9.3 BFT-ATLANTIC BLUEFIN TUNA

The Committee notes that Atlantic bluefin tuna management is embarking upon a transition to a management procedure approach, pending adoption by the Commission at its November 2022 meeting. Such an approach will link eastern and western area TACs under one management framework, providing joint management advice. This approach will also require a restructuring of the traditional separate management advice sections East and West BFT (E-BFT and W-BFT) Executive Summaries. The Committee takes this opportunity in the bluefin tuna 'preamble' to comment on recommendations for both East and West BFT in this regard.

The primary efforts of the Committee have been directed at the ongoing development of the Management Strategy Evaluation (MSE) and, as the MSE has simulation tested multiple management procedures to check that they are robust to multiple uncertainties, the Committee recommends that the Commission adopt a management procedure which will set TAC advice for both the East and the West areas for 2023 and beyond. Should the Commission not be able to adopt a management procedure in 2022, the Committee sees no undue risk to either eastern or western stocks for a rollover of the present TACs to apply for 2023, based on an evaluation of the updated abundance indices.

The Commission requested the previously scheduled stock assessment of E-BFT in 2022 to be pursued for the purposes of evaluating stock status. In that regard, the Committee has been successful, exceeding previous attempts in that three assessment models were determined to be useful for evaluating stock status relative to fishing mortality. While this is a substantial accomplishment, the assessment models for bluefin tuna are nevertheless believed to be better at providing relative stock status (e.g., status relative to $F_{0.1}$) than in providing absolute TAC advice. This challenge plays out in the substantial variability in the absolute scale of the total population size estimates coming from the assessment models. Given this uncertainty as well as a number of remaining issues related to the reliability of basic catch data, the Committee is not providing TAC recommendations based on the assessment models. For the W-BFT, the Committee conducted an assessment in 2021 which was also used only for stock status relative to overfishing and not for TAC advice. As an assessment has not been conducted for W-BFT this year, the Committee will not provide an updated Executive Summary. Instead, management advice for W-BFT will be provided specifically in response to the Commission's request (item 17.11).

In past situations where the Committee has not developed TAC advice directly from assessments, it has employed alternative options, e.g., explorations based on index trends. However, such options could not be considered the best available scientific information for informing TAC decisions in light of the extensive, robust and simulation tested advice that comes from any of the remaining available candidate management procedures. Hence the Committee reiterates its recommendation that TAC advice for 2023 (and beyond) for both East and West areas be obtained from an MSE tested management procedure (see item 17.14, Response to the Commission's request).

BFT-1. Biology

Atlantic bluefin tuna (BFT) have a wide geographical distribution but live mainly in the temperate pelagic ecosystem of the entire North Atlantic and its adjacent waters, for example the Gulf of Mexico, Gulf of St. Lawrence and the Mediterranean Sea. Historical catch information documents the presence in the South Atlantic (**BFT-Figure 1**). Electronic archival tagging information has confirmed that bluefin tuna can tolerate cold as well as warm water temperatures while maintaining a stable internal body temperature. Bluefin tuna preferentially occupy the surface and subsurface waters of the coastal and open-sea areas, but archival electronic tagging and ultrasonic telemetry data indicate that they frequently dive to depths of more than 1,000 m. Bluefin tuna are a highly migratory species that seems to display a homing behavior and spawning site fidelity to primary spawning areas in both the Mediterranean Sea and the Gulf of Mexico. Evidence indicates spawning in other areas, for example the vicinity of the Slope Sea off the Northeast USA and more recently the Cantabrian Sea, though the persistence and importance of these other areas as spawning grounds remain to be determined. Electronic tagging is also resolving the movements to the foraging areas within the Mediterranean and the North Atlantic and indicates that bluefin tuna movement patterns vary by tagging site, by month of tagging and according to the age of the fish. The reappearance of bluefin tuna in historical fishing areas (e.g., Norway and, more recently, the Black Sea) suggest that important changes in the spatial dynamics of bluefin tuna may also have resulted from interactions between biological factors, environmental variations and a reduction in fishing effort.

The fisheries for Atlantic bluefin tuna are managed as two management units, conventionally separated by the 45°W meridian. However, efforts to understand the population structure through tagging, genetic and microchemistry studies indicate that mixing is occurring at variable rates between the two management areas.

The ICCAT GBYP, as well as national research programmes, have provided the basis for improved biological studies. Substantial progress has been made in estimating regional, time varying mixing rates for Atlantic bluefin tuna, using otolith stable isotope and genetic analyses. Research on the larval ecology of Atlantic bluefin tuna has advanced in recent years through oceanographic habitat suitability models. Direct age estimation, using otoliths and dorsal fin spines from both stock areas, have been calibrated between readers from several institutions resulting in stock specific age length keys and a new growth model for the western population. Otolith preparation and reading protocols have been updated to minimize bias in age estimation. Following Rec. 18-02 para 28, a research study of growth in farms was launched in 2019 at five locations, and a new database will be created to integrate all the data from stereo-camera measurements and harvesting operations. Additionally, a Sub-group on growth of BFT in farms was established in 2020 within the BFT Species Group. This Sub-group was created to ensure that the best scientific data would be provided to the Commission.

