


BFT TRADE, MARKET, AND AUCTION DATA ANALYSES - DATA RECOVERY PLAN

International Commission for the Conservation of Atlantic Tunas

Final Report

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Submitted by

MRAG

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Acronyms

BCD	Bluefin catch document
BFT	Bluefin tuna
ERD	Entity relationship diagram
GBYP	Grande Bluefin Year Programme
ICCAT	International Commission for the Conservation of Atlantic Tunas
JFO	Joint fishing operation
MISSNM	Missing number (error code)
MISSPS	Missing product shape (error code)
MISSWT	Missing weight (error code)
SCRS	Standing Committee of Research and Statistics (of ICCAT)
SQL	Structured Query Language

Executive Summary

Three new datasets with catch data of eastern BFT were made available to the GBYP programme recently. These datasets brought together information from market sales, corporate records, and official statistics not currently used to calculate the catches for the stock assessment. As the data in the 3 datasets come from sources not currently used to provide estimates of total catches of EBFT they have the potential to provide an independent perspective of exploitation of the eastern BFT stock. This report presents the findings of analysis to develop estimates of catch removals of EBFT based on the information from the 3 datasets.

The first part of this work focused on cleaning the data and developing the database structure to facilitate the analysis and ensure that records are reliable and provided the information needed. The datasets were also critically reviewed to understand weaknesses and sources of uncertainty and get an insight into their potential in supporting analysis to calculate total catches of BFT. The final version of the datasets (once unreliable records were excluded) were then used to calculate catches per year under different assumptions for key components of the analysis such as fattening ratios and catch weight.

The results highlighted differences between the official catch statistics (Task I) used for stock assessment and catch estimates derived from the 3 new datasets. Those differences are more evident for the earlier years (before 2008) with estimated catches being much lower than official statistics while they were very close to (but still lower than) Task I data for the recent years. The lack of BCD data before 2008 could be one of the reasons for the higher differences in that period. The analysis also showed that there is considerable ambiguity with regards to records of caged fish as the 3 Forms included a number of records showing fish transferred to cages but with no corresponding records of fish harvested after the fattening period. However, it is not clear whether this is due to records missing from the 3 datasets analysed or reflects actual discrepancies.

The latter issue creates uncertainty in the interpretation of the records and our analysis has provided results under different combinations of data to capture that. Uncertainty in the estimated catches also comes from a number of other sources; including values of fattening ratios and conversion factors and allocation of fish to different fattening groups.

With regards to representativeness, the extent to which each Form captures fishing activity varies but all of them have some gaps in the data they hold. Although the 3 Forms hold data that are largely complementary, gaps still remain even after the 3 Forms are combined (e.g. they do not include catches from Japanese vessels or EBFT fish going to the Japanese market through third (non-EU) countries). For that reason, the results of the analysis are considered to represent an underestimate of total catches.

1 Introduction

One of the aims of the ICCAT Atlantic-Wide Research Programme on Bluefin Tuna (ICCAT GBYP) is to use datasets not currently incorporated into the ICCAT database for bluefin tuna (BFT) to support stock assessment work.

In this context, the GBYP put a call out in 2016 for a project to provide assistance with analysing three new datasets donated to the Programme. The three datasets provided data on BFT catches acquired from three different sources and can broadly described as (Bregazzi 2015):

Form1: Data on auctioned BFT from all major Japanese auction markets. Features of this file include:

- It described sales of BFT in the Japanese BFT auction market with specific details including weight, date of sale, origin, presentation type, and fattening status.
- Covers years from 2000 – 2012.
- Data were extracted from daily auction market reports;
- Covers fish auctioned fresh;
- Covers both wild and farmed fish;
- Only covers data for BFT belonging to the Eastern stock;
- Only covers fish that have been exported from the EU (i.e. does not include fish from the Eastern stock caught be the EU fleet which were exported to a third country (e.g. USA) before sent to Japan);
- A number of assumptions have been used to assign fish to geographical area, gears, and catch years; for example, farmed fish auctioned early in a given year (before July) have been assigned to catches in the year before or two years before depending on the farm.
- This dataset does not include data from the Japanese longline fleet fishing in the NE Atlantic and the Mediterranean.

Form 2: Data on BFT production obtained from fishing and/or ranching operators records, vessels logbooks, and sampling programmes. Features of this file include:

- It describes catches of BFT as recorded by some corporate producers with details including number of fish caught, weight, gear, country that caught the fish, fattening status, and whether it was sold frozen or fresh.
- Covers years from 1995 to 2008.
- Covers both wild and ranched fish but its main focus is on ranched fish in the Mediterranean;
- ICCAT trade or CoC records were excluded
- Covers Live, Fresh and Frozen products;

Form 3: Data on BFT production from ICCAT Bi-annual Statistical Reports, CoC Reports and BCD Database. Features of this file include:

- Provides information on some catches as reported in official statistics including weight and number of fish caught, country, date, gear, fattening status, and unique identification number (BCD).
- Covers years from 2004-2014.
- Covers Live, Frozen, and Fresh products;
- Covers both wild and ranged fish;
- BCD data were extracted in January and March 2014

Alternative approaches to calculate total BFT catches or account for misreporting in management advice have been considered in the past in response to concerns about the representativeness / completeness of official catch statistics (e.g. Metian et al 2014; Fromentin et al., 2014; Gagern et al., 2013). These studies pointed to discrepancies between the official catch data used for the stock assessments and the number of BFT fish that have actually been caught. Preliminary analysis undertaken using the 3 datasets presented above also seems to support that conclusion for the specific segment of the catches it covered (Bregazzi 2013).

For this project, MRAG has been contracted to undertake further analysis of the 3 datasets. The overarching objective of the project is to provide an assessment of the total level of possible catches (removals) of Atlantic bluefin tuna that went to the market during the period covered by the data. The 3 datasets were provided to MRAG by ICCAT and this analysis used the latest version of the 3 Forms with the data after all assumptions described in Bregazzi 2015 have been applied (e.g. assumptions used to allocate catches to different geographical areas and farmed fish to different catch years).

The specific tasks that comprise the project are:

1) Carry out a preliminary overview of the available trade and market data and define the various types of data according to the origin and the categories;

2) Carry out an in-depth analyses for further selecting the reliable data, cross-checking them with the available documents to avoid double-counting, use of different types of conversion factors, representativeness of various age classes, data coverage, sample representation, amongst other aspects that may deteriorate the data set quality and usefulness, since a clean data file will be used for assessing the total level of bluefin tuna catch in the period covered by the available data;

3) Specify in detail the type of quality checks and analyses that have been carried out for identifying the reliable raw data sets;

4) Based on the data overview and analyses, provide an assessment of the total level of possible catches of Atlantic bluefin tuna that went to the market for each year covered by the data, ideally by stock and under various hypotheses, including the expected CVs by year, for further analyses of the SCRS Bluefin Tuna Species Group.

To fulfil the requirements of the project a final report should be submitted to describe the work carried out, data that have been extracted from the original datasets and used for the calculations, and findings of the analysis. This document is the final report of the project.

2 Methodology

2.1 Database Design

Due to the size of the datasets provide by ICCAT (more than 340,000 records before exclusions), an early decision was taken to import the data into a Microsoft Access database to provide an interface to query the data simply and quickly. Three main data tables were created for the three main sources of data as shown in Table 1.

The database design implemented is relatively straightforward mimicking the design of the spreadsheets that hold the datasets provided by ICCAT. The database was created based on the main datatypes and necessary lookup tables (see ERD diagram in Annex 1). The lookup tables (named lk_*, Table 2) in the database were populated from three sources listed below:

- Domain data supplied in the Microsoft Excel spreadsheets;
- Standard ICCAT data sources; and
- From the data in the tables themselves.

Although the files for corporate producer data (Form2) and national data submissions (Form3) data had been split into two separate files the data contained in them were of the same structure and therefore when imported into the database these datasets were each combined into single datasets for their respective data types. The steps followed to produce the final database used for the estimation of BFT catches are described in the following sections.

Table 1 Summary of the main database tables and their source data.

Database Table Name	Source Data	Description
form1_BFT_Trade_Data	form1_dsTradeBFTfresh (F) Japan Auction Markets.xlsx	Individual fish data from Japanese market data.
Form2ab_BFT_Trade_Data	form2a- BFT (*Thunnus thynnus*) production per specimen Live, Fresh & Frozen (Corporate records).xlsx	1998 - 2008
	form2b- BFT-CORRECTED- (*Thunnus thynnus*) per specimen Live), Fresh & Frozen (Source Corporate records).xlsx	1995 - 2008
Form3ab_BFT_Trade_Data	form3a- BFT (*Thunnus thynnus*) production per specimen Live (L), Fresh (F) & Frozen (FR) product (Source ICCAT records).xlsx	2005 – 2014 - Wild caught from ICCAT Bi-Annual BFT Statistical Reports (2005 – 2011) and ICCAT CoC Reports (2009 – 2012)
	form3b- BFT (*Thunnus thynnus*) production per specimen Live (L), Fresh (F) & Frozen (FR) product (Source ICCAT records).xlsx	2004 – 2013 Wild and ranched caught from ICCAT Bi-Annual BFT Statistical Reports (2005 – 2011) and ICCAT CoC Reports (2009 – 2012)

Table 2 Lookup data tables

Database Table Name	Source Data	Description
lk_Areas	Data tables	Area from which fish have been caught.

Database Table Name	Source Data	Description
lk_End_Markets	Data tables	End market (country) for the BFT e.g. Japanese Market
lk_Error_Flags	Internal database table	List of all the error flags used in the analysis of the data. Allows for exclusion of specific data. NB: Not included in ERD.
lk_Farms	ICCAT provided extract	List of all BFT farms used during the period of the study
lk_Flag_State	ICCAT standard data table for flag States. NB: Combinations of flag States are not included in the base table but are included here to match the data reported.	Flag States of catching and processing vessels, traps and farms
lk_Flag_State_Used	lk_Flag_State (See above)	Cut down internal version of original table for building of the data frame
lk_Gears	Standard ICCAT gears table	List of ICCAT gears
lk_Markets_Acronyms	Data tables	Market codes in the data and the markets they represent
lk_Origin_Type	Data tables	Simple Boolean "Wild" or "Ranched"
lk_Product_Form	Standard ICCAT data table	Fresh, Frozen or Live
lk_Product_Shape	Data Tables	Showing the product form of the fish e.g. BM – "Belly meat"
lk_Sex	Standard ICCAT data table	Sex code [F,I,M,U]
lk_TIMEFRAME_YEARS	None	Internal data table defining the timeframe for the study. Used to generate the data frame.
lk_Trade_Documents	Data tables	Type of trade document listed [BCD,RC,SD]
lk_Traps	ICCAT provided extract	List of all BFT traps used during the period of the study
lk_Weight_Range	Data tables	Internal only. Weight range is a non-standard field with a number of qualifiers e.g. ">240 kgs" or "≈ 057 Kgs"
lk_Wholesalers	Data tables	List of wholesalers

2.1.1 Creation of exact database record in Access

The tables with the data for each of the 3 forms (Form 1, Form 2, and Form 3) were imported initially into an exact import copy of the spreadsheet in the Access database with no restrictions on database integrity or check on data integrity. These database tables serve two purposes:

- Tables ensure all data have been imported and a permanent record of the import is maintained; and
- When data imported into the working data tables that a check can be made to ensure all records have been imported and that records are complete.

During the import process we identified a number of problems associated with the presentation of data such as field values not matching the official (ICCAT) formatting/names. Those discrepancies from the standard presentation of data were rectified before the records were included in the database (see Annex 2). Linked to this, three additional tables have been added for completion to include the currency types used in the database for prices. During the normal import procedure the currency fields are converted to a normal “Double” data type in the database. This is due to the currency being held not as data but as a formatting type in the Microsoft Excel file. A separate additional field was added to the working copies of the original MS Excel sheets that captures the currency format.

2.1.2 Creation of Data Frames

The next stage of the data analysis was to import the data from the temporary upload tables to the working structure that we defined.

A data frame consisting of six elements has initially been created to allow matching and comparison of all records. The frame for data analysis will consist of the elements described in Table 3. This frame will include all possible combinations to allow identification of where records match across the frame from all data sources.

Four main gear types were used in the data frame (longline, purse seine, trap and unclassified) with the other gear types having very limited or no bluefin tuna catch to compare, and these have been subsumed into the “UNCL” category for this analysis. Only the years 2001 – 2012 have been used in the full data frame for comparison between data sources. For these years two BFT related data sources were available in addition to the Task I catch and effort data.

Table 3 Elements included in the full data frame.

Element	Comment	Number of Factors
Flag State	Taken from selecting distinct flag States from Form1, Form2 and Form3 (see Annex 3)	36 (all countries)
Gear	**LL** **PS** **TRAP** ~~BB~~ ~~GILL~~ ~~HAND~~ ~~MWT~~ ~~OTH~~ ~~RR~~ **UNCL**	10 (only 4 LL, PS, TRAP and UNCL are reported in forms 1 and 2,and all 10 in form 3). The 6 lesser used gear types will not be used in the full data frame instead converted to UNCL where appropriate.
Region	ADRI MED C MED E MED W MED W&C NEA TYRR	7 (all areas)
Product form	Fresh / Frozen / Live	3 (all product forms)
Wild / Ranched	Simple Boolean wild / ranched	2 (all)
Year	Form 1 – 2000 – 2012 Form 2 – 1995 – 2008 Form 3 – 2004 – 2014 Overall - 1995 – 2014 but restricted for final analysis	20 (but see specific restrictions in analysis section)

The potential range of values for the data frame have been extracted from the database tables themselves using SQL Queries.

2.1.3 Additional data

The ICCAT Task I catch data have been imported into the database and will be used as the starting point for the next phase of the work in which we will consider how information in each of the 3 Forms differ from total catches used in the stock assessment. In addition to that information, we have also considered additional information including:

- List of active farms used for BFT fattening in the Eastern Atlantic and Mediterranean;
- List of traps employed to catch Eastern BFT;
- Annual quota allocation per country;
- Standard ICCAT conversion factors for different presentation types;
- ICCAT conversion factors for weight of fattened fish; and
- Standard ICCAT bluefin tuna length-weight relationship.

This information will be used as an indirect check to test the completeness / representativeness of the information in the 3 Forms, fill gaps in the 3 datasets, or provide additional information for sensitivity analysis and interpretation of findings.

