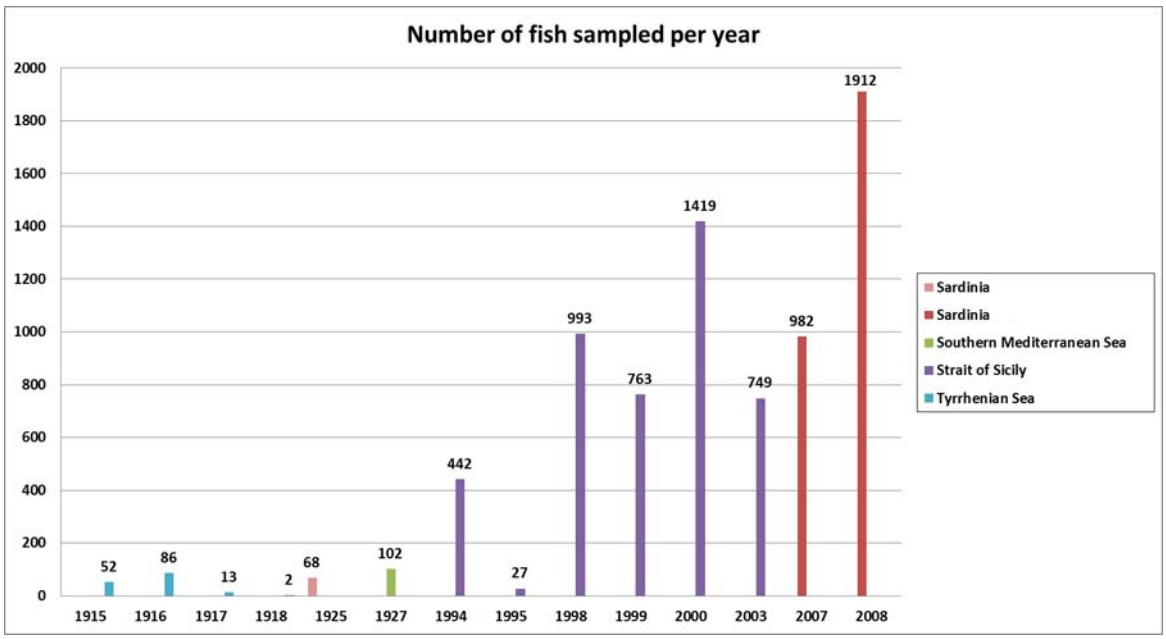

Figure 39. Distribution by year and fishing ground of the number of samples including both length and weight data (n=7610). The different colours indicate different contractors.