Currently, the Committee assumes for assessment purposes that eastern Atlantic and Mediterranean bluefin tuna contributes fully to spawning at age 5. There are also indications that some young individuals (of age 5) of unknown origin caught in the West Atlantic are mature, but there is considerable uncertainty with regards to their contribution to the western stock spawning. Therefore, the Committee has considered two spawning schedules for the western stock; one identical to that used for the East and one with peak spawning at age 15. However, the latest review of reproductive biology has shown that both the current vectors for spawning fraction at-age might be biased, and that the magnitude of that bias is unknown. Juvenile growth is rapid for a teleost fish, but slower than for other tuna and billfish species. Fish born in June attain a length of about 30-40 cm and a weight of about 1 kg by October. After one year, fish reach about 4 kg and 60 cm in length. At 10 years of age, a bluefin tuna is about 200 cm and 170 kg and reaches about 270 cm and 400 kg at 20 years of age. Bluefin tuna is a long-living species, with a lifespan of about 40 years as indicated by radiocarbon deposition and can reach 330 cm (SFL) and weigh up to 725 kg. In 2017, the Committee revised the natural mortality assumptions, and adopted a single new age specific natural mortality vector for both stocks.

Important electronic and conventional tagging activity has been conducted for both juvenile and adult fish for several years in the Atlantic and Mediterranean by the ICCAT GBYP, National Programmes and NGOs. Contributions from e-tag data from all groups are supporting ongoing efforts to provide important insights into bluefin tuna stock structure, distribution, mixing and migrations, and are helping to estimate fishing mortality rates and to condition the MSE operating models.

EAST BLUEFIN TUNA

BFTE-2. Fishery trends and indicators –East Atlantic and Mediterranean

Reported catches in the East Atlantic and Mediterranean reached a peak of over 50,000 t in 1996 and then decreased substantially, stabilizing at around the TAC levels established by ICCAT for the most recent period (**BFTE-Figure 1**). Catches between 2017 and 2021 (as of September 2022) were respectively 23,665 t, 27,782 t, 31,134 t, 35,038 t and 35,075 t for the East Atlantic and Mediterranean, of which 16,450 t, 19,624 t, 22,041 t, 24,164 t and 24,729 t were reported for the Mediterranean for those same years (**BFT-Table 1**). The Committee is aware of ongoing, unquantified, IUU catches that represents a serious impediment to being able to determine the productivity of the stock and to provide reliable TAC advice. In response, the Committee urges identification and quantification of IUU catches so that it can provide more accurate biomass-based catch advice and obtain more accurate scientific understanding of stock productivity.

Available information has demonstrated that catches of bluefin tuna from the East Atlantic and Mediterranean were seriously under-reported between the mid-1990s through 2007. The Committee estimated that the realized total catch during this period was likely of the order of 50,000 t to 61,000 t per year, based on the number of vessels operating in the Mediterranean Sea and their respective catch rates.

Since the 2017 Stock Assessment (Anon., 2018a), these estimates (1998-2007) have been treated as the actual catches.

During the 2022 Stock Assessment meeting, the decision was made to use ten abundance indices up to 2020 (seven CPUE series and three fisheries independent indices) (**BFTE-Figure 2**).

CPUE indices (**BFTE-Figure 2**) have been affected appreciably by regulatory measures through changes to operational patterns, length of the fishing season and target sizes; thus, it is difficult to distinguish the effect of these changes on CPUE index values from the effects of changes in abundance.

BFTE-3. State of the stock

There have been considerable improvements in data quality and quantity over the past few years; nevertheless, important gaps remain in the temporal and spatial coverage for detailed size and catch-effort statistics for several fisheries, especially in the Mediterranean before the implementation of stereo video cameras in 2014. The catch at size (CAS) and catch-at-age (CAA) of the NEI catch (1998-2007) were revised.

Three modelling platforms were used to conduct the assessment of the E-BFT in 2022. As in previous assessments, a virtual population analysis (VPA) was conducted, and two additional platforms, Stock Synthesis (SS) and the age-structured assessment programme (ASAP), were applied.

The three models showed similar trends in spawning stock biomass (SSB), with a progressive decline in SSB from the 1970s until the implementation of a Recovery Plan developed in 2006 (Rec. 06-05). Since the late 2000s there has been a strong increase in SSB, although the magnitude and rate of increase differ among the three models, with VPA indicating a lowest biomass while ASAP indicates the largest increase. Uncertainty in the rate and magnitude of the increase in SSB is evident for all three platforms and in the sensitivity tests conducted for each platform, especially in recent years (**BFT-E Figure 3**). The fishing mortality of the age group 2-5 and age 10+ fish showed an increasing trend since the 1970s, whereas the F for both the age group 2-5 and age 10 plus shows a drastic decline in fishing mortality since the establishment of the 2006 Recovery Plan (**BFT-E Figure 3**). Recently, fishing mortality has been increasing, however, when average over all three models, fishing mortality is still below fishing mortality target.

Recruitments estimated by the three assessment platforms show considerable variability, especially over the recent period. In general, however, there are two distinct periods, one with low recruitments before 1990 and the other with higher recruitments thereafter (**BFT-E Figure 3**).

An independent review concluded that the results of the three models are sufficient to provide general management advice that abundance has increased and is likely to continue to increase given recent patterns of fishing mortality (effort). However, the review also recommended against using the results from these models for TAC advice.

The current perception of the stock status depends on recruitment estimates which are highly uncertain. The different models showed a relatively wide range of stock status estimates relative to the $F_{0.1}$ reference level, ranging from overfishing to not overfishing ($F_{CURRENT}/F_{0.1}$): VPA = 1.16; SS = 0.72 and ASAP = 0.54. To inform stock status, the Committee recommended that the results of the three models be considered equally, by integrating the results. The resultant point estimate of F_{CUR} is below $F_{0.1}$ ($F_{CURRENT}/F_{0.1}$= 0.81; 95% CI 0.48-1.62), indicating a stock status determination of not overfishing. Furthermore, fishing mortality rates are much lower than those during the 1998-2007 period.