2.1.4 Error checks and flags

A number of checks were part of the initial phase of assessing the completeness of the datasets in the 3 Forms. To capture the outcome of those tests the design of the main data tables incorporated an additional data column which was for a text field called ERROR_FLAG. This allows any rows in which a possible error or missing data exists to be flagged with a specific text flag. The tests considered a number of possible gaps and inconsistencies including:

- Entries with number of fish but not weight and vice versa;
- Entries missing key frame data;
- Departure from expected values e.g. outliers in average weight estimates or several entries with the same BCD;
- Entries for which average weight could not be calculated;
- Inconsistencies in dates (e.g. harvest date for the fish was after the date it was put on the market (i.e. harvested in 2001 but on sale during 2000) or where the auction date was long after the fish have been harvested e.g. auctioned in August 2002 after being harvested in 2000).
- Entries for which the presentation type is missing

The specific queries and code is provided in Annex 4. For each of the checks, we keep record of the entries that have been flagged. For example, the missing weight query has identified 55,576 individual fish reported on the Japanese auction market (Form 1) that do not have a weight record although a fish was reported. In these cases a decision will have to be made to determine if we can replace missing weights with estimates based on average weights (based on source, year etc.).

2.1.4.1 Missing Frame Data

When analysing the three datasets provided a standard set of critical data elements have been used to generate an analysis frame. **Table 4** indicates the number of records that are missing one or more key data elements and have been flagged with the appropriate error flag allowing them to be excluded from the analysis at appropriate points.

Table 4 Database records missing key frame data by data source.

Error Flag	Number of records
F1FRAME	0
F2FRAME	1
F3FRAME	0

Source: ICCAT Trade and Auction Project Database – Source Queries "ERROR_F1FRAME", "ERROR_F2FRAME" and "ERROR_F3FRAME".

Table 4 shows that the data frame elements are clearly complete throughout the datasets.

2.1.4.2 Missing and Average Weight Checks

When analysing the three datasets provided a number of records in each of the data sources were observed to have no weight allocated to them, just a number of bluefin tuna (see Table 5 and Annex 5).

Table 5 Missing weight records by data source.

Error Flag	Number of records
F1MISSWT – Form 1 Missing weight (kg)	55,576
F2MISSWT – Form 2 Missing weight (kg)	2.514
F3MISSWT – Form 3 Missing weight (kg)	1.980

Source: ICCAT Trade and Auction Project Database – Source Queries "ERROR_F1MISSWT", "ERROR_F2 MISSWT" and "ERROR_F3 MISSWT".

A series of checks were made on the form 2 and form 3 datasets provided to check the average weights (kg) recorded against upper (700kg) and lower (2kg) boundaries as well as ensuring the calculated value is correct. If the calculated value was incorrect this may suggest that the catch weight recorded is not correct and may therefore be excluded from the analysis. Only a very small number of records were identified through this check and were excluded from the calculations (Table 6).

Table 6 Possible errors identified in average weights by data source.

Error Flag	Number of records
F2AVWT – Form 2 average weight errors	7
F3AVWT – Form 3 average weight errors	6

Source: ICCAT Trade and Auction Project Database– Source Queries "F2_Check_Average_Weight" and "F3_Check_Average_Weight" along with manual checks of differences between recorded and calculated average weights..

For the majority of data records, for completeness, we used average weight data where appropriate instead of missing values. Data records were only excluded where no option to replace the values was possible.

2.1.4.3 Matching EU.XXX and EU.YYY with EU.XXX + EU.YYY (JFO problem)

An additional problem exists in the differences that occur in the reporting of the flag of the catching State. The data reported by the flag States for joint fishing operations (JFO) are reported as a group for all vessels in a JFO, e.g. a joint fishing operation between Spanish, French and Libyan vessels would be recorded as "EU.ESP+EU.FRA+LBY". This makes comparing the catches of a State that undertakes JFOs particularly difficult between the datasets analysed, and even more so for those States that undertake a number of different JFOs e.g. EU.FRA+EU.ESP, EU.FRA+EU.ITA and EU.FRA+EU.MLT.

It is possible to make rough approximations by grouping multiple States together into a minimum number of groups and analysing on this basis but the major players in the purse seine fishery often work together (in a number of JFOs) and many years the catch will be dominated by one such large super group of interconnected major fishing States. Due to these discrepancies in the way catches are reported, estimation of catches per flag is ambiguous and therefore, the analysis presented here has not attempted to produce estimates of total catches per country but instead, the results are presented as total catches per year.

2.1.4.4 Duplication in data recording

The coding system ICCAT uses to describe catch / transfer status for caged fish includes one code to denote fish that were transferred to cages ("C") and two more to denote fish that were ranged and harvested during or at the end of fattening period ("D", "E"). Given the datasets included these three identification codes, this could lead to duplication if records with identification code "C" were not excluded from the calculations when records with ID codes "D" or "E" are used. Therefore, all records assigned an identification code "C" were excluded from the original analysis of determination of removals (so, only ID codes "A", "B", "D", and "E", used). However, the results were also shown when the records for the wild fish plus those caged (i.e. records with status ID of "A", "B", and "C") were used to show the impact of using different sources of data on the final catch estimates.

Another source of double counting in catch recording is created by the different presentation forms recorded. To avoid potential double counting of fish where multiple presentation forms are available in the market, only primary products i.e. the majority of a fish carcass were used e.g. dressed ("DR") or gilled and gutted ("GG")". Secondary products such as belly meat ("BM") were excluded from the calculation of removals.

2.2 Assumptions

2.2.1 Assumptions characterising the input data

A number of important points and assumptions were noted during the preliminary consideration of the data in the 3 Forms (see Annex 6 and Bregazzi 2015). This includes:

- The focus of the 3 Forms is on the Eastern BFT stock; no information related to catches from the Western stock is included in the datasets.

- Catch data from the Japanese fishing fleets operating in NE Atlantic and Mediterranean Sea were not in scope for the three datasets provided.

- It has been assumed that the market data as sourced provide 100% coverage of all existing major Japanese fish auction market (21 locations). The coverage of all sales of BFT in those markets is high but not 100% as some fish might have not been sold through auction and may not have been reported in the auction register. It does not also equate to 100% coverage of fresh tuna from EU-fleet sent to Japan since it does not account for practices such as stockpiling and product not sold through a market.

- Form 1 dataset does not include auction records of BFT coming from the US as it focuses on Eastern BFT coming from EU.

The majority of assumptions were used to categorise fish included in Form 1; the assumptions used to develop the Form 1 dataset have already been presented to the SCRS and the resulting data have been validated by the Committee so, have also been adopted for the analysis presented here.

2.2.2 Assumption used in the analysis

A number of assumptions had to be made to fill gaps in the data and be able to produce estimates that would be compatible with the official catch statistics used for stock assessment. Those assumptions are covered in the sections below.

2.2.2.1 Fattening ratios

Our analysis included data of BFT that had been fattened before sent to the market. Therefore, conversion factors to calculate the weight when the individuals were caught were needed. ICCAT has considered a number of studies that aimed to produce fattening ratios but research in this topic is ongoing and widely agreed conversion ratios have not been adopted. We reviewed relevant literature for estimates that reflect current knowledge and past practice (see Annex 7 for a summary) and used that information to identify representative values and fish categories to use in our analysis (Table 7). Sensitivity runs were also done to reflect the variance in the values found in the literature.

The ratios in Table 7 were used to represent fish that have been kept for the entire fattening period and then harvested. However, some fish were harvested before the end of the planned fattening period (Catch status, Code D: Harvested during fattening session) and therefore, the fattening ratios in Table 7 are less representative of the weight they would have gained. Two assumptions were made about catch status (or lack if t) in each of the 3 Forms and the fattening process:

a. Fish recorded as ranched in Form 1 dataset are assumed to have gone through the full fattening session and therefore the ratios in Table 7 are used to calculate weight at catch. This is because Form 1 dataset does not provide information about catch status.
b. Fish recorded with status code D in Forms 2 and 3 were assumed to have gained only 50% of the total fattening weight they would have gained had they stayed in the cage for the entire duration of the fattening session.

Table 7 Increase in weight assumed for the conversion from fattened weight to weight at catch for ranched fish.

Category of fattened tuna	Base case - Increase in weight	Other values for sensitivity analysis
Fish above 70 Kg (market weight). Origin: Other than Croatia	30%	20%, 40%
Fish above 70 Kg (market weight). Origin: Croatia	100%	80%, 120%
Fish below 70 kg (market weight) Origin: Any	80%	60%, 100%

NB: For example, an increase of 100% means that the fish doubled its weight while in a cage. Source: See Annex 7

2.2.2.2 Conversion factors and missing weights

To ensure the best estimates of total removals from each data source the missing weight records have been estimated using average values where appropriate. In the first case for the Form 1 dataset, the missing values have been generated based on averages of round weight by year, flag, gear type and product shape, the round weights calculated using conversion factors by gear type (Table 8) found in ICCAT literature. Although a deterministic approach was used here, there is uncertainty characterising the conversion factors presented in Table 8. It should also be noted that records for the gear type "BM" – "belly meat" were excluded from this calculation as these were deemed to be inappropriate for raising weights. The raising is conducted in the project database via the function **`Convert_to_RoundWeight`**.

Table 8 ICCAT conversion factors for bluefin tuna to round weight

Product Shape	Conversion Factor	Source
Dressed	1.25	Anon (2003)
Fillets	1.67	Anon (2003)
Gilled and gutted	1.16	Unknown
Other	2.00	Anon (2003)

Source: ICCAT Conversion factors for fish products adopted by the SCRS for major species. https://www.iccat.int/Documents/SCRS/Manual/Appendices/Appendix%204%20V%20Product%20conversion%20factors.pdf

A series of database queries were then used to adjust the values based on the year-flag-gear-product based averages (Table 9).

A subset of the Form 1 dataset, however are also missing product shape. In order to provide an estimated weight for these values we have regenerated a set of averages based on the round weight for all product types given a year, flag State, and gear type. An additional series of database queries then are used to raise the values based on the year-flag-gear based averages where a weight was not already given or estimated (Table 10).

Table 9 Queries used to adjust missing weights based on year-flag-gear-product based averages.

Order	Query Name
1	Summary_F1_Adjusted_Weight
2	Summary_F2_Adjusted_Weight
3	Summary_F3_Adjusted_Weight
4	Summary_Compare_T2CE_F1_F2_F3

Table 10 Queries used to calculate round weights.

Order	Query Name
1	F1_Raised_ProductWeights
2	F1_Average_Weight_Working
3	F1_Average_Weight_Final

Order	Query Name
4	F1_With_Average_Weights
5	Update_F1_Missing_Weights_to_Average
6	F2_Raised_ProductWeights
7	F2_Average_Weight_Working
8	F2_Average_Weight_Final
9	F2_With_Average_Weights
10	Update_F2_Missing_Weights_to_Average
11	F3_Raised_ProductWeights
12	F3_Average_Weight_Working
13	F3_Average_Weight_Final
14	F3_With_Average_Weights
15	Update_F3_Missing_Weights_to_Average

2.2.3 Missing Numbers

When analysing the three datasets provided a number of records in each of the data sources were observed to have no counts of fish allocated to individual records, just a weight (kg) of bluefin tuna were recorded (see Table 11). These data could still be used without a number being recreated in calculations of estimated total removals. So, those records have not been excluded from the analysis.

Table 11 Missing number records by data source.

Error Flag	Number of records
F1MISSNM – Form 1 Missing numbers	0
F2MISSNM – Form 2 Missing numbers	110
F3MISSNM – Form 3 Missing numbers	1980

Source: ICCAT Trade and Auction Project Database - – Source Queries “ERROR_F1MISSNM”, “ERROR_F2 MISSNM” and “ERROR_F3 MISSNM”.

2.3 Data duplication

There is overlap in the time period covered by the three different datasets (Forms 1, 2 and 3) and that could create double counting issues between the data. In order to address this, the three datasets were cross checked to identify records that might represent the same fish catches across the three datasets. To do so, we checked for records that appeared in more than one of the three datasets and had identical identification codes for the following categories: flag, gear type, origin, product form, area, and year. This test showed that there were some records that appeared in more than one of the three datasets. Although we could not confirm whether those records do represent duplicate information we can calculate the bias that such records could create if we assume that they are not duplicates and therefore can be included in the calculations for the total catches in a given year. The approach we adopted to calculate potential bias is as follows:

- We identified all records that had the same identification code and appeared in more than one datasets.
- Grouped them based on the number of datasets in which they appeared, this created 4 possible combinations as a record could appear in all three datasets or in only 2 of the 3 ((3 combinations: Form1 and 2, Form 1 and 3, Form 2 and 3). This gave us a table with all records that could have a duplicate in another dataset.
- For each entry in the Table we looked at the datasets that included that set of codes and chose the one with the highest weight recorded to use as the reference weight (see example in Table 12)
- If there was a duplication, that catch weight would probably already include the catch weight recorded in the other Forms in which this combination of codes appeared. Therefore, if we assume that there is no duplication and take the sum across all Forms that could lead to overestimation of catches if those records are duplicates.
- We then found the sum of weights for that set of codes recorded in the other 1 or 2 Forms (depending on whether it appeared in 2 of the 3 forms or in all 3).
- That weight would be the extra weight we would add to the total annual catch if those records did represent duplicates.
- Therefore, we divided that weight by the total estimated annual catches (i.e. the sum of weight over all 3 or 2 forms in which that combination of codes appear) to get an idea of the magnitude of bias that inclusion of all records could introduce in the estimates of total annual catches.

The results as a proportion of the total catches for each year are shown in Table 13. Figure 1 also shows that there will be only a small difference in the total catch calculated using the three datasets if potential duplicates are removed except for years 2004-2007. The potential error for those 4 years is more than 75% therefore, it could add significant positive bias to the total catch estimates for that period and therefore, catch estimates for those years are not considered to be reliable. Including all records from the three datasets in the calculation of catches provides the most conservative estimate (i.e. that no overlap occurs) and that was the assumption we used for the base case scenario in our analysis. However, total catches were also calculated excluding the potential duplicate catches to capture the impact it will have on the estimates of total catches.

Table 12 An example of records in the 3 Forms that appear in more than one form and the bias that the inclusion of all records could introduce to the total estimated catches if those records with identical identification codes did represent the same catches.

