9.10 WHM - White marlin

The most recent assessment for white marlin was conducted in 2019 through a process that included a 2019 White Marlin Data Preparatory Meeting (12-15 March 2019) (ICCAT, 2019b) and 2019 White Marlin Stock Assessment Meeting (10-14 June 2019) (ICCAT, 2020b). The last year of fishery data used in the assessment was 2017.

WHM-1. Biology

White marlin spawning areas occur mainly in the tropical western North and South Atlantic, predominantly in the same offshore locations in their normal range. In the North Atlantic, spawning activity has been reported off eastern Florida (USA), the Windward Passage (between La Hispaniola and Cuba), and north of Puerto Rico. Seasonal spawning concentrations have been noted northeast of Hispaniola and Puerto Rico, and off the East coast of Hispaniola. Spawning activity has also been reported for the equatorial Atlantic (5°N-5°S) off northeastern Brazil, and in the South Atlantic off southern Brazil.

Previous reports have mentioned that spawning takes place during austral and boreal spring-summer. In the North Atlantic, reproduction events occur from April to July, with spawning activity peaking around April-May. In the equatorial Atlantic (5°N-5°S), spawning occurs during May to June, and in the South Atlantic, reproduction events take place from December to March.

White marlin inhabits the surface mixed layer of the open ocean. Although they spend about 50% of daylight hours and 81% of nighttime hours in the warmer waters of the mixed surface layer, they do explore temperatures ranging from 7.8-29.6°C. However, a negligible amount of time is spent at temperatures less than 7°C below the mixed surface layer. Information from pop-up satellite archival tag (PSAT) data indicated frequent short-duration dives extending to >300 m depths, although most dives ranged from 100 to 200 m. Two types of diving behavior have been identified for white marlin, 1) a shorter duration V-shaped dive, and 2) a U-shaped dive characterized as those confined to a specific depth range for a prolonged period. These patterns, however, can be highly variable between individuals and also vary depending on the temperature and dissolved oxygen of the surface mixed layer. Therefore, it is important to consider vertical habitat use and the environmental factors that influence it during the standardization of catch per unit effort (CPUE) data.

All white marlin biological material sampled prior to the confirmation of the presence of roundscale spearfish (*T. georgii*) in 2006, are now presumed to contain an unknown proportion of roundscale spearfish. Therefore, reproductive parameters, growth curves and other biological studies previously thought to describe white marlin may not accurately represent this species. The Committee reviewed recent scientific nomenclature for billfish (Collette *et al*., 2006) and adopted the scientific name of *Kajikia albida* (Poey, 1860) for white marlin in ICCAT.

WHM-2. Fishery indicators

It has now been confirmed that white marlin landings reported to ICCAT include roundscale spearfish in significant numbers, so that historical statistics of white marlin most likely comprise a mixture of the two species. Studies of white marlin/roundscale spearfish ratios in the western Atlantic have been conducted, with overall estimated ratios between 23-27%, although they varied in time and space. Previously, these were thought to represent only white marlin. However, there is little information on these species ratios in the eastern Atlantic.

The decadal geographic distribution of the catches is given in **WHM-Figure 1**. The Committee used Task 1 catches as the basis for the estimation of total removals (**WHM-Figure 2**). Total removals for the period 1990-2017 were obtained during the 2019 White Marlin Stock Assessment Meeting (ICCAT, 2020b) by modifying Task 1 values with the addition of white marlin that the Committee estimated from catches reported as billfish unclassified. The dead discards were estimated for those longline fleets that have not reported dead discards (2010-2018) based on data from fleets that had reported dead discards.

Additionally, the reporting gaps for some fleets were completed using estimates based on catch values reported for years before and/or after the gap(s) years.

Preliminary Task 1 catches of white marlin and roundscale spearfish, as well as the combined WHM/roundscale spearfish (RSP) Task 1 used in the stock assessment is presented in **WHM-Table 1**. For combined white marlin and roundscale spearfish the catches in 2019, 2020, 2021, 2022 and 2023 were 287, 223, 178, 164 and 204 t respectively, compared to 265 t reported for 2018. Landings for 2023 are preliminary.

A series of indices of abundance for white marlin were presented and discussed during the 2019 White Marlin Data Preparatory Meeting (ICCAT, 2019b) and the 2019 White Marlin Stock Assessment Meeting (ICCAT, 2020b). Following the guidelines developed by the SCRS Working Group on Stock Assessment Methods (WGSAM), 14 catch per unit effort (CPUE) series were available and 13 selected for their inclusion in the final assessment models. In general, the indices showed no discerning trend during the latter part of the time series examined (**WHM-Figure 3**). During the 2019 stock assessment, all standardized CPUE indices for white marlin showed a sharp decline during the period 1960-1991, and variables patterns and no consistent trend among indices thereafter (**WHM-Figure 3**).