BFTE- 4. Outlook

The Committee considers that the three assessment platforms (VPA, SS and ASAP) have disparate and highly uncertain estimates of recent recruitment and absolute biomass, which would make short-term catch advice based on $F_{0.1}$ not robust in terms of both the consequences of taking a particular TAC and the accuracy of absolute $F_{0.1}$ estimate. Considering the uncertainties and shortcomings noted above, as well as the advice of the independent peer review, the Committee only provides VPA short-term projections and only for informative purposes. The VPA projections were conducted at both $F_{0.1}$ and at the current TAC of 36,000 t, using a long term (1968-2016) average and a recent (2007-2016) average of recruitment. Projections at $F_{0.1}$ correspond to median yields of 35,000 t and 38,500 t for 2023 and 2024, respectively. These projections, as well as those with the current TAC, indicate that the spawning biomass increases for the next two years under both scenarios and under both recruitment assumptions (**BFTE-Figure 4**).

As requested in Rec. 21-08, the Committee evaluated whether the stock size indicators supported the TAC advice for 2023 and the following years. Evaluation of recent changes in these indicators in 2022 indicate positive signs in almost all of these, because although there have been decreases in some of these indices in recent years (French Aerial survey and JPN LL NEast), their values are still high compared to historical levels (**BFTE-Figure 2**).

BFTE-5. Effect of current regulations

The Committee noted that reported catches are in line with recent TACs. However, the Committee has been informed of the existence of unquantified illegal catches.

The TAC of 36,000 t originally implemented in 2020 through Rec. 19-04 and retained in Rec. 21-08 has been in place for 3 years. The combination of size limits and the reduction of catch has certainly contributed to a rapid increase in the abundance of the stock.

BFTE-6. Management recommendations

The Committee recommends that the Commission adopt one of the MSE-tested management procedures (see item 17.14, Response to the Commission's request), and that the TAC be set based on that MP for 2023 and beyond.

Should the Commission not adopt a management procedure in 2022, the Committee sees no undue risk to the stock for a rollover of the present TAC for 2023 (36,000 t). The Committee bases this on a review of the stock indicators and from the trends in the VPA projections that indicate increases in the stock under the current management.

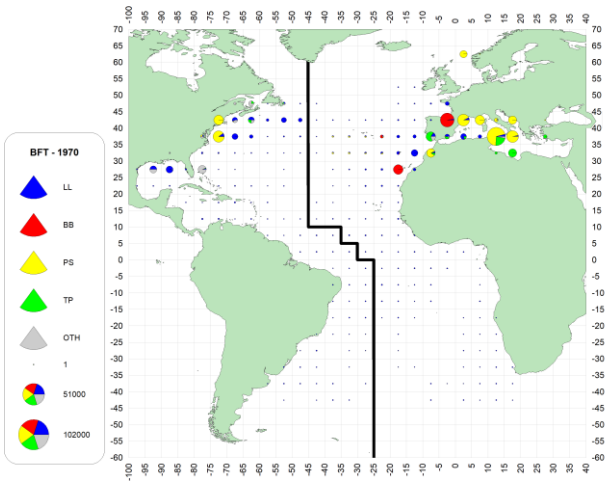
EAST ATLANTIC AND MEDITERRANEAN BLUEFIN TUNA SUMMARY	
Current reported catch (2021)	35,075 t*
$F_{CURRENT}/F_{0.1}$[2]	0.81 (0.48-1.62)[1]
Stock Status [3]	Overfishing: No
TAC 2022	36,000 t

[1] Mean and approximate 95% confidence interval from integrating across the uncertainty for each model.
[2] $F_{CURRENT}$ refers to the geometric mean of the estimates (a proxy for recent F levels) for 2017-2020 for VPA, and for 2018-2020 for ASAP and Stock Synthesis. For the VPA and ASAP, F is measured as apical F, for Stock Synthesis F is exploitation rate in biomass.
[3] Biomass reference points to determine stock status were not estimated since the 2017 assessment due to uncertainty in recruitment potential.
* As of September 2022.

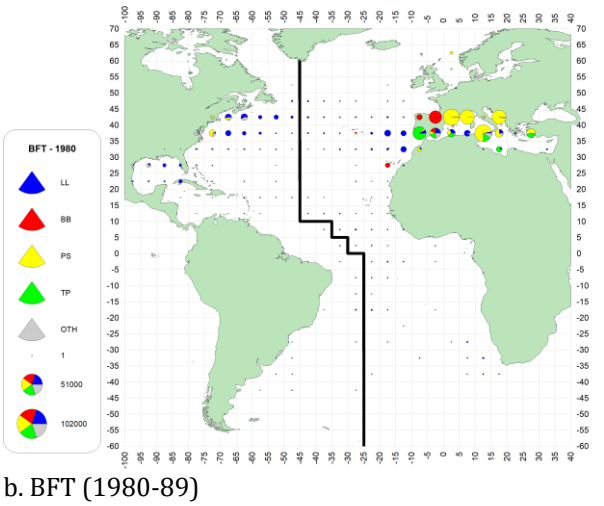
BFT-Table 1. Estimated catches (t) of northern bluefin tuna (*Thunnus thynnus*) by area, gear and flag.

