

SUMMARY OF INPUT DATA (CATCH, SIZE AND INDICES) USED IN THE ATLANTIC BLUEFIN TUNA OPERATING MODELS (VERSION 5.2.3)

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SUMMARY

ICCAT Atlantic Bluefin tuna Working Group (BFTWG) continuously has engaged in MSE process for Atlantic bluefin tuna and has been developing unique operating models (OMs) by taking into account the mixing of the stocks. At the 2019 February BFTWG meeting, the roadmap for the BFT MSE was updated, and the BFTWG requested to review and finalize catch and size input data for the OMs by 1 April 2019. This document provides the summary of input data (catch, size, and CPUEs) in the ABFT OMs (version 5.2.3).

RÉSUMÉ

Le Groupe d'espèces sur le thon rouge de l'Atlantique de l'ICCAT participe de manière continue au processus de MSE pour le thon rouge de l'Atlantique et a développé des modèles opérationnels uniques en tenant compte du mélange des stocks. Lors de la réunion du Groupe en février 2019, la feuille de route de la MSE pour le thon rouge a été mise à jour et le Groupe a demandé que les données d'entrée de capture et de taille des modèles opérationnels soient examinées et finalisées avant le 1^{er} avril 2019. Le présent document fournit le résumé des données d'entrée (prise, taille et CPUE) des modèles opérationnels appliqués au thon rouge de l'Atlantique (version 5.2.3).

RESUMEN

El Grupo de especies de atún rojo del Atlántico de ICCAT se ha involucrado de manera continua en el proceso de la MSE para el atún rojo del Atlántico y ha desarrollado modelos operativos (OM) únicos teniendo en cuenta la mezcla de stocks. En la reunión del Grupo de 2019, se actualizó la hoja de ruta de la MSE para el atún rojo y el Grupo de especies solicitó revisar y finalizar los datos de entrada de captura y talla para los OM antes del 1 de abril de 2019. Este documento proporciona el resumen de los datos de entrada (captura, talla y CPUE) en los OM del atún rojo del Atlántico (versión 5.2.3).

KEYWORDS

Atlantic bluefin tuna, Catch, CATDIS, CPUE, Size, OMs, MSE

Introduction

ICCAT Atlantic Bluefin tuna Working Group (BFTWG) continuously has engaged in MSE process for Atlantic bluefin tuna and has been developing unique operating models (OMs) by taking into account the mixing of the stocks. At the 2019 February BFTWG meeting, the roadmap for the BFT MSE was updated (Anon. 2019a, see Roadmap), and the BFTWG requested to review and finalize catch and size input data for the OMs by the 1st of April, 2019. This document provides the summary of input data (catch, size, and CPUEs) in the ABFT OMs (version 5.2.3).

Using Task 1 national catch (T1NC), Task 2 Catch and Effort (T2CE), Task 2 Size (T2SZ) data, and the estimated catch by 5x5 grid (CATDIS), catch and size data were prepared by year (1965-2016), quarter (January-March, April-June, July-September, and October-December), area (7 areas in OMs in **Figure 1**: 1. GOM, 2. WATL, 3. GSL, 4. SATL, 5. NATL, 6. EATL, and 7. MED), and fleet structure (**Table 1**), which was modified from previous OMs to set up close to the runs by Stock Synthesis (Anon. 2018). The size data was provided with the 5 cm straight fork length intervals. Historical catch at age for the period between 1864 and 1964 was estimated from the same source of database by applying similar method originally used in the previous OMs (Anon., 2019b. Appendix 6: Trial Specification Document).

Because of the resolution of the data requirement (by quarter and area), the catch data was prepared mainly from CATDIS available from 1950 to the most recent year. "CATDIS is basically an estimation of T1NC for the nine major tuna and tuna like species of ICCAT, stratified in time (trimester) and space (5x5 degree squares). Details on Flag, Fleet, Gear group, Stock and School type (Purse seiners in tropical fisheries) were also maintained. It assumes that, time/space distribution of T2CE partial data (T2CE, has with a wide range [15%, 100%] of coverage levels among all the datasets used on the estimations) is representative of T1NC overall annual catches dispersion in time and space" (ICCAT Secretariat, 2018).

The tentative analysis revealed the limitation of use of CATDIS (**Table 2**). Because historical original data submissions of T2CE and T2SZ by ICCAT Contracting Parties and Cooperating Non-Contracting Parties (CPCs) have been insufficient, mostly in East Atlantic (Anon. 2019, see Appendix standard SCRS catalogues on statistics of BFT) where most of catch occurred, causing a limitation for the use of the spacial and temporal information. The original T2CE and T2SZ especially before 1980 are scarce, thus the current method of producing CATDIS provides equipartition of the annual catch (**Table 2**).

Because Atlantic bluefin tuna is a highly migratory species, each fishery has its own fishing season and area; specially traps, bait boats, longliners, and small scale fisheries. Therefore, the equipartition of the annual catch sometimes would not be suitable approach for some of them. Although it is desirable to have full revisions of T2CE and T2SZ by CPCs to the ICCAT Secretariat, for the purpose of the input data for BFT OMs, the changes in CATDIS or in the aggregated catch by CATDIS were made by incorporating the expert knowledge on their fishery from CPC scientists. Due to the limited time, these modifications were considered for main fishing gears where the CPUE indices are available for the BFT OMs. During the detail check on the data, some obvious errors were corrected.

In addition to the catch by fleet before 2016, the allocated catch by fleet (only operates in recent years) in 2017 to 2020 (future catch in OMs) by large area (Mediterranean, East and West Atlantic) was prepared as a part of input data for OMs. T1NC in 2017 was used directly to calculate the catch in 2017. The fisheries dependent and independent abundance indices were also summarized for the input data. Most of the selected indices were used in the 2017 stock assessment (Anon. 2018).