FlagCode	Gear Code	Origin Type	Product Form	Year	F1 Weight	F2 Weight	F3 Weight	Potential duplication (t)
EU.ESP	TRAP	Wild	F	2006	5,830	994,620	**1,162,188**	1,000,450
EU.ITA	PS	Ranched	F	2005	331,537	626,117	**1,619,450**	957,654

NB: Numbers in bold indicate the Form that has the highest catches of all 3 forms for a potentially duplicate entry. The potential duplication is the sum of catches in the other two forms (or one form if the entry appears in 2 out of the 3 Forms)

Table 13 Potential total bias per year that duplicate records across the 3 Forms could create (before weight conversions were applied).

Year	Total potential bias per year (Kg)	Total estimated annual catches (Kg)	% potential bias if duplicates
2001	54,339	6,821,004	0.80
2002	523,932	6,990,316	7.50
2003	440,376	8,843,705	4.98
2004	861,347	5,694,079	15.13
2005	4,490,999	5,802,296	77.40
2006	5,783,167	7,173,810	80.62
2007	3,956,130	4,613,383	85.75
2008	2,325,568	27,221,298	8.54
2009	945,495	19,063,034	4.96
2010	328,498	8,435,709	3.89
2011	284,450	11,759,230	2.42
2012	100,348	11,852,947	0.85

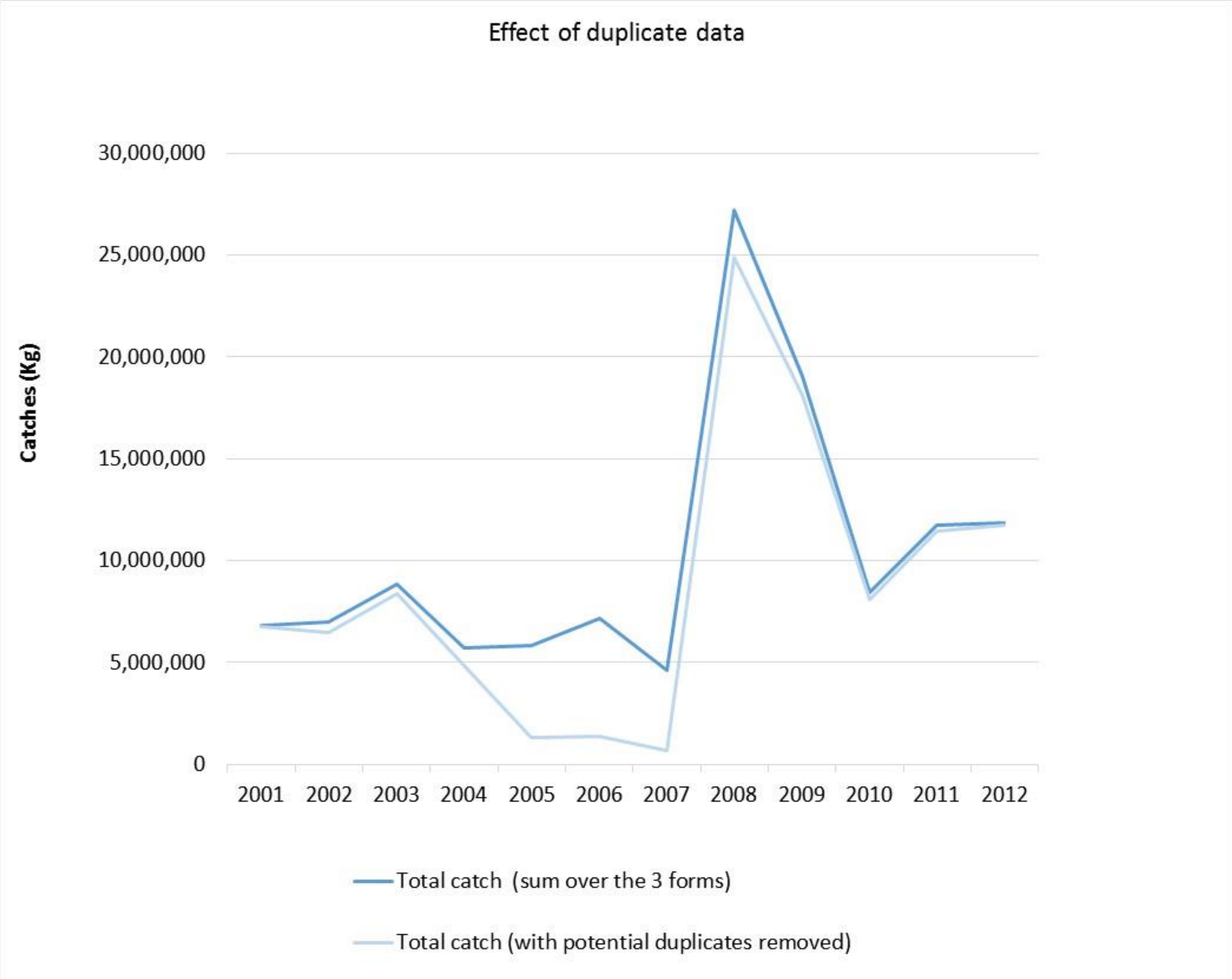

Figure 1 The effects of duplication of records across the 3 Forms on total catches (values are shown before weight conversions were applied). The sum over the 3 Forms to calculate total catches excludes catch records with status "C" to avoid duplication.

The sources used to develop Form 3 dataset could also have led to duplication of records within that Form. This is because the data for that Form came from 3 different sources and the records were not cross-checked to ensure that duplicates were excluded. To check for duplicate records within Form 3 we first looked at the year coverage provided by each of the 3 sources; this was as follows:

- ICCAT Biannual BFT statistical reports: 2004-2011
- ICCAT CoC reports: 2007-2008
- ICCAT BCD database: 2008 -2014

The information above show that duplication might occur for the period from 2007 to 2011 as that is the period that is covered by more than one of the 3 sources used. All records from that period were compared to each other to identify those that could potentially represent duplicate entries. The results show that the proportion of catches that might come from duplicate records is negligible (Table 14) except for year 2007 for which duplicate records might make up 11% of the total catches. In line with the previous calculations, these results also suggest that catch estimates for 2007 need to be treated cautiously.

Table 14 Potential bias in catch estimates from duplicate records in Form 3 for the years when duplication might have occurred (2007 – 2011).

Year	Potential duplicate catch records (Kg)	Total catch weight captured in Form 3 (Kg)	% of total catch from Form 3 that might come from duplicate records
2007	1,078,894	9,649,718	11 %
2008	527,966	24,400,847	2 %
2009	109,576	17,591,846	0 %
2010	0	8,069,333	0 %
2011	0	11,452,857	0 %

3 Results

3.1 General description of the database

Once unreliable records were excluded, the final version of the database containing the 3 datasets included more than 280,000 records covering years from 1995 to 2014 (Table 15). However, the number of records for some of the years (1995 -1998, 2014) is very low and therefore, are not considered to be representative of the magnitude of the fishing activity in those years and thus, our analysis did not cover them. Similarly, the records for years 1999, 2000, 2012, and 2013 are relatively low so, results for those years should be treated with caution.

Table 15 Number of records for each year and dataset (Form 1, 2, or 3) held in the clean database.

Year	Form 1	Form 2	Form3	Total	% contribution to total number of records
1995		77		77	0.0%
1996		28		28	0.0%
1997		244		244	0.1%
1998		1,812		1,812	0.6%
1999		5,841		5,841	2.1%
2000	2	10,471		10,473	3.7%
2001	9,431	23,141		32,572	11.6%
2002	14,637	26,480		41,117	14.7%
2003	30,237	16,516		46,753	16.7%
2004	21,589	7,122		28,711	10.2%
2005	21,336	6,112	59	27,507	9.8%
2006	14,974	668	733	16,375	5.8%
2007	8,382	444	670	9,496	3.4%
2008	11,402	72	2,863	14,337	5.1%
2009	13,777		5,346	19,123	6.8%
2010	3,343		5,170	8,513	3.0%
2011	3,398		5,561	8,959	3.2%
2012	1,041		4,028	5,069	1.8%
2013			3,301	3,301	1.2%
2014			14	14	0.0%

3.2 Representativeness of datasets

3.2.1 Length classes

The database entries that included weight information (i.e. weight had been recorded for that entry) were used in conjunction with the length-weight relationship proposed for the EBFT[1] to explore the range of lengths represented in the catch records. Specifically, only Form 1 dataset

[1] RWT = $(1.9607 \times 10^{-5}) \times (SFL)^{3.0092}$ with FL > 100 cm (Arena, unpublished) Mediterranean, https://normativapesquera.files.wordpress.com/2013/10/length-weight.pdf

was used as this contains single record data specific to individual fish and we can therefore be confident that length data are for a single fish.

The length weight relationship was used to directly convert the reported weight into fish length for all wild caught fish. For farmed fish, the recorded weight was first converted into the round weight at catch before calculating the corresponding length. We only used data from 2001 onwards because although the Form 1 dataset has some records for 2000 these are not great in number and therefore records from 2001 onwards have been used.

The converted values covered a wide spectrum of fish lengths spanning from very small fish (approx. 80 cm FL and less than 20 kg) to fish of more than 2.5mm FL (Figure 2) providing a very good representation of the entire lifespan of BFT from immature fish to older adults. Plotting the length frequency of the catches for all years covered in the database also highlighted some picks in length frequency for fish of length between 115 and 150 cm and between 170 cm and 220 cm.

The picks for catch years 2002-2005 in the area covering lengths 170 cm to 220 cm are particularly distinct showing a normal distribution moving to the right in the length axis and could reflect a single cohort exploited over those 4 years as the lengths of the individuals in that cohort increase (Figure 3). A similar pattern was also created by the length frequency data from catch years 2002 and 2003 for fish of length of less than 150 cm but the normal curve seems to disappear after those 2 years. This could also reflect a single cohort exploited over consecutive years but could also be partly due to changes in fish patterns; for example, it has been suggested that small fish were targeted for a limited period in the early 2000s as part of an experimental fishery (Di Natale et al 2016).

These results suggest that there might be preference for certain length classes and also point to a shift to focusing on smaller fish (<=160 cm) in the recent years (Figure 4). In particular, the maximum of the length frequency distributions from the last 5 years (2008 to 2012) covers fish lengths of 100 to 160 cm with a much smaller sample obtained for larger fish sizes.

It should be noted that the conversion from weight to length used only one equation to cover the entire spectrum of weights/lengths represented in the catch records instead of the two often used to describe the growth of EBFT. That makes this approach less detailed but it is not expected to change the high level picture and patterns presented here.

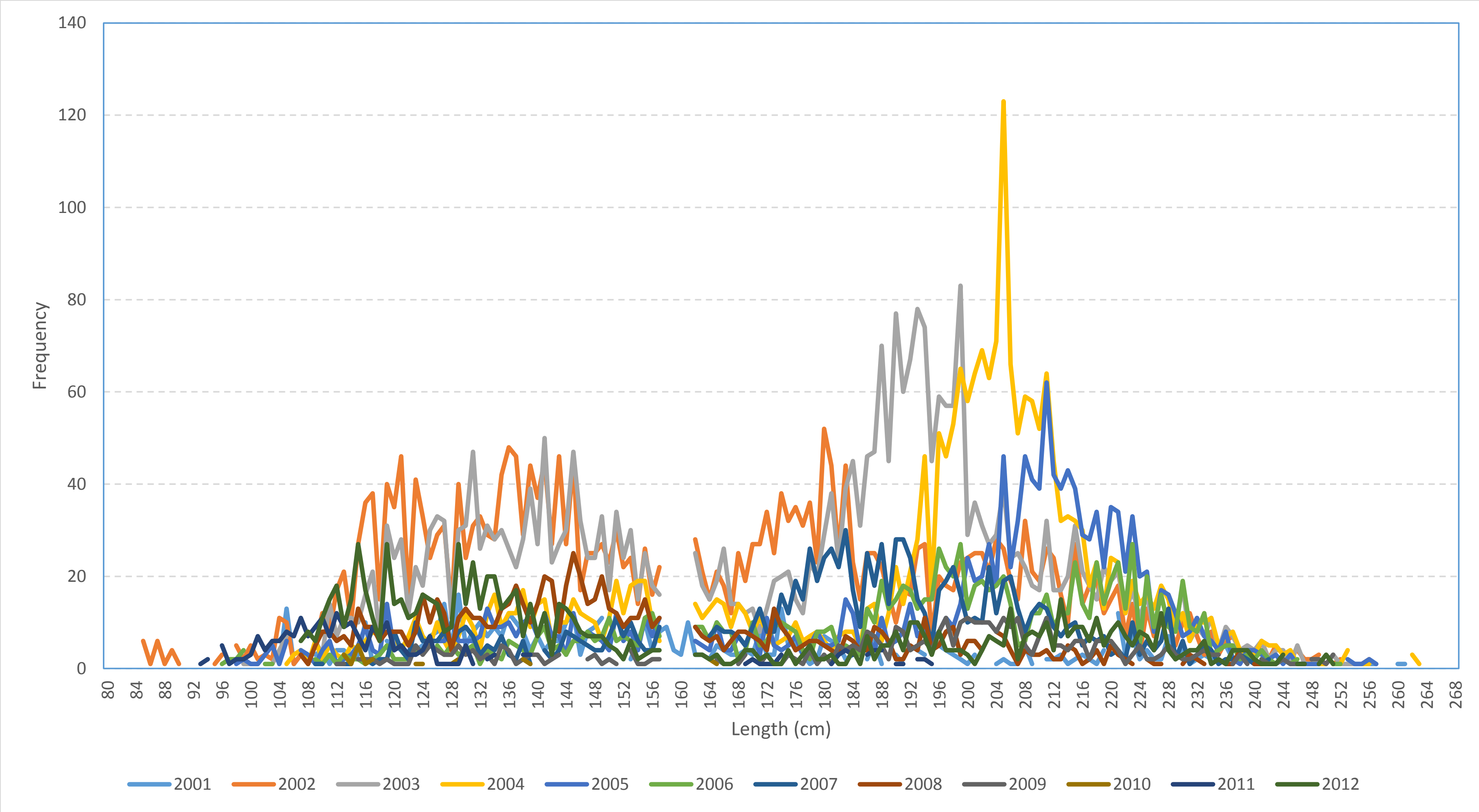

Figure 2 Length frequency of bluefin tuna as reported on the Japanese auction market (2001 - 2012). Note that for ranged fish, the length shown here corresponds to their catch length not the length at sale.