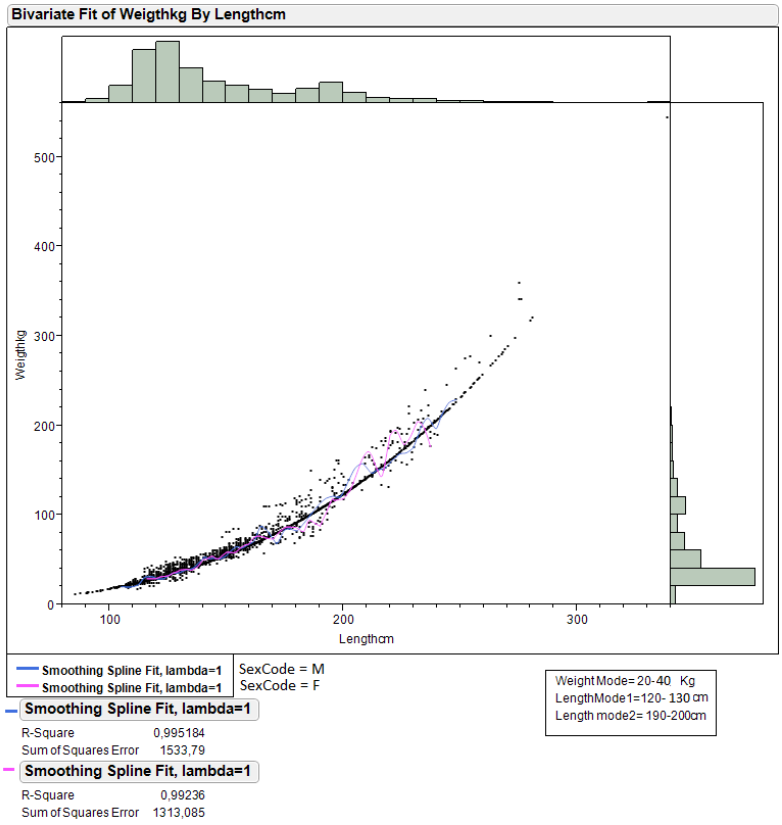

Figure 40. Bivariate fit of weight (kg) by length (cm) in tuna trap samples (n=7610, t=1915-2008). Weight mode: t=1917-1927, 1994-2008; Length mode 1: t=1917-1927, 1994-2008; Length mode 2: t=1915-1927, 1994-2008.

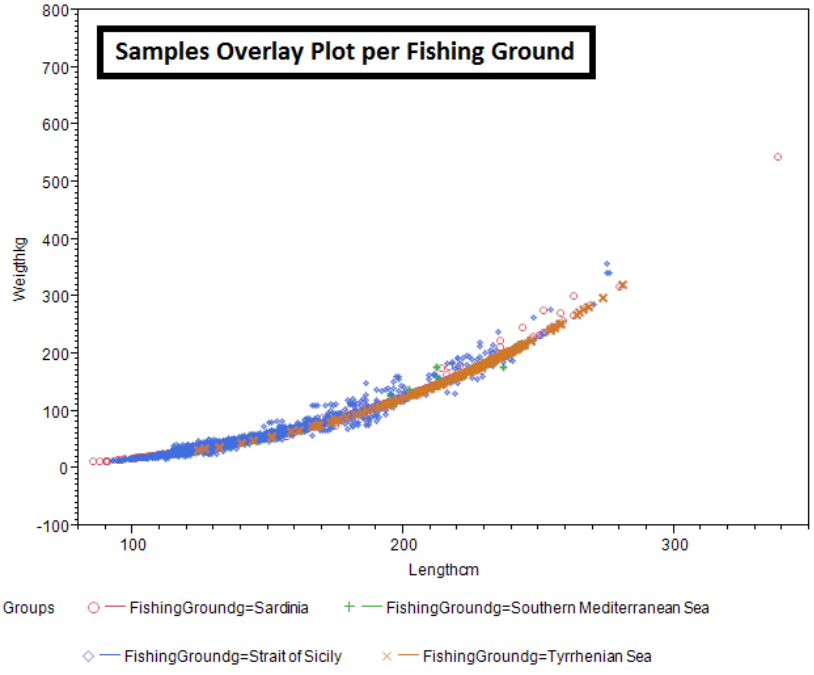

Figure 41. Tuna trap samples overlay plot for all fishing grounds (n=7610, t=1915-2008).