Material and Methods

This document provides the input data (catch, size, and CPUEs) for the ABFT OMs (version 5.2.3):

- Catch (t) by quarter, OM area and fleet between 1950 and 2017: Cobs
- Length composition by quarter, OM area and fleet with 5 cm bin between 1965 and 2017: CLobs
- Historical catch (t) at age by quarter and OM area between 1864 and 1964: HCobs
- Allocated catch by fleet by large area (Mediterranean, East and West Atlantic) between 2017 and 2020 (future catch in OMs)
- Fisheries dependent indices
- Fisheries independent indices

The following data sources were used for the input data in Oms

- Task I between 1864 and 2016 provided at 2018 SCRS (the end of September in 2018)
- CATDIS between 1950 and 2016 provided at 2018 SCRS
CATDIS Gear group (GearGrp) contains “BB (baitboat), HL (handline), LL (longline), TP (trap), TR (trawl), PS (purse sein), RR (rod and reel), oth (others)”.
- Task II Catch & Effort for USA Rod and Reel, all Canadian fishery, baitboat in the East Atlantic, and Trap in the East Atlantic between 1950 and 2016
- Task II Size data revised in 2019 up to 2017 by using the same screening method for SS3 in 2017 (Ortiz and Palma, 2017)
- ICCAT recommendations [REC. 14-04], [REC.17-07], [REC.18-02], and allocation keys by country in the EU

Catch (t) by Quarter, Area and Fleet (Cobs) between 1950 and 2016

The tentative analysis revealed the limitation of use of CATDIS (**Table 2**). Because historical original data of T2CE and T2SZ by CPCs especially before 1980 are scarce, the current method of producing CATDIS provides equipartition of the annual catch (**Table 2**, highlighted in yellow or orange). For assembling input data for BFT OMs, the changes in CATDIS or in the aggregated catch by CATDIS were made by incorporating the expert knowledge on their fishery from CPC scientists.

Due to the limited time, these modifications were considered for main fishing gears (Fleets 3, 12, 14, 15, and 16) where the CPUE indices are available for the BFT OMs. The equipartition of the annual catch mostly before 1975 were modified based on the proportion of the quarterly catch in the adjacent years or the proportion by expert knowledge, and **Table 3** shows the list of modifications where we changed and what we used for substitution. Some errors were also corrected through checking data, and consulting with CPC scientists (**Table 4**).

Fleet 3: Spanish and French Baitboat in Bay of Biscay

Fleet 12: Spanish, Moroccan, and Portuguese Trap

Spanish Baitboat index (Fleet 3) is the important historical abundance index, and the majority of catch were obtained in summer. The trap fishery around St. Gibrartar (Fleet 12) is another historical fishery for Atlantic bluefin tuna. The equipartition of the annual catch were observed mostly before 1975 (**Table 1**), and those catches were recalculated. The quarterly catch by area was estimated by multiplying the Task 1 and the average proportion of quarterly catch by area to the yearly catch. The values used for the average proportion were available in **Table 3** No. 1 to 6, and No. 7 to 12 for the baitboat and the trap, respectively.

Fleet 14: Canadian Rod and Reel

Canadian fisheries have been limited in season and area, and the catch especially in the Gulf of St. Lawrence affect largely to the OM results. Therefore, the catch by Fleet 14 Canadian rod and reel mainly before 1975 (**Table 1**) were recalculated, and the catch by quarter by area from CATDIS were directly used if there is no assumption in **Table 1**. Fleet 14 contains the catch by rod and reel, troll, harpoon, trawl, and gillnet. The quarterly catch by area was estimated by multiplying the Task 1 and the average proportion of quarterly catch by area to the yearly catch (**Table 3**, No. 13 to 17).

Fleets 15 and 16: USA Rod and Reel for fish small and fish big

For the US rod and reel (RRUSA), the fleets were separated for the size of fish: fish small (Fleet 15, RRUSAFS) or fish big (Fleet 16, RRUSAFB). Because the original complete data were partially available for the two fleets, the following steps were taken for the quarterly catch by these fleets. The steps (a) to (c) are to obtain the yearly catch by RRUSAFS or RRUSAFB in 1950-2016, and the steps (d) to (e) are to divided them into quarters.

- a) Task I catch (yearly) by RRUSAFS and RRUSAFB are available in 1950-1959, 1969-1979, 1990-2014.
- b) Task I catch in 1960-1968, 1980-1989, and 2015-2016 (mixed RRUSA) were divided by the average proportion of catch by RRUSAFS to the total between 1957-59 (0.374), 1972-79 (0.290), and 2010-2014 (0.249), respectively. The rest of Task I catch was assigned as RRUSAFB
- c) Catch in Task I by USA handline, harpoon, gillnet, trawl, and others were included in RRUSAFB.
- d) The proportion of catch by RRUSA-Recreational in T2CE by year (where available) in 1990-2016 (except 1996) were multiplied the yearly catch by RRUSAFS or RRUSAFB calculated in the steps (a) to (c).

- e) Catch by RRUSAFS pr RRUSAFB prior to 1990, or in 1996 were calculated by multiplying the average proportion of catch by RRUSA-Recreational in T2CE between 1990 and 1995, or between 1994 and 1998, respectively. The proportions of the catch are available in **Table 3** (No. 18 and 19).

Length composition by Quarter, Area and Fleet (CLobs) with 5 cm bin between 1965 and 2017

T2SZ data were revised in 2019 up to 2017 by using the same screening method for SS3 in 2017 (Ortiz and Palma, 2017). The fleet and area in OMs were applied and the length composition was provided with 5 cm bin by quarter, area, and fleet. Some criterias in **Table 4** were also applied. After screening anomalies and/or errors, 6,929,722 individual length compositions were provided between 1950 and 2017.

Historical catch (t) at age by Quarter and Area (HCobs) between 1864 and 1964

In the OMs, historical catches in years prior to the initial model year (e.g. before 1965) are used to initialize the model using stock reduction analysis. Mostly, the available information of these historical catches is only yearly total catch. Therefore to obtain catch by age, the following three steps were made.

1. Calculate yearly catch by fleet (and county for the catch between 1950 and 1965).
2. Estimate quarterly catch by assuming the proportion of quarterly catch to the total.
3. Estimate quartely catch at length (25 cm bin) by assuming length composition.
4. Convert catch at length to catch at age by an Age legnth key (ALK) constrancted from growth curves used in the 2017 stock assessment. The growth curve is Richards growth by Ailloud et al. (2017) and Von Bertalanffy by Cort (1991) in the West and the East Atlantic, respectively.

The length composition is rarely available before 1950 and the country and fishery are limited before 1950. The period before 1950 and after 1950 were separately prepared.

Period 1864 and 1949

Available historical catch by area and country is shown in **Table 5**, and they were discovered mostly in the Mediterrenean. To obtain the quartely catch (step 2), the similar proportion of quarterly catch used in the catch after 1965 in **Table 3** were assumed. To create catch at length (step3), length compositions were assumed by area (only 4 areas) in **Table 6**. Using ALK for eastern bluefin (**Table 7-a**), the catch at age by quarter and area was esimated (step 4).