Source: Form 1 dataset.

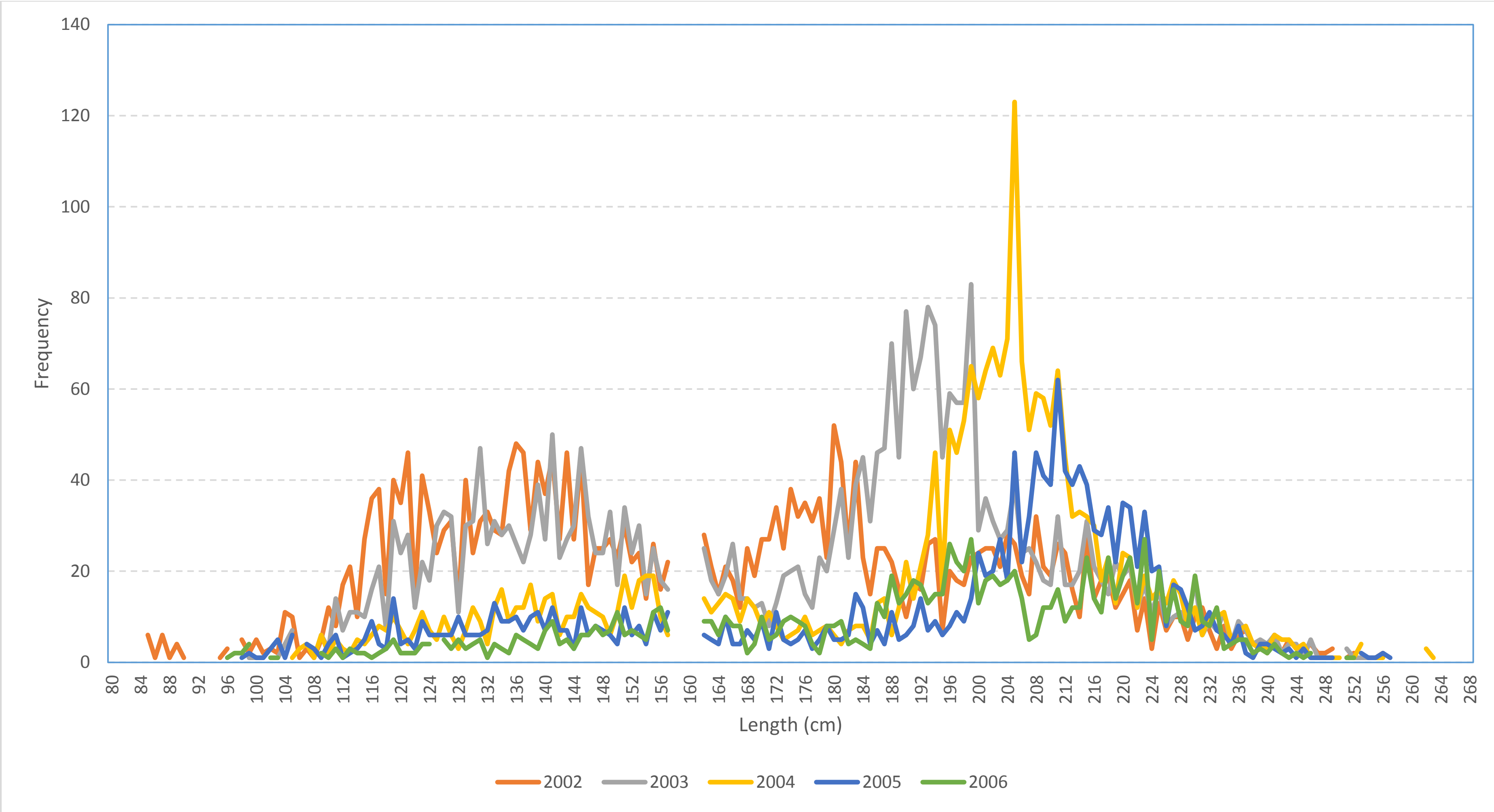

Figure 3 Length frequency of bluefin tuna as reported on the Japanese auction market (2002 - 2006). Note that for ranged fish, the length shown here corresponds to their catch length not the length at sale.

Source: Form 1 dataset.

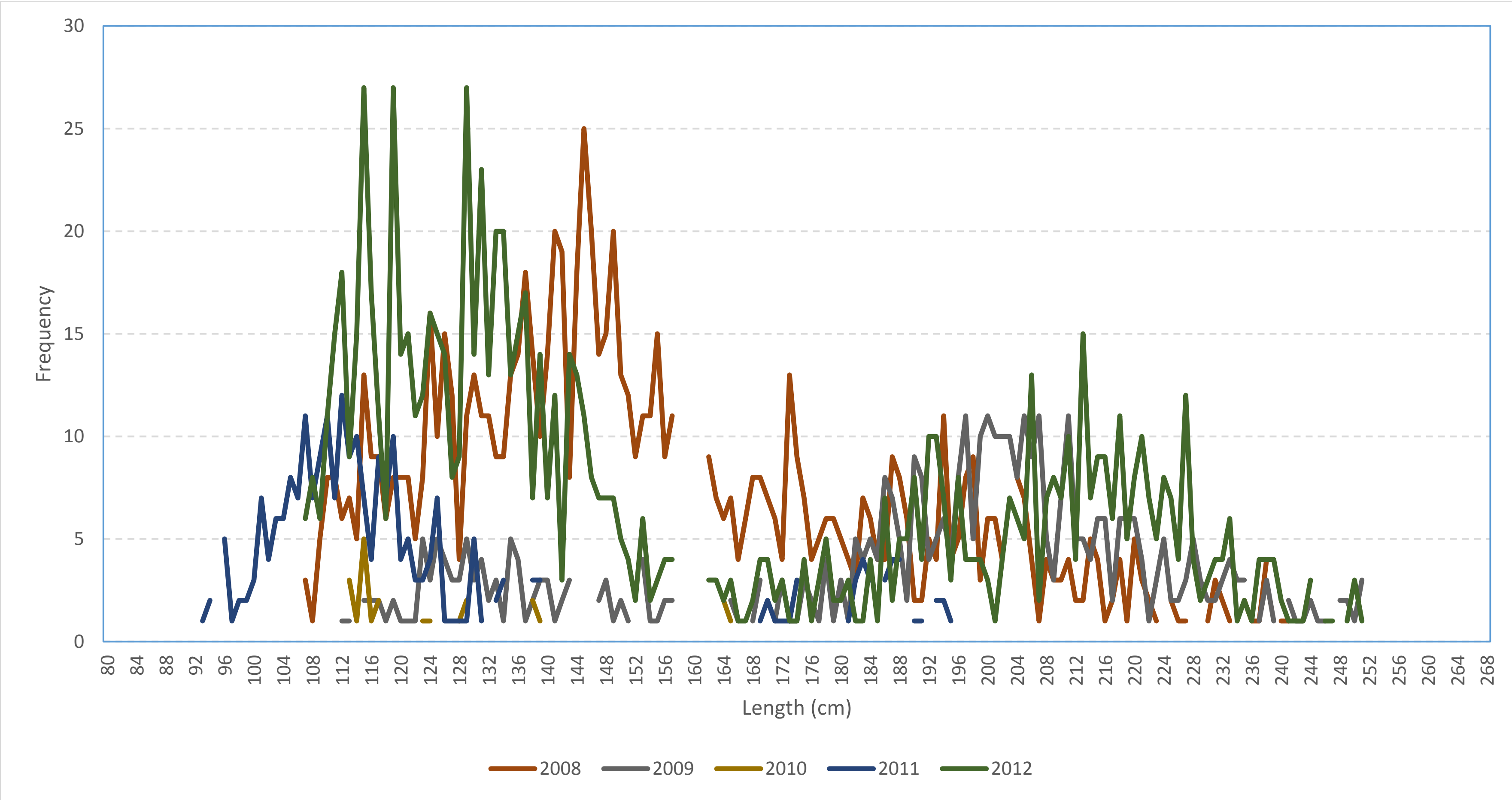

Figure 4 Length frequency of bluefin tuna as reported on the Japanese auction market (2008 - 2012). Note that for ranged fish, the length shown here corresponds to their catch length not the length at sale.

Source: Form 1 dataset.

3.3 Total catch estimates – Base case and alternative dataset

Data from the clean database described in the previous section were used to calculate total catches in each year. As mentioned earlier, although data were available for as early as 1995, we only used data from 2000 onwards for the estimation of catches since there was a small number of records included in the database in previous years and it was only provided by one of the 3 Forms. The results of the analysis using the base case assumptions for fattening ratios and data duplication are shown in Figure 5 for the case in which data for ranged fish come from the post-fattening records (catch status ID of “D” and “E”).

The catches estimated from the 3 Forms are below those shown in Task I but estimates of catches in recent years are very close to the official statists and also show the same trend.

As the results show, the catches calculated from the database for years before 2008 are considerably lower than the reported catches and that is probably due to records missing from the 3 Forms so, they underestimate catches.

The results shown in Figure 5 are considered to present an underestimate of the catches for another reason; this is because we have used the records from the post-fattening period to calculate the catches that went into tuna farms. That does not account for fish that died during the fattening period or for any missing BCD records describing the harvesting phase. This is in addition to gaps in describing the fishing activity that are due to the fact that, for certain years, the available data only cover the Japanese auction market and/or fishing carried out by European nations (including Mediterranean countries).

To explore the effects of using post-fattening records, we also estimated total catches using the records for wild fish sold to the market (Catch status code “A” and “B”) and records of fish that went to farms (pre-fattening estimates, catch status code equal to “C”). The results of the calculations are shown in Figure 6. The patterns are similar with those found under the base case with total estimates remaining lower than the Task I data for most of the years considered except in 2008 and 2010. Given that catches in the 3 Forms are expected to be an underestimate, these results suggest that total catches might be higher than what reported in Task I data for some of the recent years.

A significance difference is also found for 2007 for which the inclusion of data for fish that were sent for fattening reveal a significant number of fish caught that are not reflected in the post-fattening records. As discussed later in the report, a mismatch between estimates of fish that went for fattening and those that came out has been found for a number of records and the results for 2007 also reflect that.

Form 3 which represents data from official Member State records makes the biggest (or only) contribution to the estimated catches from 2008 onwards for both set of calculations. The catches coming from that dataset are very close to those from Task I for recent years; this suggests that the official datasets/reports included in Form 3 dataset provide a good representation of total catches. As those reports and datasets are available to ICCAT, they could be used in the future to cross check Task I data.

It should be highlighted that a number of uncertainties characterise the results presented here; for this reason, the analysis also included calculations using different assumptions about parameter values to explore the sensitivity of the results to alternative parametrisations. The results of the calculations are presented in the following sections.

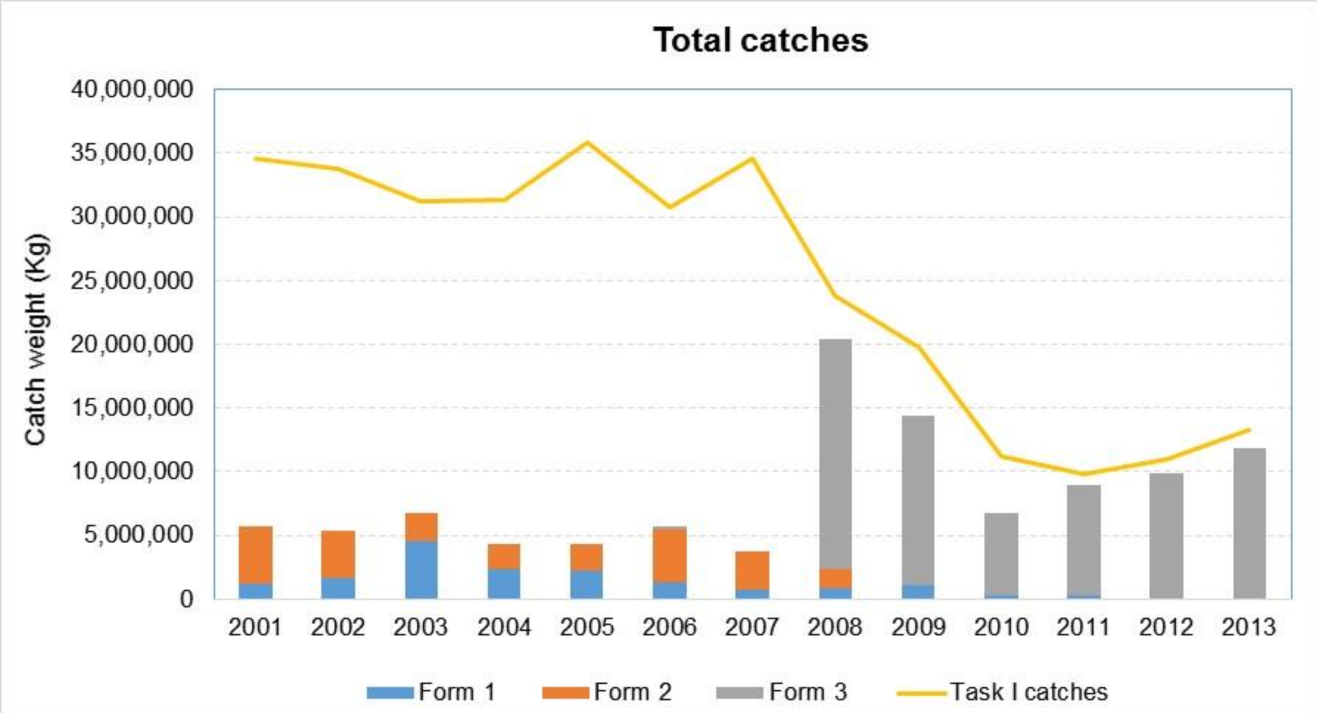

Figure 5 Total reported catch (Task I) of BFT compared to estimated values when the post-fattening records are used to calculate catches of fish that were ranged.