				1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
TOTAL				34128	36642	48881	49751	54009	53545	52657	52772	52775	52784	53319	52305	52125	51756	51812	62638	26460	21798	13195	11781	12688	14725	14887	18055	21076	25515	29809	33440	37308	37378
BFT-E				31831	34258	46769	47303	51497	51211	50000	50000	50000	50000	50000	50000	50000	50000	50000	61000	24460	19818	11338	9774	10934	13243	13261	16214	19175	23665	27782	31134	35038	35075
	ATE			7396	9317	7054	9780	12098	16379	11630	10247	10061	10086	10347	7394	7402	9023	7529	8441	8243	6684	4379	3984	3834	4163	3918	4841	5968	7216	8157	9093	10874	10346
	MED			24435	24941	39715	37523	39399	34831	38370	39753	39939	39914	39653	42606	42598	40977	42471	52559	16217	13133	6959	5790	7100	9080	9343	11372	13206	16450	19624	22041	24164	24729
BFT-W	ATW			2296	2384	2113	2448	2512	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1857	2007	1754	1482	1627	1842	1901	1850	2027	2306	2269	2303
Landings	ATE		Bait boat	1422	3884	2284	3093	5369	7215	3139	1554	2032	2426	2635	1409	1902	2282	1263	2436	2393	1260	725	636	283	243	95	172	1085	1195	692	845	936	1031
			Longline	3618	2802	2311	4522	4212	4057	3789	3570	3736	3303	2896	2748	2064	2700	2033	1705	2491	1951	1194	1125	1139	1167	1194	1467	1829	2208	2730	3177	3313	3286
			Other surf.	523	976	590	555	273	60	387	404	509	558	631	521	290	424	831	502	181	297	124	35	49	141	210	193	261	295	340	320	381	359
			Purse seine	462	24	213	458	323	828	700	726	661	153	887	490	1078	1197	408	0	0	2	1	0	0	2	0	0	42	49	11	56	190	147
			Sport (HL+RR)	7	0	25	0	0	237	28	33	126	61	63	109	89	11	99	11	12	11	44	51	53	46	43	104	35	101	118	92	156	267
			Traps	1365	1631	1630	1152	1921	3982	3586	3960	2996	3585	3235	2116	1978	2408	2895	3788	3166	3164	2292	2137	2311	2564	2376	2905	2716	3362	4258	4594	5889	5255
	MED		Bait boat	158	48	0	206	5	4	11	4	38	28	1	9	17	5	0	0	0	38	1	0	2	2	9	25	0	50	56	72	103	81
			Longline	3145	2470	6993	8469	9856	7313	4117	3338	3424	4144	3234	3484	3036	3427	3408	3269	2376	1344	1242	962	587	605	588	776	1523	1184	1518	1436	1824	1619
			Other surf.	447	371	776	545	417	282	284	228	728	354	340	198	197	175	81	85	0	0	1	1	1	20	29	3	37	90	34	51	282	65
			Purse seine	18580	20065	27948	23799	26021	24279	31792	33798	33237	33043	34044	37291	37869	36639	38363	48994	13540	11448	4986	4293	6172	7982	8184	9993	11340	14493	17128	19515	20872	21989
			Sport (HL+RR)	952	1238	2307	3562	2149	2340	1092	1533	1773	1167	1520	1404	1325	619	494	117	149	160	448	356	202	240	289	373	297	351	582	611	713	718
			Traps	1152	749	1691	942	951	613	1074	852	739	1177	515	221	154	112	125	93	152	144	281	165	125	222	232	192	0	272	300	353	366	252
	ATW		Longline	689	712	539	491	545	382	764	915	858	610	729	186	644	425	565	420	606	366	529	743	478	470	498	553	562	559	664	675	576	651
			Other surf.	509	406	307	384	429	293	342	279	283	201	107	139	97	89	85	63	78	121	107	147	117	121	119	138	93	123	77	168	134	175
			Purse seine	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	38	34	0	0	0	0	0	
			Sport (HL+RR)	586	854	804	1114	1032	1181	1108	1125	1121	1650	2036	1399	1139	924	1005	1023	1134	1251	1009	888	917	692	810	1085	1204	1144	1263	1450	1543	1444
			Traps	1	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6	10	13	3	4	4	4
Discards	ATE		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	9	8	1
	MED		Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2	9	10	6	4	5	4
	ATW		Longline	211	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	145	139	19	29	10	17	7	8	25
			Other surf.	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	1	2	2	4	3
			Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	5	0	0	0	0	0	
			Sport (HL+RR)	0	0	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATE	CP	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			China PR	0	0	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	45	54	64	79	89	101	101
			EU-Denmark	0	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	3
			EU-España	2318	4962	3137	3819	6186	9519	4565	4429	3493	3633	4089	2172	2801	3102	2339	3680	3536	2409	1550	1483	1329	1553	1282	1655	1986	2509	2489	2729	3289	2953
			EU-France	894	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	212	254	343	350	461	462	557	559
			EU-Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU-Ireland	0	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	19	14	32	16	17	6	16	16
			EU-Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	
			EU-Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU-Portugal	128	91	363	169	199	712	323	411	441	404	186	61	27	82	104	29	36	53	58	180	223	235	243	263	327	429	450	475	592	614
			EU-Sweden	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Great Britain	0	0	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	0	2
			Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	7	0	0	
			Guinée Rep	0	0	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Iceland	0	0	0	0	0	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	37	6	0	0	0	1	1
			Japan	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1578	1905	2262	2514	2773	2779
			Korea Rep	0	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0	0	0	0	161	181	208	232	247	242
			Maroc	562	415	720	678	1035	2068	2341	1591	2228	2497	2565	1795	1953	2389	1923	2418	1947	1909	1348	1055	990	960	959	1176	1433	1703	2164	2525	3089	2922
			Norway	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	44	51	12	49	194	152
			Panama	0	0	1	19	550	255	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	
			Sierra Leone	0	0	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC		Chinese Taipei	0	6	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCO		Faroe Islands	0	0	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	6	2
			NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	144	223	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Seychelles	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	MED	CP	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	9	34	40	47	56	100	156	168	148
			Algerie	1104	1097	1560	156	638	829	1674	1760	2083	2098	2056	1504	1440	1500	1673	1489	1311	0	0	0	69	244	244	370	448	1038	1300	1437	1649	1650
			China PR	0	0	97	137	93	49	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU-Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			EU-Croatia	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456	515	630	738	827	903	903