Period 1950 and 1964

T2SZ data before 1965 is very limited. The quartely catch by fleet between 1950 and 1964 was used (see above; Catch (t) by quarter, OM area and fleet (Cobs) between 1950 and 2017). The length compositions were assumed by fleet, area, and quarter in **Table 8**. Length was converted into age using ALK by large area (**Table 7**, East and West Atlantic). Finally, the catch at age was reaggregated by quarter and area.

Allocated catch by fleet by large area (Mediterranean, East and West Atlantic) between 2017 and 2020 (future catch in OMs)

The catch in 2017 was provided from TINC by recent fleets (1, 2, 4, 7-9, 11, 13-16). Allocated catch between 2018 and 2020 for recent fleets was provided from the ICCAT recommendations [REC.17-07], [REC.18-02], and allocation key by country in the EU (European Union 2018, and 2019). The allocation key in EU in 2020 was applied to be same as one in 2019 because the key has been constant for several years. The allocated catch by country was shown in **Table 9**. If a country has multiple fisheries, the average catch ratio in the recent years (2016 and 2017) was assumed to calculate catch by fleet (detailed assumption is in **Table 10**).

Final Data Set in BFT OMs

All output was shared at the second BFT MSE Technical Group meeting (23-27 July, 2019 in Canada) on the owncloud.

- Catch (t) by Quarter, Area and Fleet (Cobs) between 1950 and 2017 is available in "Cobs.csv" in **Table 11**.
- Length composition by Quarter, Area and Fleet (CLobs) with 5 cm bin between 1965 and 2017 is available in "CLobs_5cm.csv".

- Historical catch (t) at age by Quarter and Area (HCobs) between 1864 and 1949, 1950 and 1964 are available in "HCobs1864_1949.csv" and "HCobs5064_final.csv", respectively. **Figures 2 and 3** show historical catch at age by area between 1864 and 1949, 1950 and 1964, respectively.
- Allocated catch by fleet by large area (Mediterranean, East and West Atlantic) between 2017 and 2020 (future catch in OMs) is available in **Table 12**.
- List of Fisheries dependent indices is available in "CPUE_indices_compiled_2019OM.csv", in **Table 13**. **Figures 4 and 5** show the CPUE indices in the East and the West Atlantic, respectively.
- List of Fisheries independent indices is available in "FI_indices_compiled_OM2019.csv" in **Table 14** and **Figure 3**.

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Table 1. Fleet structure agreed by BFTWG defined in BFT OMs (version 5.2.3).

No.	Name	Gear	Flag	Area/Quarter	Start	End	Explanation
1	LLOTH	LL	All except Japan	All	1960	2016	Other longline
2	LLJPN	LL	Japan	All	1960	2016	Japanese longline
3	BBold	BB	EU.Spain, EU.France	Bay of Biscay	1960	2006	Baitboat in Bay of Biscay before 2006
4	BBnew	BB	EU.Spain, EU.France	Bay of Biscay	2007	2016	Baitboat in Bay of Biscay after 2007
5	PSMEDold	PS	All except EU.Croatia	Med, No Quarter2	1960	2008	Purse seine in Med before 2008 in Quarters 1,3,4
6	PSMEDoldQ2	PS	All except EU.Croatia	Med, Quarter2	1960	2008	Purse seine in Med before 2008 in Quarter 2
7	PSMEDnew	PS	All except EU.Croatia	Med	2009	2016	Purse seine in Med after 2009
8	PSNOR	PS	Norway	ATE	1950	2016	Norwegian Purse seine
9	PSHRV	PS	EU.Croatia	Med	1991	2016	Croatian Purse seine
10	PSWold	PS	USA, Canada	ATW	1960	1984	Purse seine in West Atlantic before 1984
11	PSWnew	PS	USA, Canada	ATW	1985	2016	Purse seine in West Atlantic after 1985
12	TPold	TP	EU.Spain, Morocco, EU. Portugal	St. Gibrartar	1950	2011	Trap in St. Gibrartar before 2011
13	TPnew	TP	EU.Spain, Morocco, EU. Portugal	St. Gibrartar	2012	2016	Trap in St. Gibrartar after 2012
14	RRCAN	RR	Canada	ATW, GSL	1960	2016	Canadian rod and reel
15	RRUSAFS	RR	USA	ATW	1960	2016	US rod and reel fish small
16	RRUSAFB	RR	USA	ATW	1960	2016	US rod and reel fish large
17	OTH	other	other	other	1960	2016	Others

Table 2. The catch by fleet, area, and quarter using original CATDIS. The values highlighted in yellow or orange are probably equipartition of the annual catch.

[illegible]

Table 2. Continued.

[illegible]

Table 3. The proportion of catch by quarter by area to replace the estimation by CATDIS. Catch in Task1 in a particular fishery (2nd column) in particular year (5th column) was separated by the average proportion (7th to 10th column) of the quarterly catch by area in the adjacent years (6th column).

No	Fishery	Fleet	Area	Years	Average	Qt1	Qt2	Qt3	Qt4
1	BB by Spain	3	6	1950-1975	1975-1978	0.000	0.044	0.801	0.155
2	BB by Spain	3	6	1976-1981	1975-1982	0.000	0.042	0.826	0.133
3	BB by Spain	3	6	1984-1987	1988-1992	0.000	0.018	0.739	0.243
4	BB by Spain	3	6	1998, 2001-2004	1996-2000	0.000	0.107	0.786	0.107
5	BB by Spain	3	6	2013-2015	2010-2012	0.000	0.037	0.779	0.184
6	BB by France	3	6	2015	2011-2016 (except 2015)	0.000	0.099	0.878	0.023
7	TP by Spain	12	4	1950-1989 (except 1986)	1986, 1990-1993	0.000	0.894	0.106	0.000
8	TP by Spain	12	7	1950-1998	CPC expert	0.000	0.000	0.900	0.100
9	TP by Morocco	12	4	1950-1971	Expert	0.000	0.900	0.100	0.000
10	TP by Morocco	12	4	1974-1998	Expert	0.000	0.900	0.100	0.000
11	TP by Morocco	12	7	1950-2016	Expert	0.000	0.000	0.900	0.100
12	TP by Portugal	12	4	1950-1995	1996-2000	0.007	0.433	0.209	0.352
13	HP by Canada	14	2	1950-1959	1993-1997	0.000	0.000	0.976	0.024
14	TL by Canada	14	2	1982-1989	1990-1995	0.000	0.000	0.742	0.119
			3			0.000	0.000	0.085	0.054
15	RR by Canada	14	2	1950-1974	1975-1981	0.000	0.000	0.013	0.000
			3			0.000	0.000	0.822	0.165
16	RR by Canada	14	2	1982-1989	1977-1981	0.000	0.000	0.227	0.071
			3			0.000	0.000	0.489	0.213
17	RR by Canada	14	2	1999	1997-2001	0.000	0.000	0.417	0.193
			3			0.000	0.000	0.265	0.124
18	USARR (FS,FB)	15,16	2	1950-1989	1990-1995	0.000	0.239	0.717	0.044
19	USARR (FS,FB)	15,16	2	1996	1994-1998	0.000	0.100	0.877	0.022

Table 4. Some expert knowledge or errors in the database to correct the catch data.