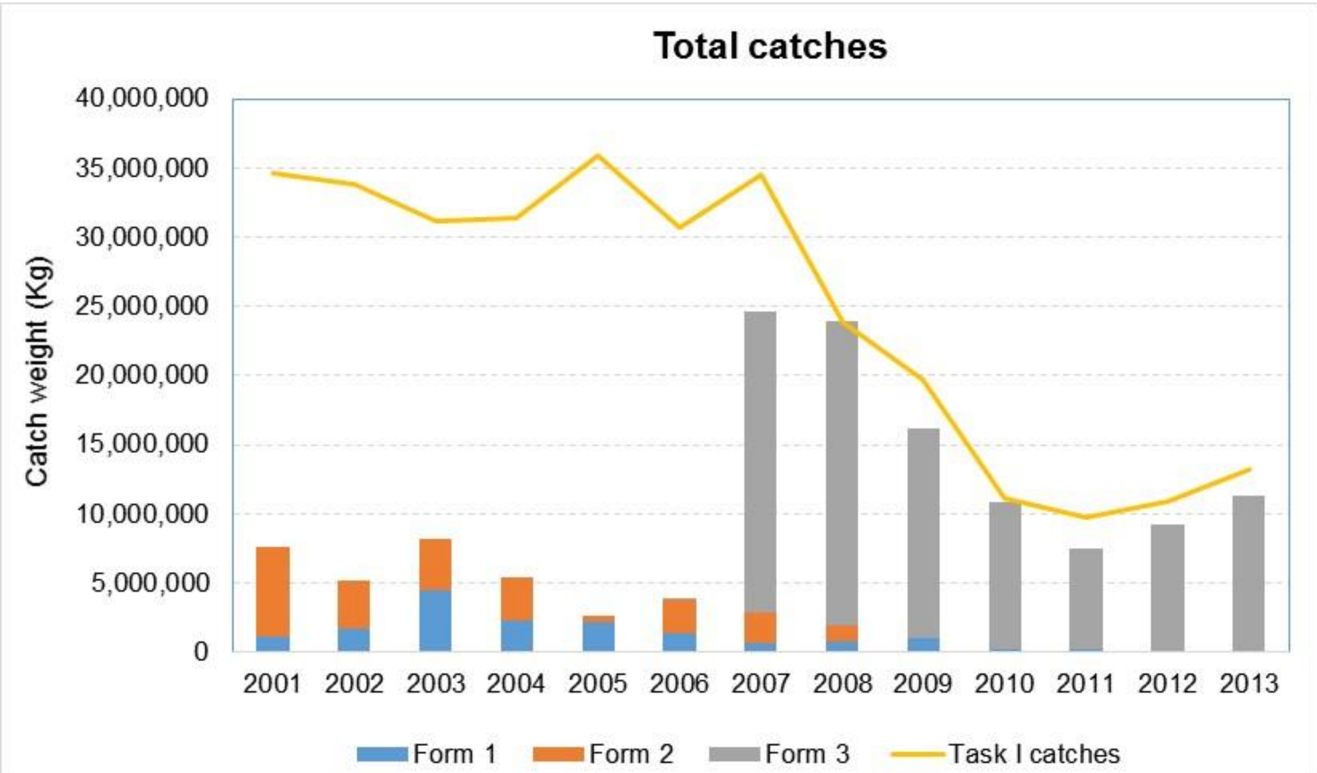

Figure 6 Total reported catch (Task I) of BFT compared to estimated values when the pre-harvesting records (catch status "C") are used to calculate catches of fish that were ranged.

3.4 Impact of assumptions and gaps filling

As described in the analysis section, a number of assumptions had to be made to address issues relating to gaps in the information in the Forms such as missing catch weights, duplicate entries across the 3 datasets and the need to account for fattening effects. This section considers some of the main sources of uncertainty and their effects. These results are presented using records for wild fish and from post-fattening events (catch status “A”, “B”, “D” and “E”) and as already discussed, might be underestimates of total catches.

3.4.1 Assumptions about fattening

Different fattening ratios were assumed in the analysis depending on the final weight of the fish and their origin. However, there is considerable uncertainty about those ratios and in addition to that, there are no direct data confirming that the allocation of fish to the chosen fattening group was the right one. To explore the impact that our assumptions could have on the total catches we did sensitivity analysis for two components:

a) Did the calculations using values for the fattening ratio that were either higher or lower than the one applied for the base case (Table 7)

b) Calculated the contribution that each sub group of fattened fish (over 70 kg non-Croatian, under 70 Kgs, over 70 Kg Croatian farms) makes to the total weight of fish that was recorded each year to understand the potential impact that assigning fish to the wrong fattening group could have.

For the latter, the proportion of total catch weight that corresponds to each fattening group is shown in Table 16. To calculate these values we used the final weight of the fattened fish before any fattening ratios were applied to avoid adding bias that could come from the application of those ratios. The results show that ranched fish that weigh more than 70 Kgs and come from non-Croatian farms make the biggest contribution ranging from 30% to more than 70% of total catches.

This group has the smallest fattening ratio (increase in weight between 0.2 and 0.4) which means that their pre-fattening weight is assumed to be very close to its final one so, the total weight it will contribute to the total catch using the pre-fattening weight will be even higher than the one shown in table 16. This is because the weight of the other 2 groups of ranged fish will be reduced more than this one.

Therefore, if the assumption we have made about the fattening ratio of the Ranched >70 Kg group is not correct it will add positive bias to the final estimate of total catches. This means that our results will support total catches that would be greater than the actual catches.

With that in mind, the sensitivity analysis calculated total catches using

- the additional fattening ratios as shown in Table 7 (sensitivity values)
- or assuming that all fish in the Ranched >70 Kg (Non-Croatian farms) category had the same fattening ratios as the fish in the Ranched <70 Kg category.

The results of the calculations (Table 17 and Figure 7) are very similar to those under the base case scenario indicating that errors in the fattening ratio adopted do not affect the outcomes significantly. Estimates for recent years remain very close to those in Task I data suggesting that either the 3 datasets present an almost complete set of catch data for that period or, if they are still an underestimate, that Task I data also underestimate total catches.

Table 16 Contribution that each sub-group of fattened animals make to the total weight of catches recorded each year. The contribution is shown using the final weight of fattened fish (i.e. without the conversion to calculate their weight at catch).

Catch Year	RANCHED - < 70kg Non -Croatia	RANCHED - > 70kg	RANCHED > 70 Kg Croatia	WILD
2001	10.4%	51.4%	0.2%	38.0%
2002	25.9%	52.1%	0.3%	21.7%
2003	10.1%	75.0%	3.3%	11.6%
2004	16.3%	71.0%	0.1%	12.6%
2005	15.2%	69.4%	4.2%	11.2%
2006	11.6%	66.7%	1.4%	20.2%
2007	25.2%	30.5%	0.5%	43.8%
2008	16.1%	55.5%	9.8%	18.6%
2009	18.0%	55.3%	8.0%	18.8%
2010	24.2%	39.7%	0.0%	36.0%
2011	10.2%	48.1%	17.2%	24.6%
2012	8.0%	56.5%	0.0%	35.5%
2013	3.8%	65.8%	0.0%	30.4%

Table 17 Estimated values of total catches (kg) under different assumptions about fattening ratios when the post-fattening records are used to calculate catches of fish that were ranged.

Year	Base case	Lower estimates	Higher estimates	Lower estimates with higher fattening ratio for Ranched > 70 Kg fish
2000	2,476,481	2,624,444	2,350,121	2,006,760
2001	5,690,095	5,964,905	5,457,381	4,900,452
2002	5,341,683	5,701,038	5,040,692	4,463,357
2003	6,785,728	7,285,432	6,361,202	5,314,524
2004	4,352,161	4,675,051	4,078,937	3,438,290
2005	4,361,485	4,693,998	4,080,455	3,441,588
2006	5,653,788	6,022,768	5,340,898	4,583,194
2007	3,760,171	3,932,376	3,617,227	3,394,091
2008	20,455,362	21,876,467	19,260,405	16,860,451
2009	14,347,403	15,345,395	13,508,872	11,836,218
2010	6,751,438	7,108,487	6,453,522	5,921,668
2011	8,914,048	9,471,573	8,445,290	7,548,250
2012	9,885,786	10,380,935	9,465,141	8,402,332
2013	11,884,497	12,525,751	11,337,006	9,842,484

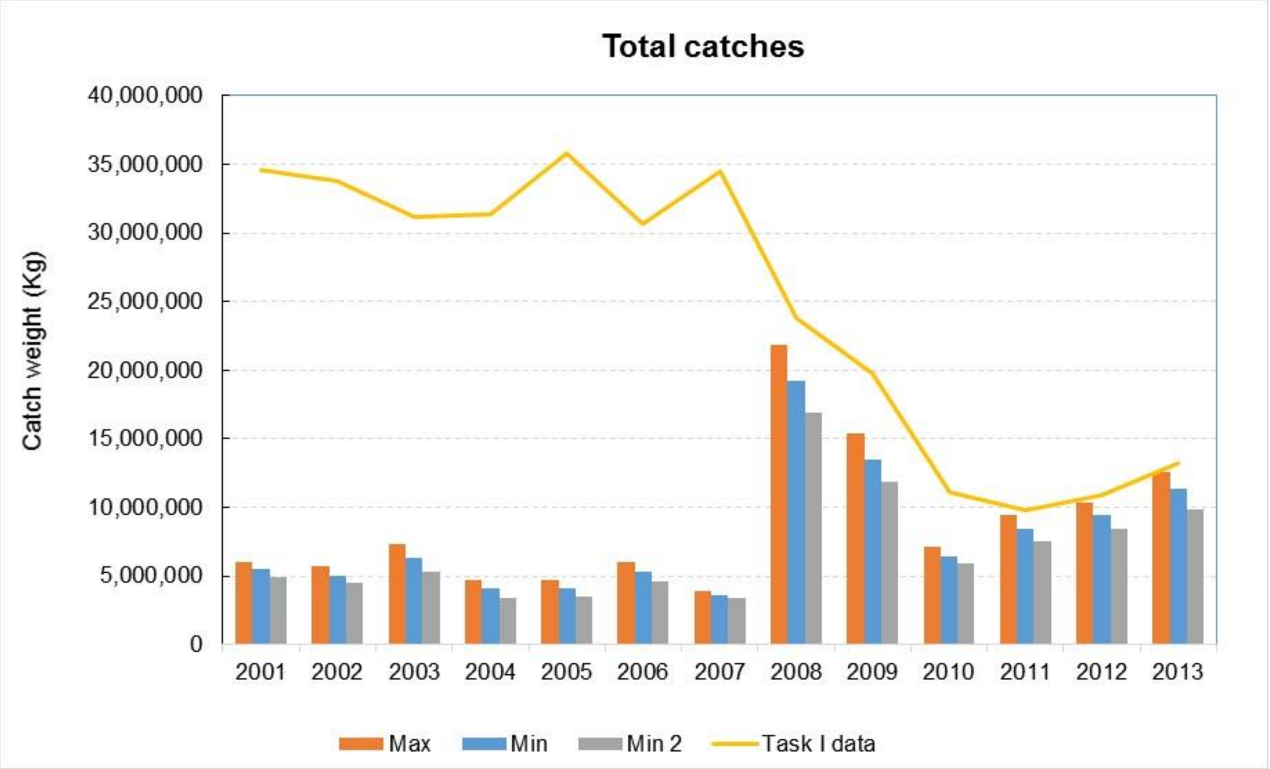

Figure 7 Minimum and maximum estimates of total catches for different assumptions about fattening ratios. Min and max denote estimates when the alternative fattening ratios shown in Table 7 (other values) are used. Min 2 assumes that all fish above 70 Kg have the same fattening ratios as fish below 70 Kg from non-Croatian farms.

3.4.2 Missing data on catch weight

As mentioned earlier, a number of records in the 3 datasets did not have information about the weight of the catch. To address this, the weight information was filled using average weight estimates that were calculated using information from records with similar attributes (e.g. year, flag). However, this is another source of uncertainty and therefore, the analysis considered the contribution that those records make to the total catch estimates (Table 18). The results indicated that a considerable proportion of catches for years before 2008 is made up by records that are missing weight information. Therefore, if the average weight calculated here does not represent the catches for these records this could add bias in the calculations. Further work to identify additional information that might help calculate the weight for those records with more accuracy will therefore, improve the robustness of our estimates but it is not expected to change the overall picture as it does not affect the results for recent years.

Table 18 Contribution of records with missing catches to total catch estimates

Harvest Year	% catches calculated using average weight
2000	0.48%
2001	4.69%
2002	11.09%

Harvest Year	% catches calculated using average weight
2003	**25.04%**
2004	**28.64%**
2005	**77.71%**
2006	**78.99%**
2007	**62.99%**
2008	1.11%
2009	1.02%
2010	0.25%
2011	0.21%
2012	0.03%
2013	0.00%

3.5 Examples of discrepancies and unusual patterns

A number of factors and tests were run to identify records that might need to be excluded from the final database and also in an attempt to cross reference records within datasets. As part of that work, we have identified a number of records that produced unusual patterns. Here we demonstrate some examples that provide further insight into the type of behaviour the data analysed highlighted and possible uncertainties they can introduce in the analysis. Although a flag-specific estimation of total catches is not provided here, this section also touches on Member State - specific observations that could be made using the 3 datasets considered in the analysis.

3.5.1 BCD repetition and number of fish caged compared to harvested

A number of specific BCDs recorded in the Form 3 dataset appear to have been used a number of times (those with 5 records or more are shown in Table 19). There also are a number of historic BCD records where the number of fish caged and harvested do not correspond. A number of records show a difference of ±50% of the harvested number of fish.

As an example, BCD IT-08-000-003 from 2008 has 8 records (1 caging and 7 harvest). Under this BCD, 1300 bluefin tuna of an estimated weight of 100,000 kg were caged. From this, over the next 7 months, 745 fish were harvested (approximately 119,000 kg), leaving 555 estimated fish unaccounted for.

Table 19 BCDs used several times.

ICCAT Ref # or BCD	Trade Doc Type	Record Count
MA-08-008-003	BCD	23
LY-08-000-146	BCD	18
LY-08-000-008	BCD	14
HRV-08-134-003	BCD	12
LY-08-000-147	BCD	10
IT-08-003-008	BCD	8
IT-08-000-003	BCD	8
LY-08-000-009	BCD	7
HRV-08-134-004	BCD	7
MA-08-008-001	BCD	6
IT-08-005-008	BCD	6
LY-08-000-145	BCD	5
FR-08-017-701	BCD	5

Source: Form 3 dataset.

If we assume that all BCD records for a specific BCD are captured in Form 3 dataset then such difference could mean that either fish were underestimated entering the cage (either at the initial caging or through a subsequent transfer) or fish had been removed from the cage (either harvested or transferred) and not recorded on a BCD.