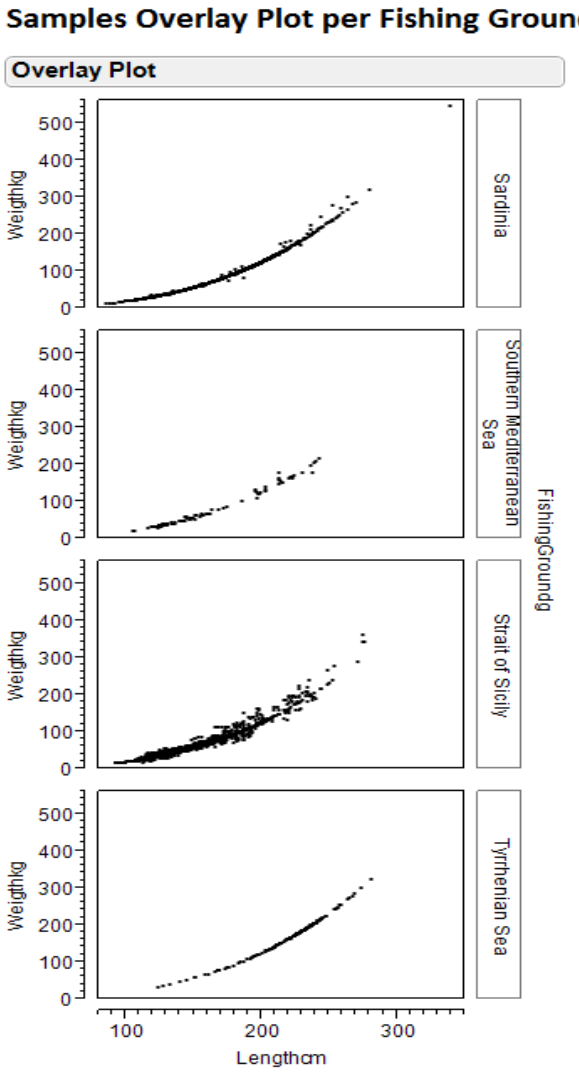

Figure 42. Tuna trap samples overlay plot by each fishing ground. Sardinia: n= 2962; t= 1925, 2007-2008; Southern Mediterranean Sea: n= 102; t= 1927; Strait of Sicily: n= 4393; t= 1994-2003; Tyrrhenian Sea: n= 153, t= 1915-1918.

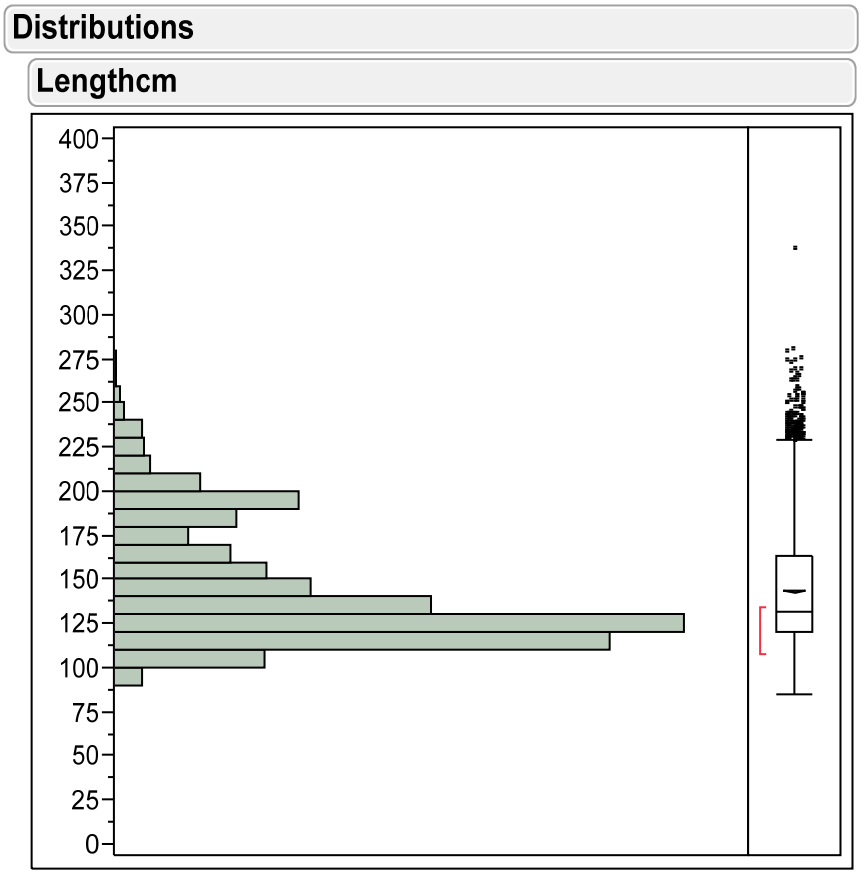

Figure 43. Length distribution of all samples from the many data sets recovered from all tuna traps in all areas.