Fishery	Error	Move to
Canadian TP	Not in GSL	BF51 or WATL in Quarters 2-3
Canadian LL	Not in GSL	WATL, BF51 or BF52 in Quarters 2-4
FR. St Pierre et Miquelon	Not in GSL	WATL
Japanese LL	Not in GSL	WATL
Norwegian PS	Not in SATL	NATL
Norwegian PS	Not in Quarter 2	Quarter 3
Korean LL	70W was in EATL	WATL
USA PS	Not in GOM	WATL
Portugees TP	Not in EATL	SATL
French and Spanish BB	40N, 0E was in MED	EATL

Table 5. Available historical catch before 1949 by area and county, and the assumption for the proportion of quarterly catch.

<i>Flag</i>	<i>Area</i>	<i>Year</i>	<i>Proportion for quarterly catch</i>
EU.España	4	1872-1949	Table 3, No 7
EU.Portugal	4	1864-1949	Table 3, No 12
Maroc	4	1927-1949	Table 3, No 9
Norway	5	1927-1949	100% Qt3
EU.Denmark	6	1938-1949	Table 3, No 11
EU.España	6	1901-1949	Table 3, No 1
EU.Germany	6	1947-1949	Table 3, No 11
EU.Sweden	6	1937-1949	Table 3, No 1
EU.España	7	1920-1949	Table 3, No 8
EU.Italy	7	1864-1949	Table 3, No 11
Libya	7	1915-1949	Table 3, No 11
Maroc	7	1940-1949	Table 3, No 11
Tunisie	7	1864-1949	Table 3, No 11
Turkey	7	1909-1923	Table 3, No 11

Table 6. Assumption of length composition for the historical catch before 1950.

<i>Area</i>	<i>Country</i>	<i>Gear</i>	<i>Fleet</i>	<i>Average</i>	<i>Quarters</i>	<i>Mean size</i>
4	Spain, Portugal, Morocco	TP	12	1953-1964	2,3,4	180 cm
5	Norway	PS	8	1950-1954	3	170 cm
6	Spain, France	BB	3	1953-1968	2,3,4	100 cm
7	Same as Area 4 due to not enough data					

Table 7. Age length key for (a) Eastern bluefin and (b) Western bluefin.

a) Eastern bluefin

		Length bin														
		25	50	75	100	125	150	175	200	225	250	275	300	325	350	375
Age	1	1.000	0.728	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.272	0.398	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3	0.000	0.000	0.600	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.000	0.000	0.002	0.806	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	0.000	0.000	0.000	0.043	0.683	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.001	0.242	0.330	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	7	0.000	0.000	0.000	0.000	0.024	0.452	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	8	0.000	0.000	0.000	0.000	0.002	0.164	0.319	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	9	0.000	0.000	0.000	0.000	0.000	0.034	0.325	0.095	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	10	0.000	0.000	0.000	0.000	0.000	0.006	0.171	0.219	0.012	0.000	0.000	0.000	0.000	0.000	0.000
	11	0.000	0.000	0.000	0.000	0.000	0.001	0.065	0.249	0.054	0.001	0.000	0.000	0.000	0.000	0.000
	12	0.000	0.000	0.000	0.000	0.000	0.000	0.022	0.188	0.117	0.005	0.000	0.000	0.000	0.000	0.000
	13	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.113	0.159	0.019	0.000	0.000	0.000	0.000	0.000
	14	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.061	0.162	0.042	0.001	0.000	0.000	0.000	0.000
	15	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.031	0.138	0.068	0.005	0.000	0.000	0.000	0.000
	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.105	0.088	0.011	0.000	0.000	0.000	0.000
	17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.075	0.097	0.021	0.001	0.000	0.000	0.000
	18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.052	0.096	0.033	0.004	0.000	0.000	0.000
	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.036	0.089	0.044	0.007	0.001	0.000	0.000
	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.024	0.079	0.053	0.013	0.002	0.000	0.000
	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.017	0.068	0.060	0.020	0.004	0.000	0.000
	22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.058	0.064	0.028	0.007	0.001	0.000
	23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.049	0.066	0.037	0.012	0.003	0.000
	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.041	0.066	0.045	0.019	0.006	0.001
	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.034	0.065	0.053	0.028	0.010	0.003
	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.029	0.063	0.061	0.038	0.018	0.007
	27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.025	0.060	0.067	0.049	0.028	0.013
	28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.021	0.057	0.072	0.061	0.041	0.023
	29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.018	0.055	0.077	0.074	0.057	0.038
	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.016	0.052	0.080	0.087	0.077	0.059
	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.014	0.049	0.083	0.100	0.099	0.086
	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.013	0.046	0.085	0.112	0.124	0.121
	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.044	0.087	0.124	0.150	0.164
	34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.010	0.042	0.088	0.136	0.179	0.214
	35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.009	0.040	0.089	0.146	0.208	0.271

Table 7. Continued.