The discrepancies in the number of fish caged and those harvested for each BCD can be seen in Figure 8 where if data were correct the individual data points should sit around or just below the 1:1 ratio line to account for minor errors in reporting or mortality seen during the period of caging. However a number of records can be seen both above the line indicating the 1:1 ratio, i.e. more fish have been taken out of the cage than were caged in the first place and significantly below the line indicating that fish were caged but no record of harvest exists. These discrepancies could also mean that the datasets analysed did not contain all relevant BCD records but it was not possible to check that in the context of this project.

Some records also show considerable duplication; this can be seen at the group of data points to the bottom right hand corner of Figure 8 that all show an identical number of fish entering a number of cages but the total number did not enter each cage, causing a discrepancy on the balance for each of the cages. The consistency in the pre and post-harvest records is better for the more recent years and this could be due to the introduction of the observer programme (in 2011 after the pilot programme in 2010). As shown in Figure 9 there is a reduction in data points in the negative percentage since 2011. The negative percentage suggests that many more fish came out of the farm than those originally reported going into the farm. However, a number of records in the datasets still represent fish going into the cage with no records of their harvesting.

As mentioned already, our base case analysis did not account for records with catch status "C" which shows the number of fish going into the cage; instead we used the weight records of the fish once they have been harvested as we considered this to be a more accurate depiction of the catches. However, as a number of BCD records show a much greater number of fish going into the cage than that coming out, it is possible that the catch estimates used in the analysis for those BCDs is an underestimation of the actual catches.

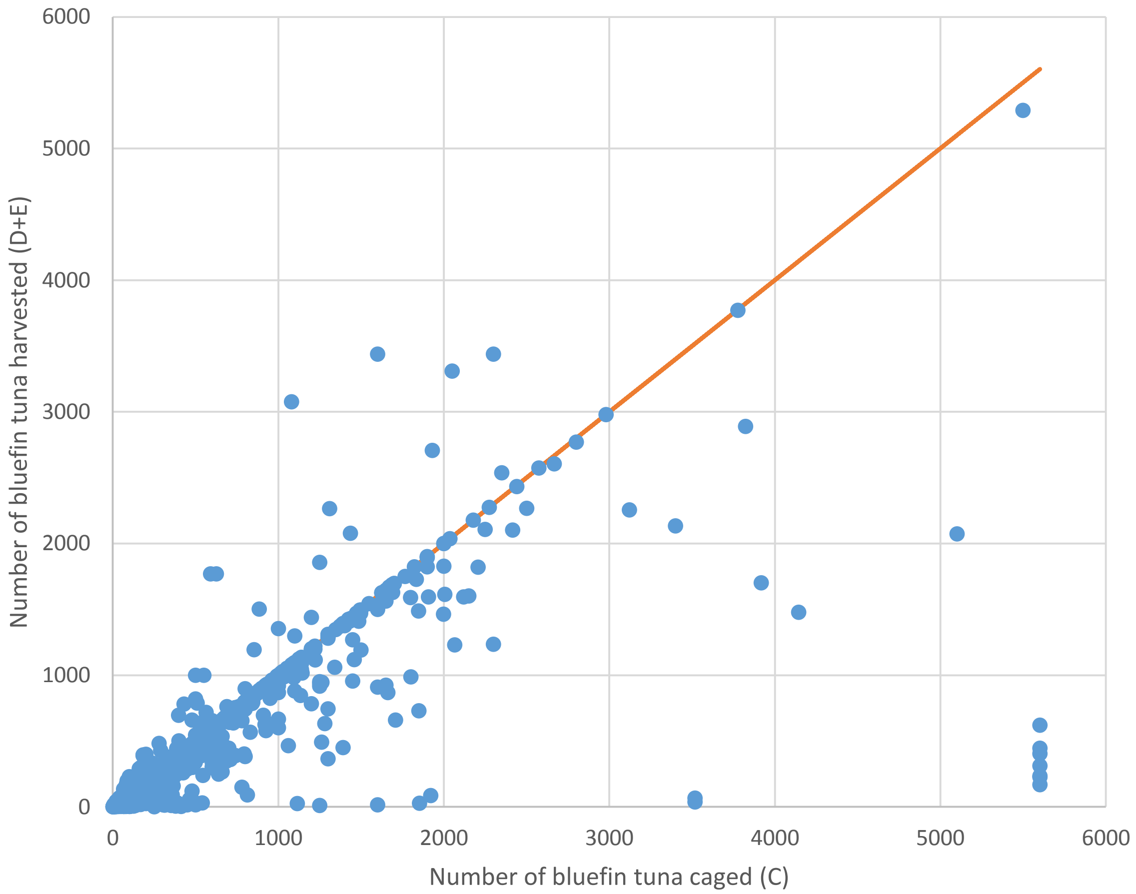

Figure 8 Comparison of BCD records of the number of bluefin tuna caged versus number of bluefin tuna harvested.

Source: Form 3 BCD records.

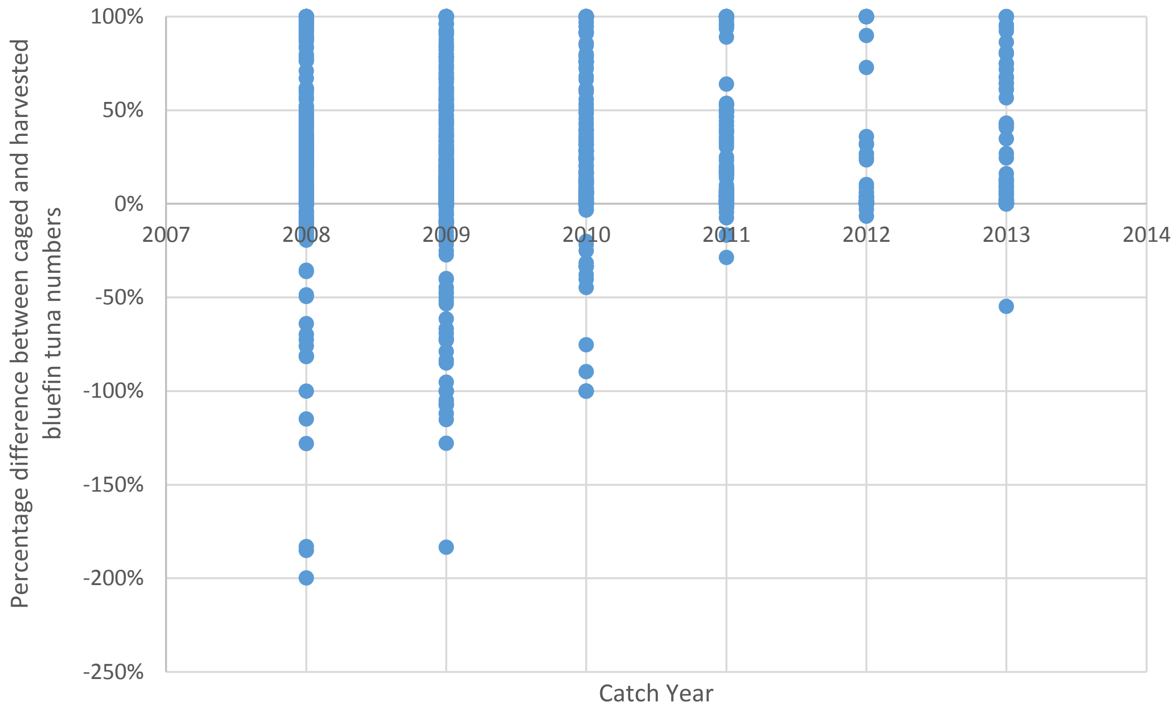

Figure 9 Percentage difference between caged and harvested bluefin tuna numbers (2008-2013).

Source: Form 3 BCD records.

3.5.2 Consistency in data reporting.

A comparison of the total weight of bluefin tuna catches per flag reported under Task I against the Form 3 dataset which includes statistical and BCD data show a wide range of consistency in reporting. Mainly, the estimates from Form 3 are less than Task I catches but some records show catches that are higher than their equivalent in Task I. An example of those findings is shown in Table 20 for the Italian longline fishery. The catches reported under Task I for that fishery are higher than the estimates from Form 3 except for year 2009 and 2013 for which the catches estimated using the dataset are higher than the Task I catches.

Table 20 Comparison of official catches (Task I) to estimated catches for the Italian longline fleet

Year of Catch	Flag Code	Gear	Task I Reported Catch (kg)	Form 3 – Catch (kg)
2008	EU.ITA	LL	215,618	28,107
2009	EU.ITA	LL	193,204	227,729
2010	EU.ITA	LL	520,542	291,763
2011	EU.ITA	LL	669,516	223,899
2012	EU.ITA	LL	256,351	137,684
2013	EU.ITA	LL	180,384	194,958

Other examples show reported catches in the documents included in Form 3 but there is no detailed reported Task II catch and effort data and only limited Task I data, (see example for the Egyptian purse seine fishery in 2011 in Table 21). This clearly shows a mismatch between Task I / Task II catch reporting and the statistical reporting captured in Form 3. It is also highly unlikely that these catches were made in the previous year as no records exist for 2010.

Table 21 Comparison reported data (Task I, Task II and statistical sources) for Egyptian purse seiners in 2011.

Flag	Area	Gear	Year	Source	Catch (kg)
Egypt	MED	PS	2011	Task I	No data
				Task II	No data
				Form 3	207.04

The reporting of catches from joint fisheries operations (JFO) as combined fishing entity codes (e.g. EU.FRA+EU.ESP) adds another degree of complexity as these catches can only be effectively estimated by merging the data submission from all members of the combined operations to understand the overall level of reporting.

4 Conclusions

A number of different data sources were explored through the analysis of the 3 new datasets made available to ICCAT. The results show that those additional sources could offer alternative ways to verify the catch data used for stock assessment. In particular, the estimated catches were very close to official statistics (Task I) for the most recent period and that could mean that the new datasets reflect total catches in recent years very well. However, if we assume that the records in the 3 Forms do not capture all catches, these findings might also suggest that Task I data underestimate catches.

Gaps in the data included in the 3 Forms were created by a number of issues including the fact that data did not cover Japanese vessels operating in the NE Atlantic, or mapped the volume of catch that went to markets other than the Japanese auction market, or could be missing some of the BCD records.

Although the analyses produced total catch estimates per year, it was not possible to achieve disaggregation at flag level. This is because catches in joint fishing operations are reported in an aggregated format not per single country so, catches per flag cannot be calculated. In future, we would recommend reporting be modified to ensure all reporting is linked to a specific vessel and single fishing entity.

Important gaps in the data such as missing weights mean that there is considerable uncertainty in the estimated catches and the same is true for problems with the use of BCD records. These inconsistencies in data reporting reduce the potential of these datasets in generating accurate estimates of removals especially in early years. Sensitivity analysis showed that there is significant uncertainty characterising estimates for years before 2008 but recent catch estimates are much more robust.

Despite the data gaps and uncertainty in the findings, the analyses provides an insight into the value of considering multiple sources of data in calculating total catches and highlights potential avenues for getting additional data.

5 Recommendations for future work and further use of data

The analyses presented in the previous sections highlighted a range of issues that could be explored and informed by the data included in the 3 forms and also provides an insight into the value of combining and using data from different sources. Some of the additional analysis and use of these data and data of similar type are discussed below. Similarly, the analysis identified weaknesses and limitations that characterise the dataset and considered possible implications for using this data to produce catch estimates. We have built on that knowledge to provide recommendations for work that could address some of the gaps or weaknesses to increase the robustness of the dataset.

5.1 Additional analysis

- The amount of records that were missing weight information was considerable and that requires further exploration to characterise the associating uncertainty possibly using estimates of variance coming from the calculation of average weights where possible.
- It is also worth considering other sources that could provide further insight into growth rates over time for fish in farms to assess whether better estimates could be used for the calculations in this analysis.
- The analysis highlighted important discrepancies between the number of fish that were reported caged and the corresponding number that was harvested from the same cages. Further examination of the reasons that have led to those high discrepancies could provide useful insight to improve recording of ranched fish in the future.
- As BCD records show a much greater number of fish going into the cage than that coming out for a number of BCDs, it is possible that the catch estimates used in our analysis for those BCDs is an underestimation of the actual catches. Further work to identify combinations of records in catches with status C or catch status D and E that better represent the caging operations will improve the level of accuracy from that part of the dataset.
- Problems arising from the way in which catches from joint fishing operations are recorded mean that this analysis did not produce total catch estimates per country as it is not straightforward to allocate catches from joint operations to individual Member States. Further analysis of the data could be done to consider possible assumptions and methodologies for splitting the catches shown in the Forms and provide catch estimates per flag for each year.
- BCD records in Form 3 did not include processed weight (only round weight); information on round weight and processed weight could be used to verify/update relevant conversion ratios if such information become available.
- A full mapping of traps and farm operations against the official records held by ICCAT was not done as part of this analysis because the naming and ID of traps, farms and cages is often unclear (e.g. ID does not match official ID, names vary with year, etc). A way to address this issue is to manually correct and replace the names that appear in the 3 Forms with the corresponding official ID. This will provide another level of cross-referencing to check the completeness of the data in the 3 Forms.

5.2 Work to validate the data through third party sources

- Trade and other databases can be used to cross reference the data in the 3 Forms; this could include Eurostat (Comext), GTIS (IHS Markit), customs data (e.g. Japan customs), and official auction records from the Japanese market
- Official trade data from the US could also be used to get estimates for the amount of BFT that went to the US[2] to complement the catch estimates that the data from the Japanese market gives.