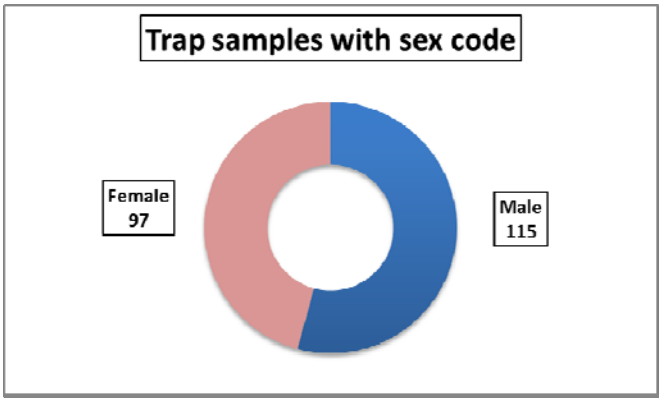

Figure 44. Distribution by sex of tuna trap samples having all data (length, weight, sex); n=212.

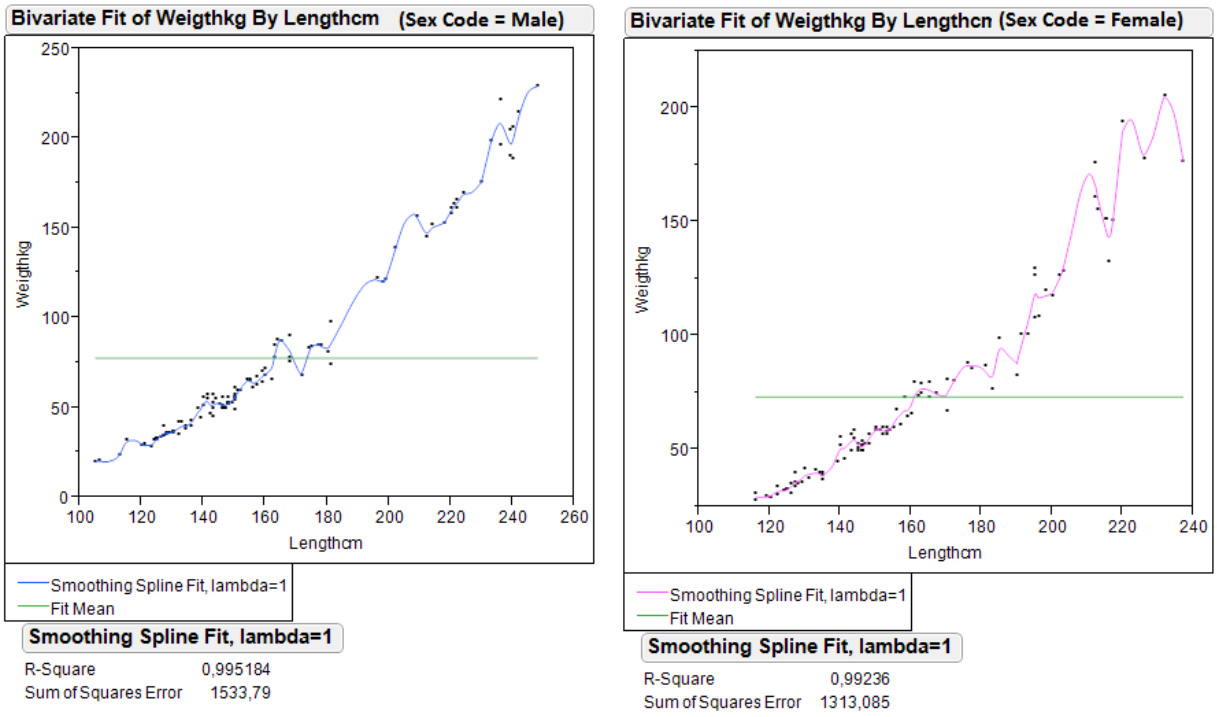

Figure 45. Bivariate fit of weight (kg) by length (cm) for tuna trap sub-samples samples having sex data. M: n= 115; t= 1925, 1927, 2003, Mean= 77.74 kg; F: n= 97; t= 1925, 1927, 2003. Mean= 73.41 kg.