b) Western bluefin

		Length bin														
		25	50	75	100	125	150	175	200	225	250	275	300	325	350	375
Age	1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	2	0.000	0.999	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	3	0.000	0.001	0.963	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.000	0.000	0.037	0.738	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	0.000	0.000	0.000	0.259	0.417	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	6	0.000	0.000	0.000	0.003	0.538	0.193	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	7	0.000	0.000	0.000	0.000	0.043	0.593	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	8	0.000	0.000	0.000	0.000	0.002	0.184	0.393	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	9	0.000	0.000	0.000	0.000	0.000	0.026	0.341	0.134	0.001	0.000	0.000	0.000	0.000	0.000	0.000
	10	0.000	0.000	0.000	0.000	0.000	0.003	0.135	0.252	0.016	0.000	0.000	0.000	0.000	0.000	0.000
	11	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.223	0.054	0.001	0.000	0.000	0.000	0.000	0.000
	12	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.142	0.089	0.006	0.000	0.000	0.000	0.000	0.000
	13	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.081	0.100	0.016	0.001	0.000	0.000	0.000	0.000
	14	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.045	0.092	0.027	0.003	0.000	0.000	0.000	0.000
	15	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.027	0.079	0.037	0.008	0.001	0.000	0.000	0.000
	16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.065	0.043	0.014	0.003	0.000	0.000	0.000
	17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011	0.054	0.047	0.021	0.007	0.002	0.000	0.000
	18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.045	0.049	0.028	0.012	0.004	0.001	0.000
	19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.039	0.049	0.034	0.018	0.008	0.003	0.001
	20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.034	0.049	0.039	0.025	0.014	0.006	0.003
	21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.030	0.048	0.044	0.032	0.021	0.012	0.006
	22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.028	0.048	0.048	0.039	0.028	0.019	0.012
	23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.026	0.047	0.051	0.046	0.037	0.027	0.019
	24	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.024	0.046	0.053	0.051	0.045	0.037	0.028
	25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.023	0.046	0.055	0.056	0.053	0.046	0.039
	26	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.022	0.045	0.057	0.060	0.060	0.056	0.050
	27	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.021	0.045	0.058	0.064	0.066	0.064	0.061
	28	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.021	0.044	0.059	0.067	0.071	0.072	0.071
	29	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.020	0.044	0.060	0.070	0.076	0.079	0.081
	30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.020	0.044	0.060	0.072	0.080	0.085	0.089
	31	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.020	0.044	0.061	0.073	0.083	0.091	0.097
	32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.019	0.044	0.061	0.075	0.086	0.095	0.103
	33	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.019	0.044	0.062	0.076	0.088	0.099	0.109
	34	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.019	0.043	0.062	0.077	0.090	0.102	0.114
	35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.019	0.043	0.062	0.077	0.091	0.104	0.117

Table 8. Assumption of length composition for the historical catch between 1950 and 1964 (for missing years).

Fleet	Area	Average	Note
1	2	1983-1987	
1	4	1995-1999	
1	7	1984-1992	No data in 1990
2	1	1975-1979	
2	2	1973, 1975, 1976, 1977, 1978	borrow from GOM over 140cm
2	4	1957,75-77,1979	use directly data in 1953 and 1956 for those years
3	6	1953-1968	use directly data in 1957 for the year
5	7	1970-1974	
6	7	1970-1974	
8	5,6	There are complete data!	use directly data in 1950-1960 for those years
10	2	1977-1983	
12	4	1956-1964	use directly data in 1965-1964 for those years except 1960 and 1962
12	7	No data	borrow from trap (fleet 12) in area 4
14	2	1989-93	
14	3	1974-78	
15	2	1979-85	no data in 1980 and 1981
16	2	1955-61	
17	2	1955-61	use directly data in 1955-1961 for those years
17	4	1977-81	
17	5	No data	borrow from PSNOR
17	6	1952-62	use directly data in 1952-1962 for those years
17	7	1956-64	use directly data in 1956-1964 for those years

Table 9. Allocated catch for major countries between 2017 and 2020 in (a) East and (b) West Atlantic.

a) East Atlantic

	REC. 14-04	REC.17-07	REC.18-02	REC.18-02
Year	2017	2018	2019	2020
East TAC	23,155	28,200	32,240	36,000
Japan	1930.88	2279	2528	2801
Morocco	2152.71	2578	2892	3219
Norway	52.48	104	239	300
Cyprus	117.66	138.65	153.4	169.36
Greece	218.7	257.7	285.11	314.77
Spain	4243.57	5000.28	5532.16	6107.59
France	4187.3	4933.97	5458.8	6026.59
Croatia	661.82	779.84	862.79	952.53
Italy	3304.82	3894.13	4308.36	4756.49
Malta	271.14	319.49	353.48	390.25
Portugal	399.03	470.19	520.21	574.32
Other EU	47.32	55.76	61.69	68.11

b) West Atlantic

	REC. 16-08	REC. 17-06	REC. 17-06	REC. 17-06
Year	2017	2018	2019	2020
West TAC	2,000	2,350	2,350	2,350
Japan	345.74	407.48	407.48	407.48
Canada	437.47	515.59	515.59	515.59
US	1058.79	1247.86	1247.86	1247.86

Table 10. Assumption of allocated catch by fleet between 2017 and 2020.

<i>Gear</i>	<i>Fleet</i>	<i>Area</i>	<i>Country</i>	<i>Note</i>
LL	LLOTH (1)	Med		Total EATLTAC * %MED catch (ave16-17) * %MED LL catch in MED (ave16-17)
LL	LLOTH (1)	East		Total EATLTAC * %EATL catch (ave16-17) * %EATL LL catch in EATL (ave16-17) - JPNallocationEBFT
LL	LLOTH (1)	West		Total EATLTAC * %WATLcatch (ave16-17) * %WATL LL catch in WATL (ave16-17) - JPNallocationWBFT
LL	LLJPN (2)	East	JPN	JPNallocationEBFT
LL	LLJPN (2)	West	JPN	JPNallocationWBFT
BB	BBnew (4)	East	FRA+ESP (BF54)	ESPallocationEBFT * %ESPBB catch in ESP (ave16-17) +FRAallocationEBFT * %FRABB catch in FRA (ave16-17)
PS	PSMEDnew (7)	Med		Total EATLTAC * %MED catch (ave16-17) * %MED PS catch in MED (ave16-17) - PSHRV
PS	PSNOR (8)	Med	NOR	NORallocationEBFT * %NORPS catch in NOR (ave16-17)
PS	PSHRV (9)	Med	EU.Croatia	HRVallocationEBFT (in EU) * %HRVPS catch in HRV (ave16-17)
TP	TPnew (13)	East	MOR+POR+ESP	MORallocationEBFT * %MORTP catch in MOR (ave16-17) +PORallocationEBFT * %PORTP catch in POR (ave16-17) +ESPallocationEBFT * %ESPTP catch in ESP (ave16-17)
RR	RRCAN (14)	West	Canada	CANallocationWBFT * %CANRR9(RR,HL,HP) catch in CAN (ave16-17)
RR	RRUSAFS (15)	West	USA	USAallocationWBFT * %USARRFS (small) catch in USA (ave16-17)
RR	RRUSAFB (16)	West	USA	USAallocationWBFT * %USARR (RR+HP+HL) catch in USA (ave16-17) - USRRFS

Table 11. The catch by fleet, area, and quarter used in OMs. The values highlighted in yellow or orange are probably equipartition of the annual catch.