[2] http://www.st.nmfs.noaa.gov/commercial-fisheries/publications/index

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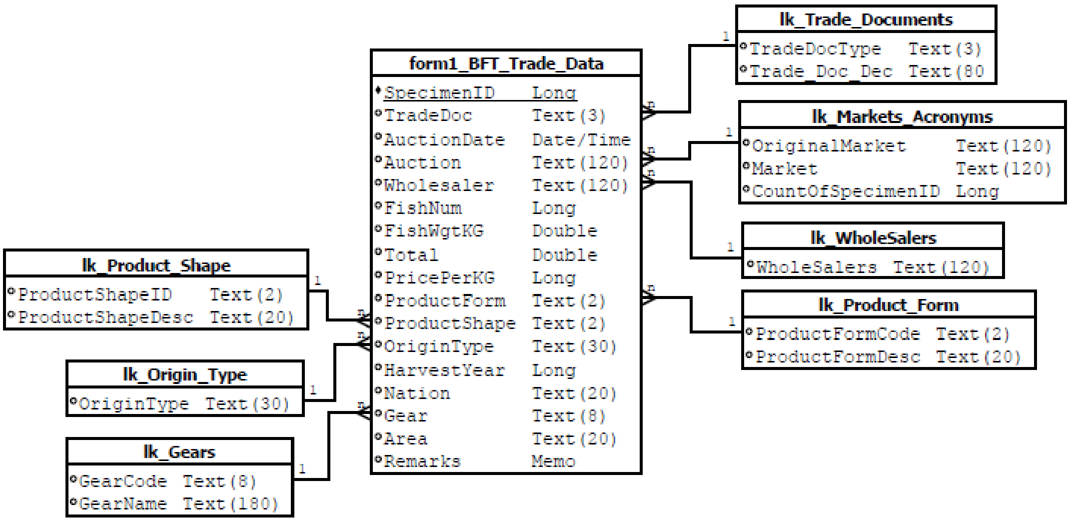
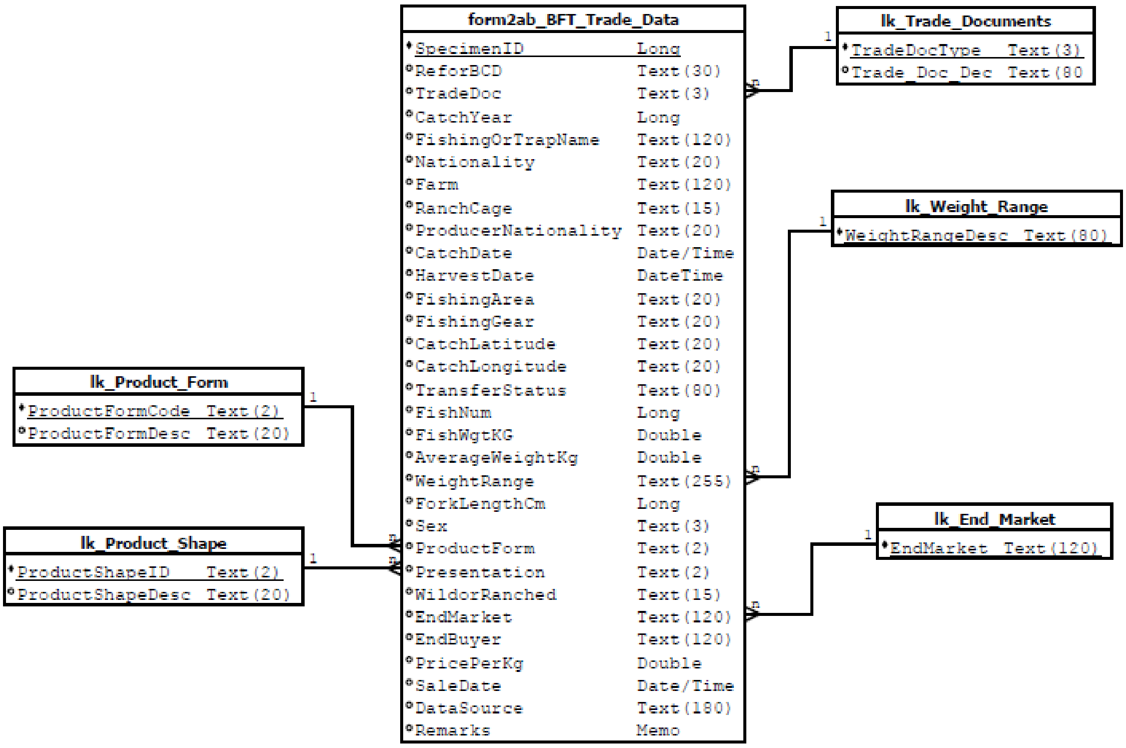
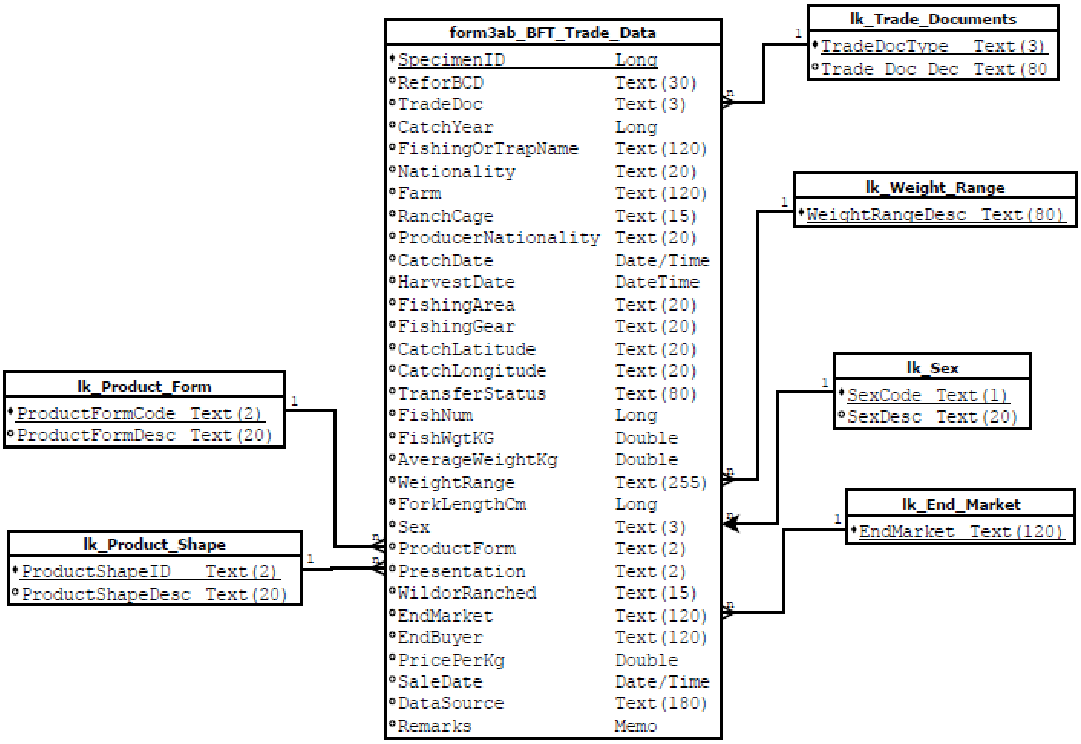
Annex 1 Entity-Relationship Diagram (Main tables only)

NB: For display purposes only the main data tables and fields have been displayed and the lookup tables repeated for each for clarity, i.e. the internal data management table and fields within each table to highlight errors have not been included.






form3ab_BFT_Trade_Data
SpecimenID Long
ReforBCD Text(30)
TradeDoc Text(3)
CatchYear Long
FishingOrTrapName Text(120)
Nationality Text(20)
Farm Text(120)
RanchCage Text(15)
ProducerNationality Text(20)
CatchDate Date/Time
HarvestDate DateTime
FishingArea Text(20)
FishingGear Text(20)
CatchLatitude Text(20)
CatchLongitude Text(20)
TransferStatus Text(80)
FishNum Long
FishWgtKG Double
AverageWeightKg Double
WeightRange Text(255)
ForkLengthCm Long
Sex Text(3)
ProductForm Text(2)
Presentation Text(2)
WildorRanched Text(15)
EndMarket Text(120)
EndBuyer Text(120)
PricePerKg Double
SaleDate Date/Time
DataSource Text(180)
Remarks Memo
lk_Trade_Documents
TradeDocType Text(3)
Trade Doc Dec Text(80
lk_Weight_Range
WeightRangeDesc Text(80)
lk_Sex
SexCode Text(1)
SexDesc Text(20)
lk_End_Market
EndMarket Text(120)
lk_Product_Form
ProductFormCode Text(2)
ProductFormDesc Text(20)
lk_Product_Shape
ProductShapeID Text(2)
ProductShapeDesc Text(20)

Annex 2

6.1.1 Data Import Problems

6.1.1.1 Fishing Vessel or Trap Nationality

Data entries in the spreadsheets do not match values in the standard lookup table and therefore were rejected on initial attempts to import.

In the case of EU countries the code "EU " (noting the space) need to be replaced with "EU." throughout. In addition, a number of composite fields for multiple States have been created in the data that do not appear in the lookup table. These include

- EU.FRA+EU.ESP; (i.e. France and Spain) and
- EU.FRA+EU.ESP+LBY+EU.ITA (i.e. France, Spain, Italy and Libya).

6.1.1.2 BFT Producer or Tuna Ranch Nationality

As for the fishing vessels or trap nationality above.

6.1.1.3 Sex Codes

Sex codes not correct for 1 record ("Sex") and 2430 blank records that would be better coded as "U" – unknown.

6.1.1.4 Records missing Specimen ID

Some records were presented with no primary key i.e. Specimen ID. We have added numbers based on the maximum value represented in the data and sequentially after that (i.e. 101,925 to 101,948).

6.1.1.5 Currency Format

The import process loses the currency formats used for fields representing prices. These data were extracted independently (as described above) and added to the database as three separate tables for each of the main data tables.

6.1.2 Error Identification and Flagging

On each of the main data tables an additional data column has been added. This simple text field called ERROR_FLAG on each table allows any rows in which a possible error or missing data exists to be flagged with a specific text flag. During any analysis, these records may be simply excluded from the analysis, noting at the time of analysis which sets of records have been excluded. A summary of the error flags listed can be found in lk_Error_Flags database table.

Annex 3 SQL Queries used to define the Data Frame.

Source	SQL Query
Form 1 - Nationality	`SELECT DISTINCT form1_BFT_Trade_Data.Nation FROM form1_BFT_Trade_Data;`
Form 2 – Vessel Nationality	`SELECT DISTINCT form2ab_BFT_Trade_Data.Nationality FROM form2ab_BFT_Trade_Data ORDER BY form2ab_BFT_Trade_Data.Nationality;`
Form 2 - Producer	`SELECT DISTINCT form2ab_BFT_Trade_Data.ProducerNationality FROM form2ab_BFT_Trade_Data;`
Form 3 – Vessel Nationality	`SELECT DISTINCT form3ab_BFT_Trade_Data.Nationality FROM form3ab_BFT_Trade_Data;`
Form 3 - Producer	`SELECT DISTINCT form3ab_BFT_Trade_Data.ProducerNationality FROM form3ab_BFT_Trade_Data;`

Data were extracted for the nations involved in the BFT trade from each of the complementary datasets. A temporary database UNION query was used to merge these five tables and a SELECT DISTINCT used to finalise the list of all flag States involved in the BFT market. (Query definition: SELECT DISTINCT lk_Flag_State_USED.FlagCode FROM lk_Flag_State_USED ORDER BY lk_Flag_State_USED.FlagCode;) which are shown in **Error! Reference source not found.**.

Output nations for the Data Frame.

Source	SQL Query
Form 1 - Nationality	EU.CYP, EU.ESP, EU.FRA, EU.GRC, EU.HRV, EU.IRL, EU.ITA, EU.MLT, EU.PRT, ISL, ISR, LBY, MAR, NOR, TUN and TUR.
Form 2 – Vessel Nationality	EU.ESP, EU.FRA, EU.FRA+EU.ESP, EU.FRA+EU.ESP+EU.ITA, EU.FRA+EU.ITA, EU.FRA+EU.ITA+LBY, EU.FRA+LBY, EU.ITA, LBY, MAR, TUN and TUR.
Form 2 - Producer	EU.ESP, EU.FRA, EU.HRV, EU.ITA, EU.MLT, LBY, MAR, TUN and TUR.
Form 3 – Vessel Nationality	ALB, CHN, DZA ,EGY, EU.CYP, EU.ESP, EU.FRA, EU.FRA+EU.ESP, EU.FRA+EU.ITA+LBY, EU.FRA+EU.MLT+LBY, EU.GRC, EU.HRV, EU.ITA, EU.ITA+EU.GRC, EU.MLT, EU.MLT(KORCHR), EU.PRT, GIN, ISL, KOR, LBY, MAR, NOR, SYR, TUN, TUR, TUR(KORCHR), TWN, USA and VEN.
Form 3 - Producer	CHN, DZA, EGY, EU.CYP, EU.ESP, EU.FRA, EU.GRC, EU.HRV, EU.ITA, EU.ITL, EU.MLT, EU.PRT, GIN, ISL, KOR, LBY, MAR, NOR, TUN, TUR, TWN, USA and VEN
Total	**ALB, CHN, DZA, EGY, EU.CYP, EU.ESP, EU.FRA, EU.FRA+EU.ESP, EU.FRA+EU.ESP+EU.ITA, EU.FRA+EU.ITA, EU.FRA+EU.ITA+LBY, EU.FRA+EU.MLT+LBY, EU.FRA+LBY, EU.GRC, EU.HRV, EU.IRL, EU.ITA, EU.ITA+EU.GRC, EU.ITL, EU.MLT, EU.MLT(KORCHR), EU.PRT, GIN, ISL, ISR, KOR, LBY, MAR, NOR, SYR, TUN, TUR, TUR(KORCHR), TWN, USA and VEN.**

Annex 4 A summary of the error checks developed and performed

Error Flag	Query Name	Description	SQL

F!FRAME	ERROR_F1FRAME	Check for errors in frame fields of form 1.	`SELECT form1_BFT_Trade_Data.SpecimenID, form1_BFT_Trade_Data.ProductForm, form1_BFT_Trade_Data.OriginType, form1_BFT_Trade_Data.HarvestYear, form1_BFT_Trade_Data.Nation, form1_BFT_Trade_Data.Gear, form1_BFT_Trade_Data.Area`
			
			`FROM form1_BFT_Trade_Data`
			
			`WHERE (((form1_BFT_Trade_Data.ProductForm) Is Null)) OR (((form1_BFT_Trade_Data.OriginType) Is Null)) OR (((form1_BFT_Trade_Data.HarvestYear) Is Null)) OR (((form1_BFT_Trade_Data.Nation) Is Null)) OR (((form1_BFT_Trade_Data.Gear) Is Null)) OR (((form1_BFT_Trade_Data.Area) Is Null));`