WHM-3. State of the stock

A full stock assessment was conducted for the combined white marlin/roundscale spearfish in 2019, applying to the available data through 2017, using both surplus production and age-structured models, which included estimations of management benchmarks. As recommended by the Committee in 2010, the model configuration was an effort to use all available data on white marlin, including lengths, dimorphic growth patterns, steepness and other biological data. Although it is believed that the modeling methods employed were relatively robust, the input data for the models were very likely less so. Perhaps the most important uncertainty was that associated with the catch data and some of the biological parameters of their life history. The uncertainty of the magnitude of the catch is especially a problem with the landings and discards data reported after 1998 when recommendations promoting or mandating the release of billfish that were alive at haulback. This led to a decrease in reported landings but not necessarily a decrease in fishing and/or release mortality. This apparent drop in landings led to a marked decrease in the estimates of F/F_{MSY} from 2002-present, however the Committee considers that this trend is likely overly optimistic due to unreported catch and unaccounted release mortality. The Committee addressed this issue by including estimates of dead discards for the longline fisheries.

The results of the 2019 assessment indicated that the stock of Atlantic white marlin was overfished but not undergoing overfishing (**WHM-Figure 4**). The probability of being in the red quadrant of the Kobe plot was estimated to be 1%. The probability of being in the yellow quadrants of the Kobe plot was estimated to be 99% and that of being in the green quadrant less than 1%. The estimated MSY was determined to be 1,495 t with approximate 95% confidence intervals of 1,316 t-1,745 t.

Generally, all models estimated similar annual trends and values of both B/B_{MSY} and F/F_{MSY}. Relative fishing mortality has been declining since the late 1990s and is now most likely to be below F_{MSY} (**WHM-Figure 5**). Relative biomass has probably stopped declining over the last ten years prior to the assessment, but still remains well below B_{MSY} (**WHM-Figure 5**). There is considerable uncertainty in these results. These results are conditional on the reported catch being a true reflection of the fishing mortality experienced by white marlin. The Committee reiterated that this evaluation is for both stocks of white marlin and roundscale spearfish, and that the presence of unknown quantities of roundscale spearfish in the catches and data used to estimate relative indices of abundance increases the uncertainty of white marlin stock status and outlook for this species.

WHM-4. Outlook

All assessment models estimated that the stock has been less productive than usual (e.g. lower recruitment) since the 1990s, which can be observed in **WHM-Figure 5** wherein relative biomass has not increased by much despite relative fishing mortality having declined considerably over that time period. Projections were carried out using the assessment models, but those projections assumed higher productivity into the future. This resulted in projections of the stock building quickly in the future, responding with much more productivity in the future than has been observed for the past two decades, even when the same levels of catch are assumed into the future as have been experienced by the stock in the past 20 years.

As such, the Committee considered the projections to be overly optimistic and did not support their use to develop Kobe strategy matrices.

WHM-5. Effect of current regulations

A 2006 recommendation (Rec. 06-09) established that the annual amount harvested by pelagic longline and purse seine vessels and retained for landing must be no more than 33% for white marlin and 50% for blue marlin of the 1996 or 1999 landing levels, whichever is greater. Furthermore, in 2012, the Commission established a TAC for 2013, 2014, and 2015 of 400 t (Rec. 12-04), placed additional catch and commerce restrictions in recreational fisheries for blue marlin and white marlin, and requested methods for estimating live and dead discards of blue marlin and white marlin/spearfish. In 2019, the Commission further strengthened the plan to rebuild white marlin stock by imposing a landings limit to 335 t for white marlin/spearfish (Rec. 19-05).

The Committee is concerned with the significant increase in the contribution from fishing by artisanal and small-scale fleets to the total white marlin harvest and that these fisheries are not fully accounted for in the current ICCAT statistics. The Committee expressed its serious concern over this limitation on data for future assessments. Such data limitation precludes any analysis of the current regulations. In addition, the Committee expressed concern about the status of white marlin due to the misidentification of spearfishes in the white marlin catches. This situation adds uncertainty to the stock assessment results.

Currently, ICCAT Rec. 22-12 and four ICCAT Contracting Parties (Brazil, Canada, Mexico, and the United States) mandate or encourage the use of circle hooks on their pelagic longline fleets. Research has demonstrated that in some longline fisheries the use of non-offset circle hooks resulted in a reduction of billfish mortality, while the catch rates of several of the target species remained the same or were greater than the catch rates observed with the use of conventional J hooks or offset circle hooks.

The Committee noted that more countries have started reporting data on live releases in 2006. However, there is not enough information on the proportion of fish being released alive to evaluate the effectiveness of the ICCAT recommendation, relating to the live release of white marlin.