[illegible]

[illegible]

Table 12. The estimated allocated catch by fleet between 2017 and 2020.

<i>Fleet</i>	<i>Area</i>	<i>Country</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>
LLOTH (1)	Med	all others except Japan	1183.78	1809.66	2068.92	2310.20
LLOTH (1)	East	all others except Japan	303.12	344.94	471.86	548.72
LLOTH (1)	West	all others except Japan	224.77	323.02	323.02	323.02
LLJPN (2)	East	Japan	1910.61	2279.00	2528.00	2801.00
LLJPN (2)	West	Japan	345.83	407.48	407.48	407.48
BBnew (4)	East	France and Spain in Bay of Biscay	867.17	1063.05	1176.12	1298.46
PSMEDnew (7)	Med	All PS except Croatia in Med	13883.70	16293.17	18652.74	20837.71
PSNOR (8)	Med	Norway	47.14	97.78	224.71	282.06
PSHRV (9)	Med	Croatia	586.63	687.67	760.82	839.95
PSWnew (11)	West	USA,Canada	0.00	0.00	0.00	0.00
TPnew (13)	East	Spain,Morocco and Portugal	3362.45	4141.50	4616.08	5118.64
RRCAN (14)	West	Canada	344.1203	414.1369	414.1369	414.1369
RRUSAFS (15)	West	USA	197.5411	254.5472	254.5472	254.5472
RRUSAFB (16)	West	USA	597.1076	856.4611	856.4611	856.4611

Table 13. Fisheries dependent indices in OMs.

Flag	Gear	Details
Spain	Baitboat	1952-2006, Q3, E Atl
Spain / France	Baitboat	2007-2014, Q3, E Atl
Morocco / Spain	Trap	1981-2011, Q2, SE Atl
Morocco / Portugal	Trap	2012-2016, Q2, SE Atl
Japan	Longline	1975-2009, Q2, SE Atl
Japan	Longline	1990-2009, Q4, NE Atl
Japan	Longline	2010-2016, Q4, NE Atl
US (66cm - 114cm)	Rod and reel	1993-2016, Q3, W Atl
US (115cm - 144cm)	Rod and reel	1993-2016, Q3, W Atl
US (177cm+)	Rod and reel	1993-2016, Q3, W Atl
US (<145cm)	Rod and reel	1980-1992 (gap in 1984), Q3, W Atl
US (195cm+)	Rod and reel	1983-1992, Q3, W Atl
US	Longline	1987-1991, Q2, GOM
US	Longline	1992-2016, Q2, GOM
Japan	Longline	1974-1980, Q2, GOM
Japan	Longline	1976-2009, Q4, W Atl
Japan	Longline	2010-2016, Q4, W Atl
Canada GSL	Rod and reel	1984-2016, Q3, GSL
Canada SWNS	Rod and reel	1988-2016, Q3, W Atl

Table 14. Fisheries independent indices in OMs.

Type	Details
French aerial survey	2000-2003, 2009-2017 (gap in 2013), Q3, Med
Spanish Larval survey	2001-2015 (gaps in 2006-2011), Q2, Med
Canadian acoustic survey	1994-2016, Q3, GSL
USA Larval survey	1977-2016 (gaps in 1979-1980, and 1985), Q2, GOM
Aerial survey – GBYP*	2010-2017 (gaps in 2012, 2014, and 2016), Q2, Med

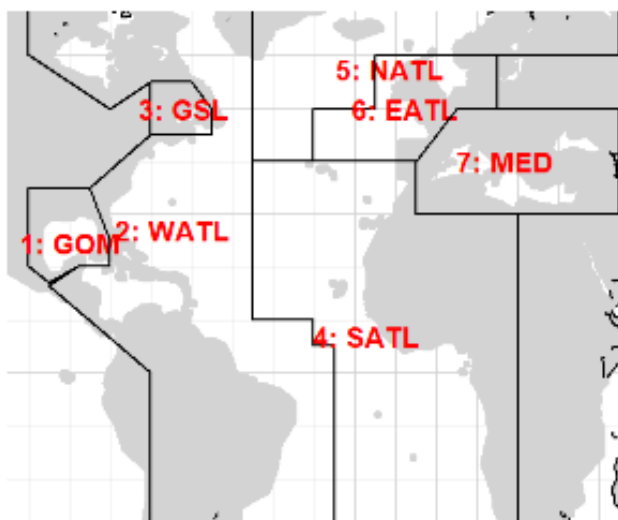


Figure 1. Area stratification defined in BFT OMs (version 5.2.3).