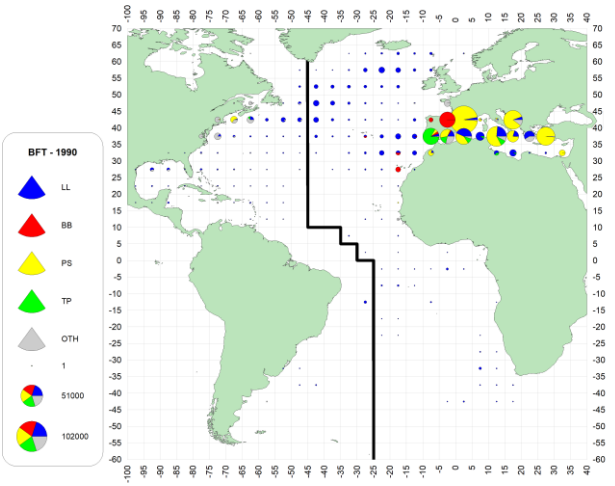
			EU-Cyprus	10	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	18	22	59	110	133	151	153	169
			EU-España	2165	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942	1064	948	1164	1238	1467	1688	2706	2660	2774	3228
			EU-France	7376	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10200	2670	3087	1755	805	791	2191	2216	2565	3054	3661	4360	4919	5316	5289
			EU-Greece	447	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	161	195	218	235	267	313	354	327
			EU-Italy	5006	5379	6901	7076	10200	9619	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1061	1783	1788	1938	1946	2273	2488	3196	3860	4286	4731	4699
			EU-Malta	81	259	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	316	136	142	137	155	160	182	212	261	308	338	387	382
			EU-Portugal	211	164	306	313	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	77	77	155	99	124	181	263	122	327
			Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	
			Japan	123	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0	0	0	0	0	0	0	0	0	
			Korea Rep	0	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	77	80	81	0	0	0	0	0	0	
			Libya	737	635	1422	1540	1388	1029	1331	1195	1549	1941	638	752	1300	1091	1327	1358	1318	1082	645	0	756	929	933	1153	1368	1631	1792	2052	2228	2234
			Maroc	205	79	1092	1035	586	535	687	636	695	511	421	762	827	108	463	641	531	369	205	182	223	309	310	322	350	439	407	395	365	372
			Panama	484	467	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	0	0	0	0	40	47	57	66	72	79	
			Tunisie	1195	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	431	2679	1932	1042	852	1017	1057	1047	1248	1486	1783	2102	2380	2653	2730
			Türkiye	2817	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	1091	1324	1515	1284	1771	2258	2266
		NCC	Chinese Taipei	0	328	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCO	Gibraltar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	14	16	15	17	20	
			ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	1	0	1	1	0	0	0	0
			Israel	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	0	0	427	639	171	1058	761	78	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (combined)	1398	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (inflated)	0	0	0	0	0	0	9471	16893	16458	15298	15880	18873	18376	14164	18343	28234	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Serbia & Montenegro	0	0	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Yugoslavia Fed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	CP	Brazil	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
			Canada	443	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	463	531	466	472	508	666	642	626
			EU-España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			FR-St Pierre et Miquelon	0	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0	0	0	9	0	0	0	0	0	
			Japan	512	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	345	346	406	406	407	408
			Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Mexico	15	17	4	23	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	23	51	53	55	34	80	39	28	63
			Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK-Bermuda	0	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1
			UK-British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			UK-Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			USA	1085	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	502	667	877	1002	986	1013	1185	1178	1177
		NCC	Chinese Taipei	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NCO	Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Cuba	0	0	0	0	0	0	0	0	0	0	74	11	19	27	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Dominica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			NEI (Flag related)	17	0	0	0	0	0	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
			Sta Lucia	14	2	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards		ATE	CP	Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	7	9	8	1
		MED		Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
				EU-Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	2	2	4	5	6	4	5	4
				EU-España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	
				Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	0	0	0	0	0	0	
				Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	5	5	0	0	0	
				Türkiye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	
		ATW		Canada	0	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17	0	0	3	8	1	3	3	5	5
				Japan	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
				Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
				USA	211	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	159	143	22	24	10	15	6	8	23



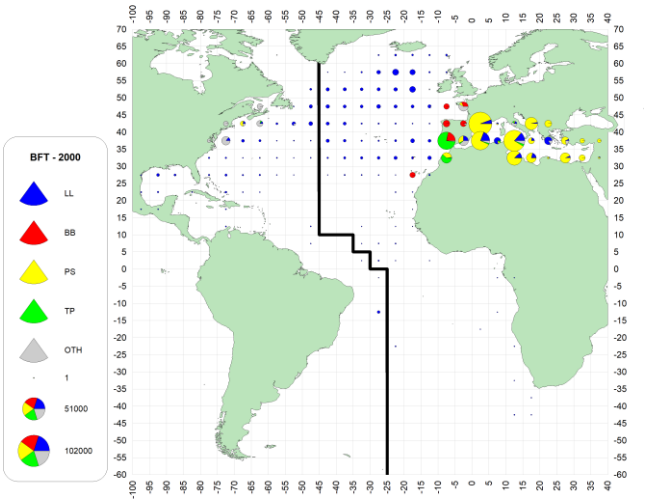
a. BFT (1970-79)