F"FRAME	ERROR_F2FRAME	Check for errors in frame fields of form 2.	`SELECT form2ab_BFT_Trade_Data.SpecimenID, form2ab_BFT_Trade_Data.CatchYear, form2ab_BFT_Trade_Data.Nationality, form2ab_BFT_Trade_Data.FishingArea, form2ab_BFT_Trade_Data.FishingGear, form2ab_BFT_Trade_Data.ProductForm, form2ab_BFT_Trade_Data.WildorRanched`
			
			`FROM form2ab_BFT_Trade_Data`
			
			`WHERE (((form2ab_BFT_Trade_Data.CatchYear) Is Null)) OR (((form2ab_BFT_Trade_Data.Nationality) Is Null)) OR (((form2ab_BFT_Trade_Data.FishingArea) Is Null)) OR (((form2ab_BFT_Trade_Data.FishingGear) Is Null)) OR (((form2ab_BFT_Trade_Data.ProductForm) Is Null)) OR (((form2ab_BFT_Trade_Data.WildorRanched) Is Null));`

F3FRAME	ERROR_F3FRAME	Check for errors in frame fields of form 3.	`SELECT form3ab_BFT_Trade_Data.SpecimenID, form3ab_BFT_Trade_Data.CatchYear, form3ab_BFT_Trade_Data.Nationality, form3ab_BFT_Trade_Data.FishingArea, form3ab_BFT_Trade_Data.FishingGear, form3ab_BFT_Trade_Data.ProductForm, form3ab_BFT_Trade_Data.WildorRanched`
			
			`FROM form3ab_BFT_Trade_Data`
			
			`WHERE (((form3ab_BFT_Trade_Data.CatchYear) Is Null)) OR (((form3ab_BFT_Trade_Data.Nationality) Is Null)) OR (((form3ab_BFT_Trade_Data.FishingArea) Is Null)) OR (((form3ab_BFT_Trade_Data.FishingGear) Is Null)) OR`

Error Flag	Query Name	Description	SQL
			(((form3ab_BFT_Trade_Data.ProductForm) Is Null)) OR (((form3ab_BFT_Trade_Data.WildorRanched) Is Null));
F1MISSNM	ERROR_F1MISSNM	Check for missing fish number in form 1.	SELECT form1_BFT_Trade_Data.SpecimenID, form1_BFT_Trade_Data.FishWgtKG, form1_BFT_Trade_Data.FishNum FROM form1_BFT_Trade_Data WHERE (((form1_BFT_Trade_Data.FishWgtKG) Is Not Null) AND ((form1_BFT_Trade_Data.FishNum) Is Null));
F2MISSNM	ERROR_F2MISSNM	Check for missing fish number in form 2.	SELECT form2ab_BFT_Trade_Data.SpecimenID, form2ab_BFT_Trade_Data.FishNum, form2ab_BFT_Trade_Data.FishWgtKG FROM form2ab_BFT_Trade_Data WHERE (((form2ab_BFT_Trade_Data.FishNum) Is Null) AND ((form2ab_BFT_Trade_Data.FishWgtKG) Is Not Null));
F3MISSNM	ERROR_F3MISSNM	Check for missing fish number in form 3.	SELECT form3ab_BFT_Trade_Data.SpecimenID, form3ab_BFT_Trade_Data.FishNum, form3ab_BFT_Trade_Data.FishWgtKG FROM form3ab_BFT_Trade_Data WHERE (((form3ab_BFT_Trade_Data.FishNum) Is Null) AND ((form3ab_BFT_Trade_Data.FishWgtKG) Is Not Null));
F!MISSWT	ERROR_F1MISSWT	Check for missing fish weight in form 1.	SELECT form1_BFT_Trade_Data.SpecimenID, form1_BFT_Trade_Data.FishWgtKG, form1_BFT_Trade_Data.FishNum FROM form1_BFT_Trade_Data WHERE (((form1_BFT_Trade_Data.FishWgtKG) Is Null) AND ((form1_BFT_Trade_Data.FishNum) Is Not Null));

Error Flag	Query Name	Description	SQL
F"MISSWT	ERROR_F2MISSWT	Check for missing fish weight in form 2.	SELECT form2ab_BFT_Trade_Data.SpecimenID, form2ab_BFT_Trade_Data.FishNum, form2ab_BFT_Trade_Data.FishWgtKG FROM form2ab_BFT_Trade_Data WHERE (((form2ab_BFT_Trade_Data.FishNum) Is Not Null) AND ((form2ab_BFT_Trade_Data.FishWgtKG) Is Null));
F3MISSWT	ERROR_F3MISSWT	Check for missing fish weight in form 3.	SELECT form3ab_BFT_Trade_Data.SpecimenID, form3ab_BFT_Trade_Data.FishNum, form3ab_BFT_Trade_Data.FishWgtKG FROM form3ab_BFT_Trade_Data WHERE (((form3ab_BFT_Trade_Data.FishNum) Is Null) AND ((form3ab_BFT_Trade_Data.FishWgtKG) Is Not Null));
F1DATES	F1_Check_Auction_Dates	Check consistency of auction date fields in form 1.	SELECT form1_BFT_Trade_Data.SpecimenID, Year([AuctionDate]) AS [Year], form1_BFT_Trade_Data.HarvestYear, form1_BFT_Trade_Data.SpecimenID, form1_BFT_Trade_Data.FishNum, form1_BFT_Trade_Data.FishWgtKG, form1_BFT_Trade_Data.WeightRatioKg, form1_BFT_Trade_Data.ERROR_FLAG FROM form1_BFT_Trade_Data WHERE (((form1_BFT_Trade_Data.HarvestYear)>Year([AuctionDate])));
F2DATES	F2_Check_Catch_Harvest_Dates	Check consistency of catch and harvest date fields in form 2.	SELECT form2ab_BFT_Trade_Data.SpecimenID, form2ab_BFT_Trade_Data.CatchYear, Year([CatchDate]) AS Year_CATCHDATE1, Year([HarvestDate]) AS Year_HARVESTDATE, [CatchYear]-Year([CatchDate]) AS Expr1, [CatchYear]-Year([HarvestDate]) AS Expr2, form2ab_BFT_Trade_Data.ERROR_FLAG FROM form2ab_BFT_Trade_Data WHERE ((([CatchYear]-Year([CatchDate]))<>0 And ([CatchYear]-Year([CatchDate])) Is Not Null)) OR ((([CatchYear]-Year([HarvestDate]))<>0 And ([CatchYear]-Year([HarvestDate]))<>-1 And ([CatchYear]-Year([HarvestDate])) Is Not Null));
F3DATES	F3_Check_Catch_Harvest_Dates	Check consistency of catch and harvest date fields in form 3.	SELECT form3ab_BFT_Trade_Data.SpecimenID, form3ab_BFT_Trade_Data.CatchYear, Year([CatchDate]) AS Year_CATCHDATE1, Year([HarvestDate]) AS Year_HARVESTDATE, [CatchYear]-Year([CatchDate]) AS

Error Flag	Query Name	Description	SQL
			Expr1, [CatchYear]-Year([HarvestDate]) AS Expr2, form3ab_BFT_Trade_Data.ERROR_FLAG FROM form3ab_BFT_Trade_Data WHERE ((([CatchYear]-Year([CatchDate]))<>0 And ([CatchYear]-Year([CatchDate])) Is Not Null)) OR ((([CatchYear]-Year([HarvestDate]))<>0 And ([CatchYear]-Year([HarvestDate]))<>-1 And ([CatchYear]-Year([HarvestDate])) Is Not Null));
F2AVWT	F2_Check_Average_Weight	Check average weights of bluefin tuna are within acceptable bounds in form 2.	SELECT form2ab_BFT_Trade_Data.SpecimenID, form2ab_BFT_Trade_Data.FishNum, form2ab_BFT_Trade_Data.FishWgtKG, [FishWgtKG]/[Fishnum] AS Calc_AvWT, form2ab_BFT_Trade_Data.AverageWeightKg, form2ab_BFT_Trade_Data.ERROR_FLAG, * FROM form2ab_BFT_Trade_Data WHERE (((form2ab_BFT_Trade_Data.FishNum) Is Not Null And (form2ab_BFT_Trade_Data.FishNum)<>1) AND ((form2ab_BFT_Trade_Data.FishWgtKG) Is Not Null) AND (([FishWgtKG]/[Fishnum])<=2 Or ([FishWgtKG]/[Fishnum])>=700) AND ((form2ab_BFT_Trade_Data.ERROR_FLAG) Not Like "F2MISSWT*"));
F3AVWT	F3_Check_Average_Weight	Check average weights of bluefin tuna are within acceptable bounds in form 3.	SELECT form3ab_BFT_Trade_Data.SpecimenID, form3ab_BFT_Trade_Data.FishNum, form3ab_BFT_Trade_Data.FishWgtKG, form3ab_BFT_Trade_Data.AverageWeightKg, [FishWgtKG]/[FishNum] AS Calc_AvWT, form3ab_BFT_Trade_Data.ERROR_FLAG FROM form3ab_BFT_Trade_Data WHERE (((form3ab_BFT_Trade_Data.FishNum) Is Not Null) AND ((form3ab_BFT_Trade_Data.FishWgtKG) Is Not Null) AND (([FishWgtKG]/[FishNum])<=2 Or ([FishWgtKG]/[FishNum])>=700));
F!MISSPS	Update_F1_ProductType_Where_NULL	Flag missing product shape code in Form 1.	UPDATE form2ab_BFT_Trade_Data SET form2ab_BFT_Trade_Data.ERROR_FLAG = [form2ab_BFT_Trade_Data]![ERROR_FLAG] & "F2MISSPS" WHERE (((form2ab_BFT_Trade_Data.ERROR_FLAG) Like "F2MISSPS*") AND ((form2ab_BFT_Trade_Data.Presentation) Is Null));
F2MISSPS	Update_F2_ProductType_Where_NULL	Flag missing product shape code in Form 2.	UPDATE form2ab_BFT_Trade_Data SET form2ab_BFT_Trade_Data.ERROR_FLAG = [form2ab_BFT_Trade_Data]![ERROR_FLAG] & "F2MISSPS"

Error Flag	Query Name	Description	SQL
			`WHERE (((form2ab_BFT_Trade_Data.ERROR_FLAG) Like "F2MISSPS*") AND ((form2ab_BFT_Trade_Data.Presentation) Is Null));`

F3MISSPS	Update_F3_ProductType_Where_NULL	Flag missing product shape code in Form 3.	`UPDATE form3ab_BFT_Trade_Data SET form3ab_BFT_Trade_Data.ERROR_FLAG = [form3ab_BFT_Trade_Data]![ERROR_FLAG] & "F3MISSPS"`
			
			`WHERE (((form3ab_BFT_Trade_Data.ERROR_FLAG) Like "F3MISSPS*") AND ((form3ab_BFT_Trade_Data.Presentation) Is Null));`

NB: Other error codes have been added manually during data investigations

Annex 5 Missing weights

List of queries for form 1

Below are executed with a function

Update_F1_WorkingProductType_Where_NULL
Update_F1_Working_ProductType_NOT_NULL
F1_withAverageWeights **– Make Table**
update_F1_withAverageWeights

Update_F1_ProductType_Where_NULL
update_F1_withAverageWeights_without_ProductShape **– Make Table**
update_F1_withAverageWeights_No_ProductShape

Average_Weight_F1_Check_Missing_vs_Average
Average_Weight_F1_Check_Missing_vs_Average_WithoutNation

List of queries for form 2

Below are executed with a function

Update_F2_WorkingProductType_Where_NULL
Update_F2_Working_ProductType_NOT_NULL
F2_withAverageWeights **– Make Table**
update_F2_withAverageWeights

Update_F2_ProductType_Where_NULL
update_F2_withAverageWeights_without_ProductShape **– Make Table**
update_F2_withAverageWeights_No_ProductShape

Average_Weight_F2_Check_Missing_vs_Average
Average_Weight_F2_Check_Missing_vs_Average_WithoutNation

List of queries for form 3

Below are executed with a function

Update_F3_WorkingProductType_Where_NULL
Update_F3_Working_ProductType_NOT_NULL
F3_withAverageWeights **– Make Table**
update_F3_withAverageWeights

Update_F3_ProductType_Where_NULL
update_F3_withAverageWeights_without_ProductShape **– Make Table**
update_F3_withAverageWeights_No_ProductShape

Average_Weight_F3_Check_Missing_vs_Average
Average_Weight_F3_Check_Missing_vs_Average_WithoutNation

Annex 6 Assumptions and important points about the data included in the 3 forms

- Catch data included in the 3 forms reflect catches from the European/Mediterranean nations and do not include catches from other countries (e.g. Japanese LL fishing fleet in NE Atlantic and Med).
- The market data provide 100% coverage of all existing major Japanese fish auction market (21 locations)
- The coverage of all sales of BFT in those fish markets is high but not 100% as some fish might have not been sold through auction so, not reported in the auction register.

Points specific to Form 1

- The allocation of fish to different presentation categories was done based on assumptions – not actual observation
- Fish that do not carry the code "Farm" are assumed to be "Wild"
- Fish with the code "wild" but no gear code was assigned to LL
- The raw data do not say if the fish are caught in the Med or NE Atlantic so, the country of origin was used to allocate them to different sea basins
- For farmed/trap fish, the geographical area in which the fish was caught is assigned based on the nation where the farms/traps are located.
- The catch at sea date is an assumption, does not come from raw data. The majority of wild fish is assigned to the same year of the auction. Farmed fish are backdated by 6 months and the resulting year is recorded as the catch year (slightly more complex approach for Croatia).
- Data for fish that came from the US were not included/considered even though some of the fish might come from the EU.

Annex 7 Fattening ratios

Starting weight	Increase in weight	Reference	Comments
RWT of 190.5kg (average)	36.0% in weight	Deguara et al 2010	4 months farming
128 cm SFL or 210 cm SFL	85% for small fish 36.4% for big	Deguara 2016,	4-5 months farming
200-240 cm 120 -150 cm	20-35% 80%	Galaz, 2012	6 months farming, Spain
All	Ranges from 180% to 39% depending on size at catch	Anonymous 2010	Values provided here correspond to 6 months farming
All	25% for fish above 70Kg 60% for fish less than 70 Kg 100% for fish from Croatia with weight above 70 Kg	Bregazzi, 2015	Range adopted based on literature review – Not a field study
All (non-Croatian)		Gagern et al 2013	Range adopted based on literature review – Not a field study