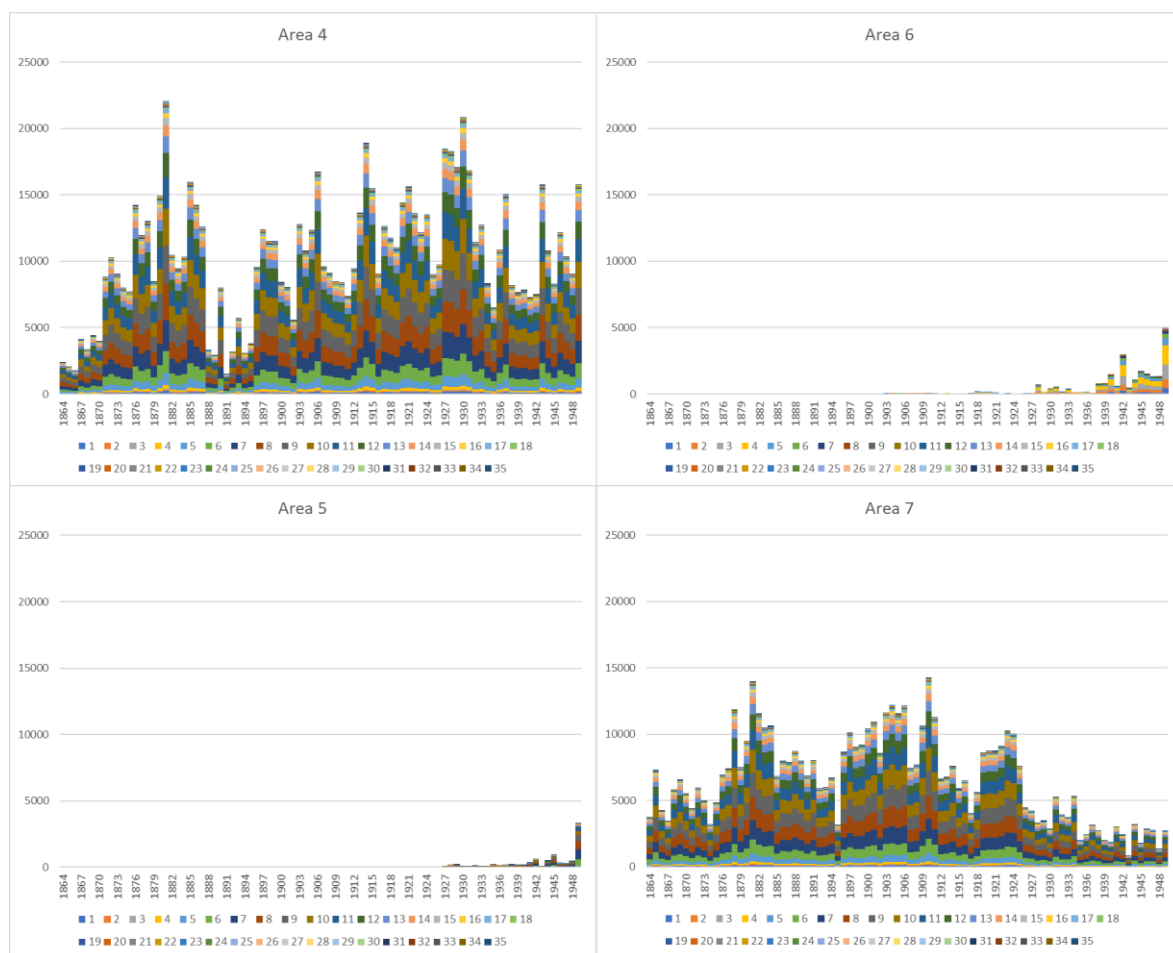


Figure 2. Historical catch (t) at age by Area (HCobs) between 1864 and 1949.

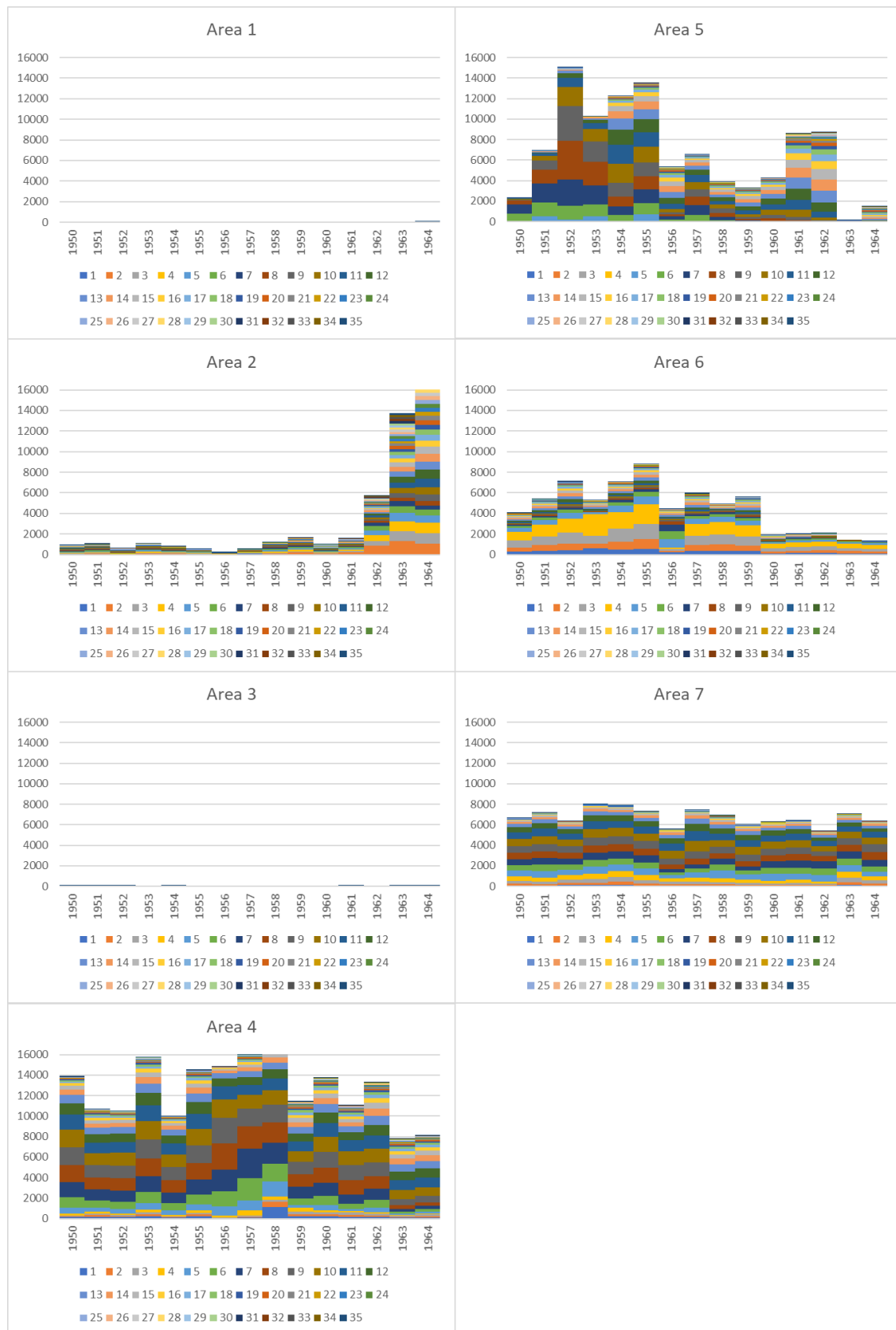


Figure 3. Historical catch (t) at age by Area (HCobs) between 1950 and 1964.