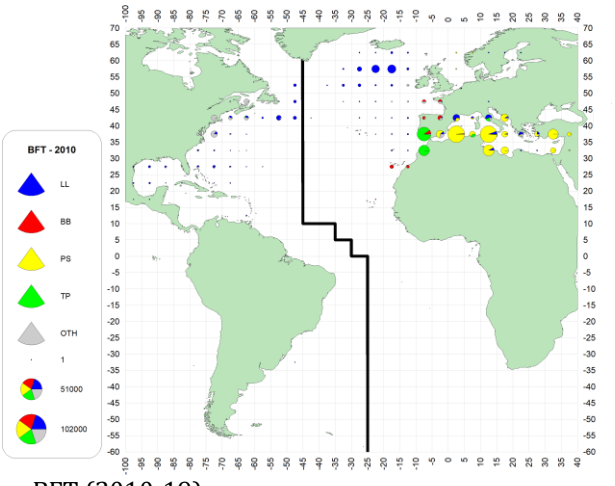
b. BFT (1980-89)



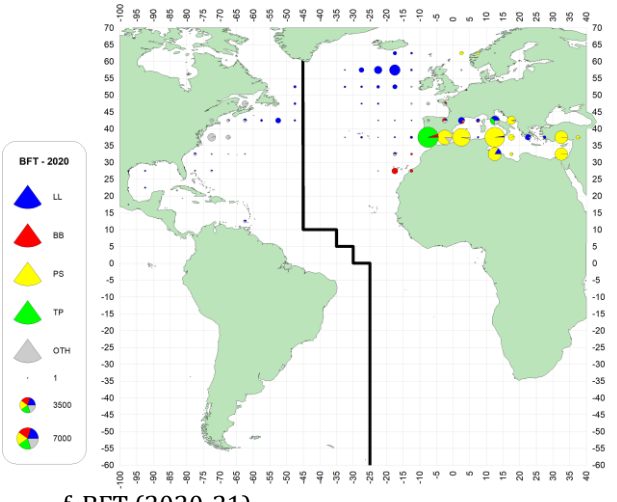
c. BFT (1990-99)



d. BFT (2000-09)

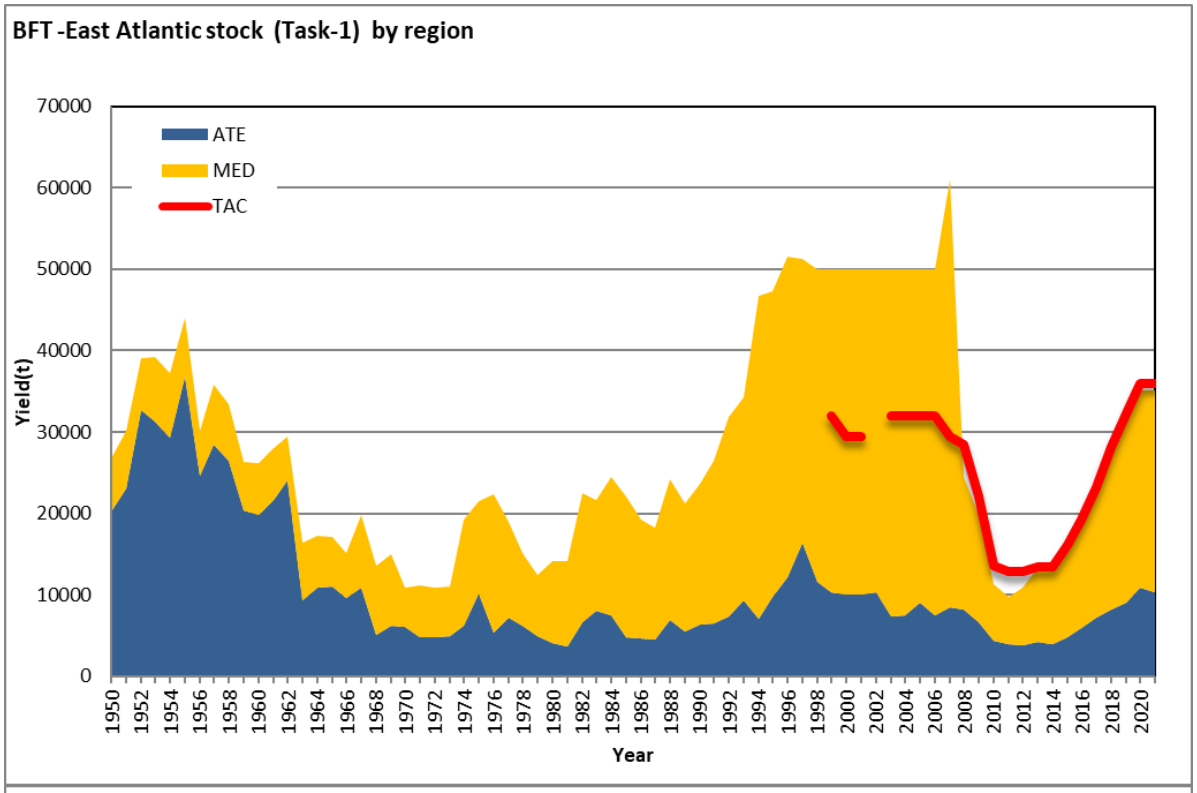


e. BFT (2010-19)