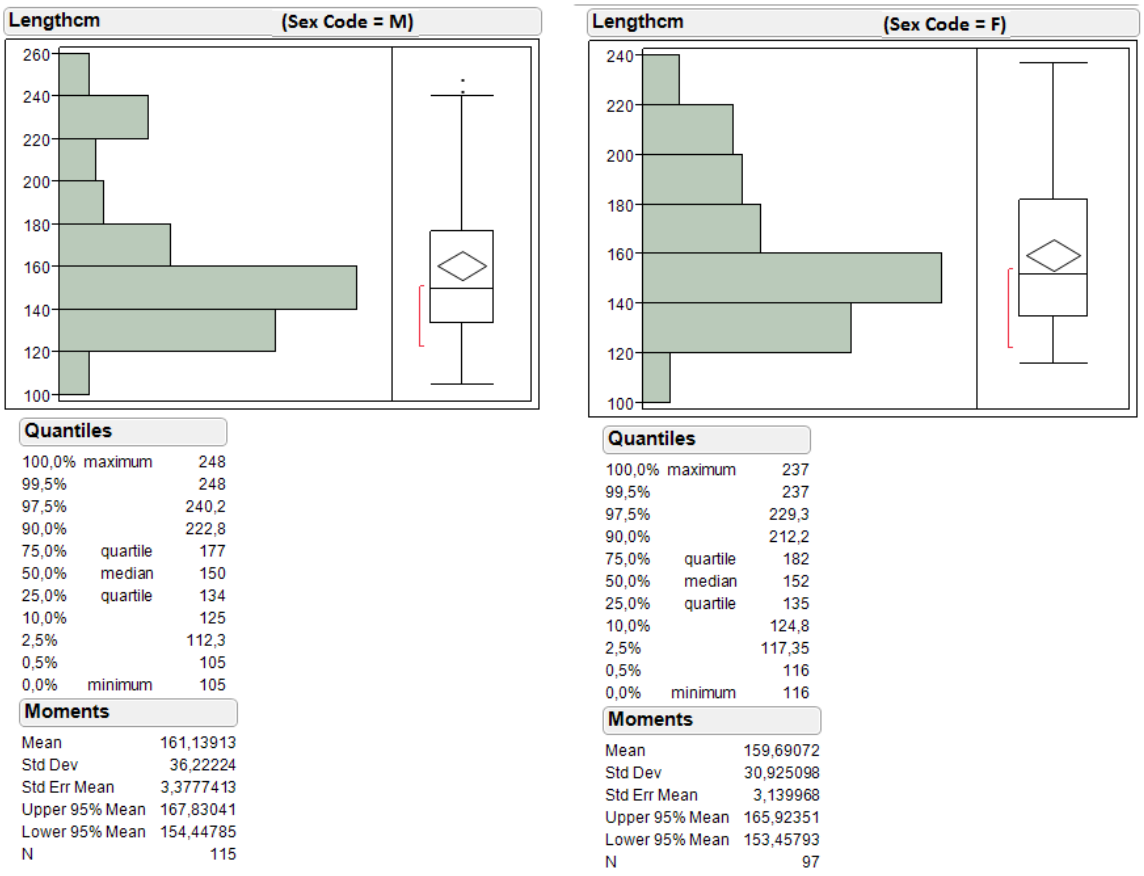

Figure 46. Length distribution of tuna trap sub-samples having sex code (along with both weight and length data). M: n=115; t= 1925, 1927, 2003 ; F: n= 97; t= 1925, 1927, 2003.