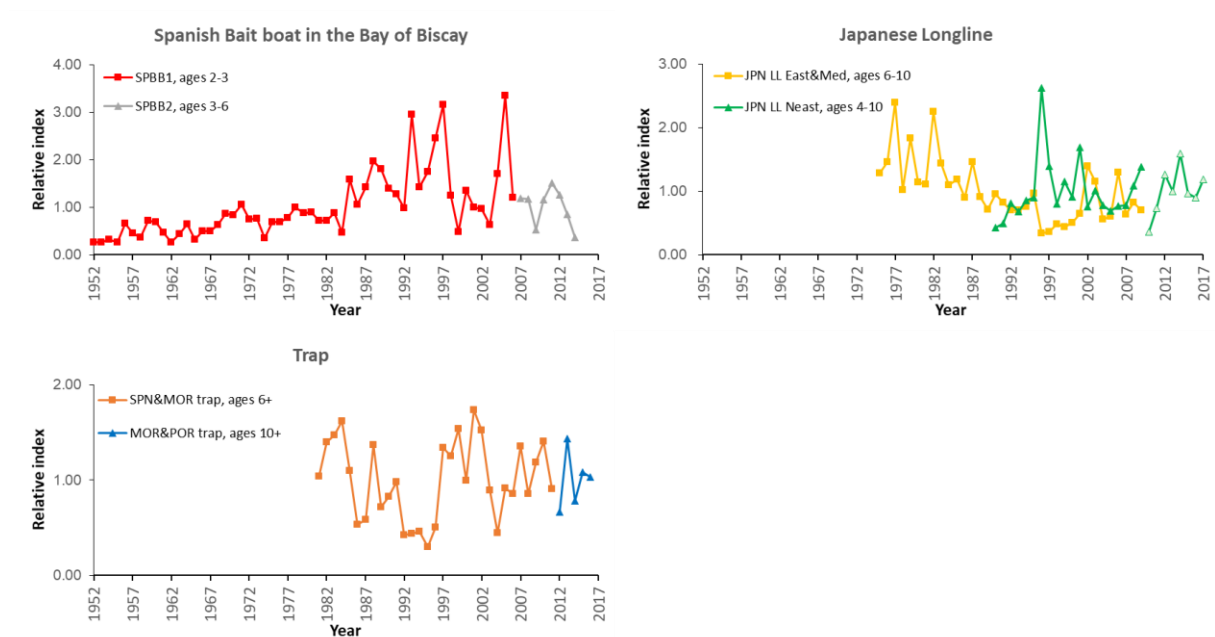


Figure 4. CPUE indices in the OMs in the East Atlantic.

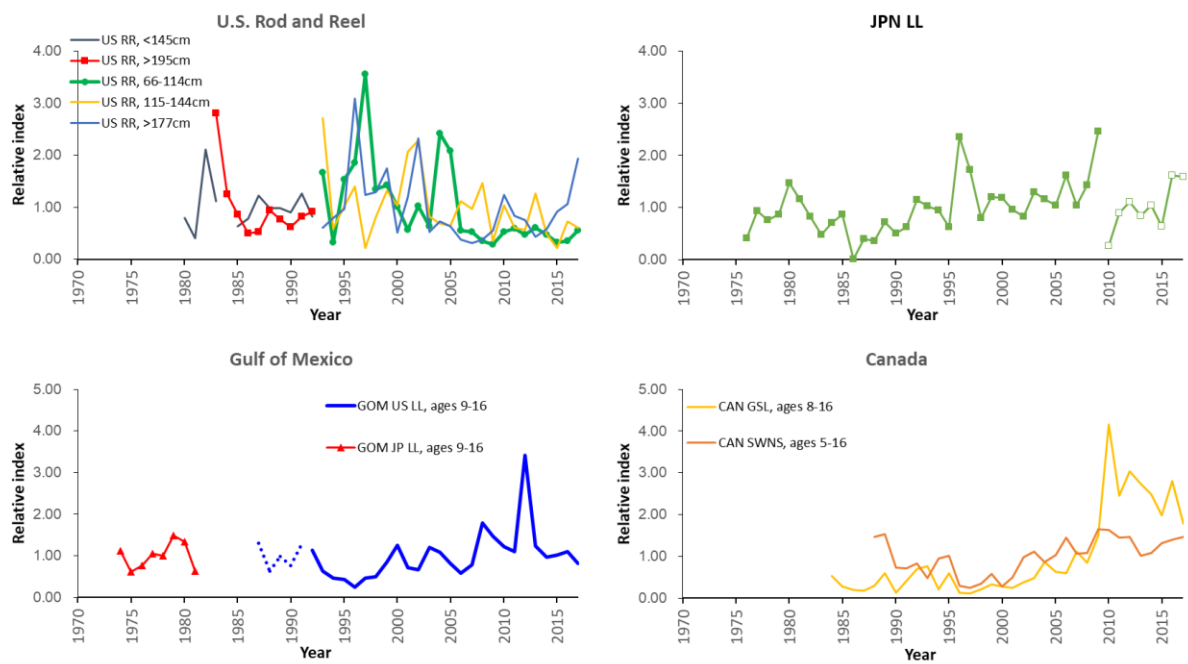


Figure 5. CPUE indices in the OMs in the West Atlantic.

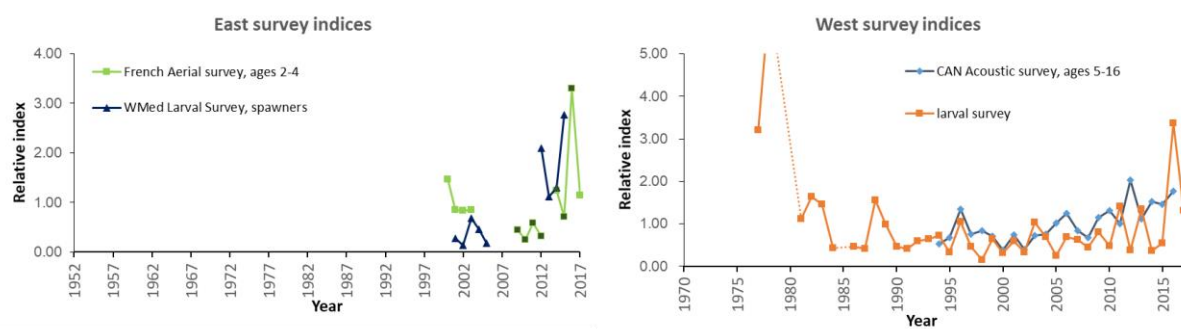


Figure 6. Fisheries independent survey indices in the OMs in the East and the West Atlantic.