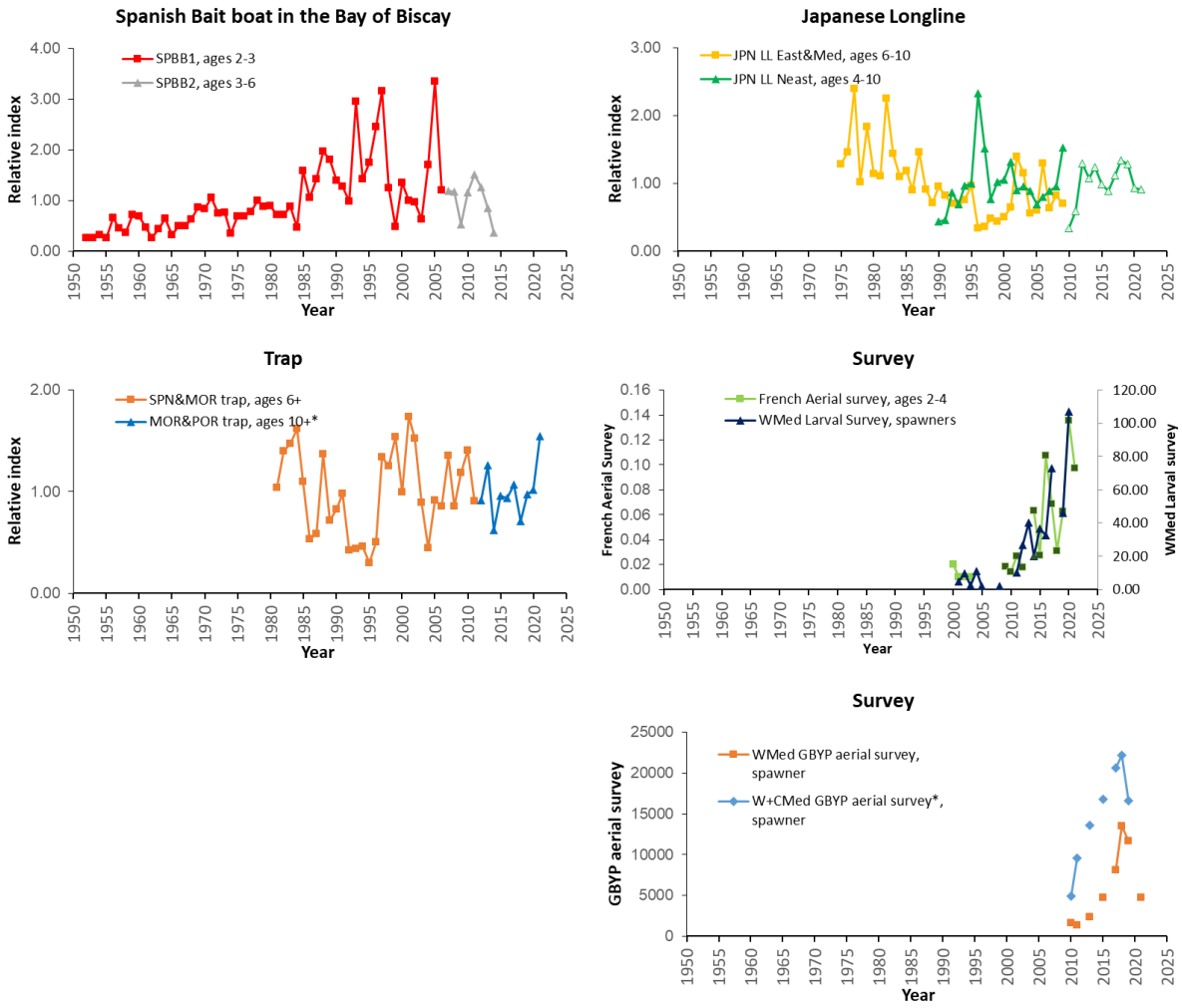


f. BFT (2020-21)

BFT-Figure 1. Geographic distribution of bluefin tuna catches per 5x5 degrees and per main gears from 1970 to 2021 (last decade only covers 2 years).

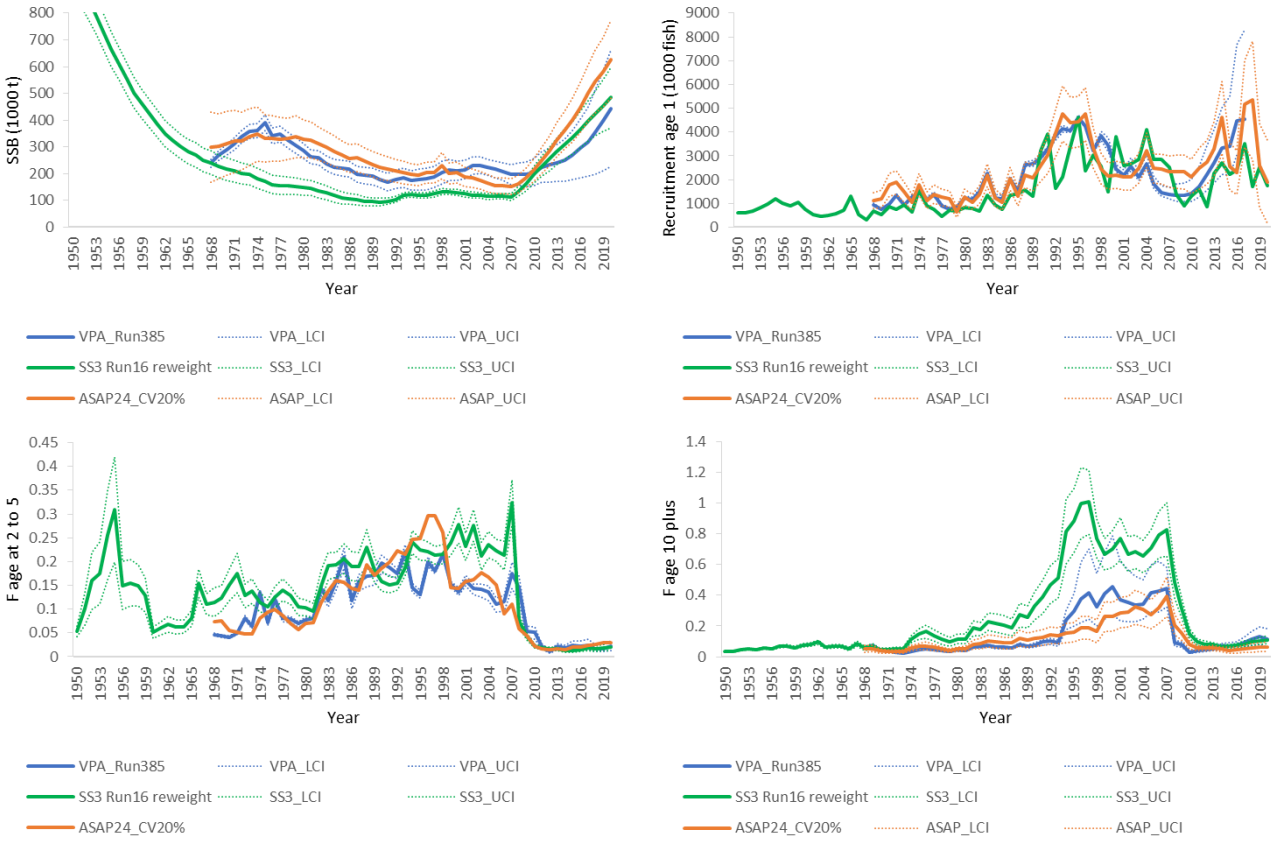


BFTE-Figure 1. Reported catch for the East Atlantic and Mediterranean from Task 1 data from 1950 to 2021 split by main geographic areas (top panel) and by gears (bottom panel) together with unreported catch estimated by the Committee from 1998 to 2007 and TAC levels since 1998.

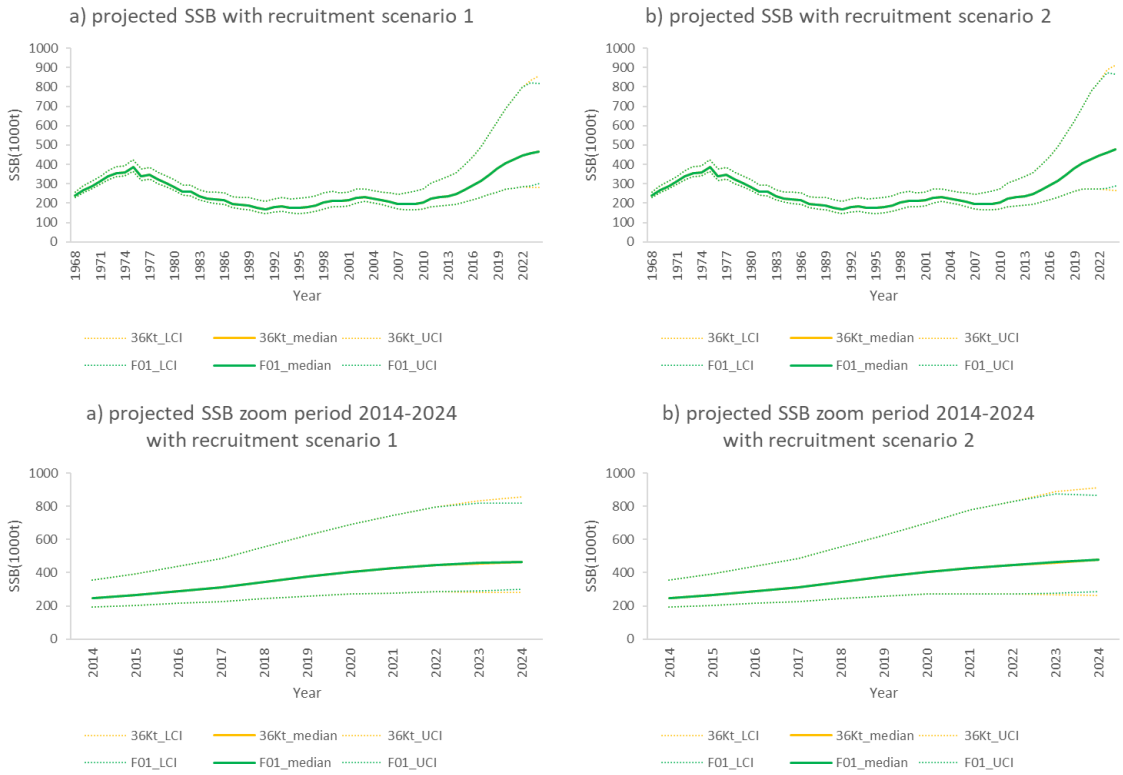


* GBYP aerial survey for the West and Central Mediterranean will be used as auxiliary information.

BFTE-Figure 2. Plots of the updated fishery dependent and independent indicators used for the East Atlantic and Mediterranean bluefin tuna stock. All indicators are standardized series and scaled to their averages. The Spanish BB series was split in two series to account for changes in selectivity patterns, and the latest series was calculated using French BB data due to the sale of the quota by the Spanish fleet. The Japanese longlines CPUE for the northeast Atlantic (split in 2009/2010), the Morocco-Portugal trap combined CPUE, the French aerial survey index (split in 2008/2009) and the GBYP aerial survey for the western Mediterranean (WMed) have been updated until 2021. The larval survey in the western Mediterranean was updated until 2020.



BFTE-Figure 3. Comparisons of the trends in estimated spawning stock biomass (SSB), recruitment (age 1), F at age 2 to 5, and F at age 10 plus group between base cases by model platform: VPA (blue lines), Stock Synthesis (green lines), and ASAP (orange lines). The time series of recruitments for the VPA have the terminal three years removed as it is standard practice not to consider these due to their estimates being unreliable.



BFTE-Figure 4. Projected spawning stock biomass (SSB) with 95% confidence intervals in VPA Run 385 projection with 2 recruitment scenarios (a: the average between 1986 and 2016 and b: the average between 2007 and 2016) assuming constant catch at $F_{0.1}$ or 36,000 t. The top panels show the entire assessment period and the projection until 2024, and the bottom panels only show since 2014.