WHM-6. Management recommendations

The Committee notes that Rec. 19-05 states "An annual limit of [1,670 t for blue marlin and] 335 t for white marlin/roundscale spearfish".

In 2012, the Commission adopted Rec. 12-04, intended to reduce the total harvest to 400 t in 2013-2015 to allow the rebuilding of the white marlin stock from the overfished condition. Subsequently, the Commission extended the 400 t annual catch limit to 2016-2018 (Rec. 15-05), 2019 (Rec. 18-04), and in 2019 (Rec. 19-05) established a landings limit of 335 t. Although there is some evidence of slow rebuilding in recent years, the Committee noted that catches have exceeded the 400 t landings limit in every year since its initial implementation and warns that if catches continue to exceed the landings limit, the rebuilding of the stock will proceed more slowly, or be put at risk of further declines. Further reductions in fishing mortality are likely to speed up the rebuilding of the stock. Unfortunately, the inability to accurately estimate fishing mortality will continue to compromise the Committee's ability to predict and monitor the stock's recovery period. This is due to the inadequate reporting of discards, as well as the lack of reports from some artisanal and recreational fisheries that take marlin species.

- Measures should be taken to ensure that monitoring and reporting of all landings and discards, including live releases, are appropriate, accurate, and complete. This will likely require improvements to the observer programmes of many CPCs, as well as the implementation of discard estimation methods using those data.

- Efforts should be made, building on previous work, to fully account for the catches of artisanal and all recreational fisheries.

Given the overfished status of the stock and the uncertainties in the data, including for both total removals and indices of abundance:

- the Commission, at the minimum, should ensure that catches do not exceed current TAC until the stock has fully recovered.

Given that experimental research has demonstrated that in longline fisheries the use of circle hooks resulted in a reduction of marlin catch rates and haulback mortality, and noting that they have different impacts on both target and bycatch species; then to reduce the chance of exceeding any established landings limit or TAC, the Commission should consider:

- the use of non-offset circle hooks,
- the release of all marlins that are alive at haul back in ways that maximize their survival.

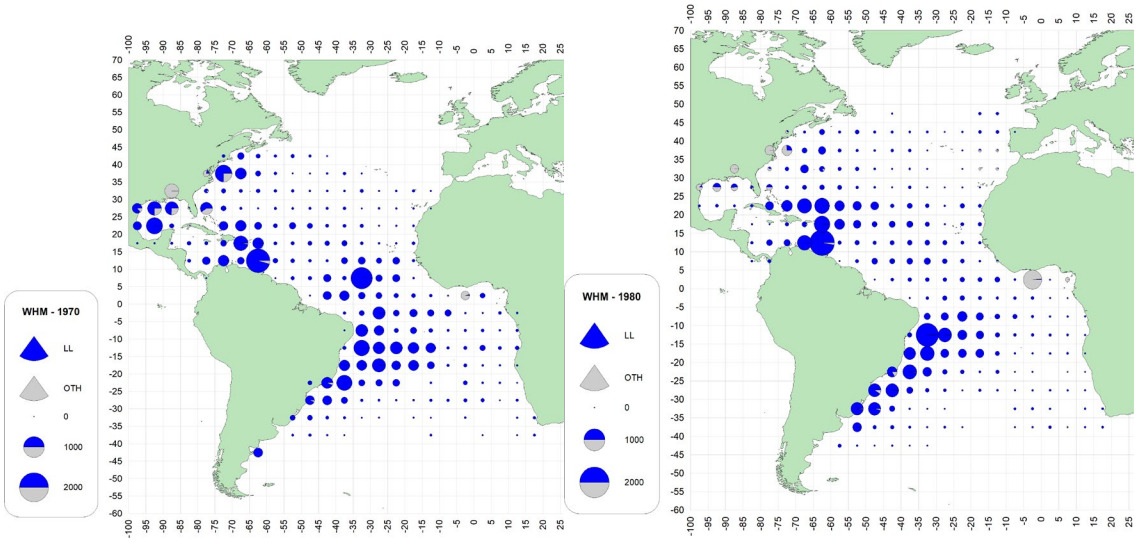
ATLANTIC WHITE MARLIN/ROUNDSCALE SPEARFISH SUMMARY TABLE

MSY	1,495 (1,316 – 1,745) t[1]
Current (2023) Yield	204 t [2]
Relative Biomass: B_{2017}/B_{MSY}	0.58 (0.27-0.87)[1]
Relative Fishing Mortality: F_{2017}/F_{MSY}	0.65 (0.45-0.93)[1]
Stock Status (2017)	Overfished: Yes [99% prob][3] Overfishing: Not [99% prob][3]
Conservation and Management Measure in Effect:	Rec. 18-04 and Rec. 19-05. Landing limit of 335 t beginning in 2020 Minimum size for recreational fisheries (168 cm Lower Jaw Fork Length (LJFL))

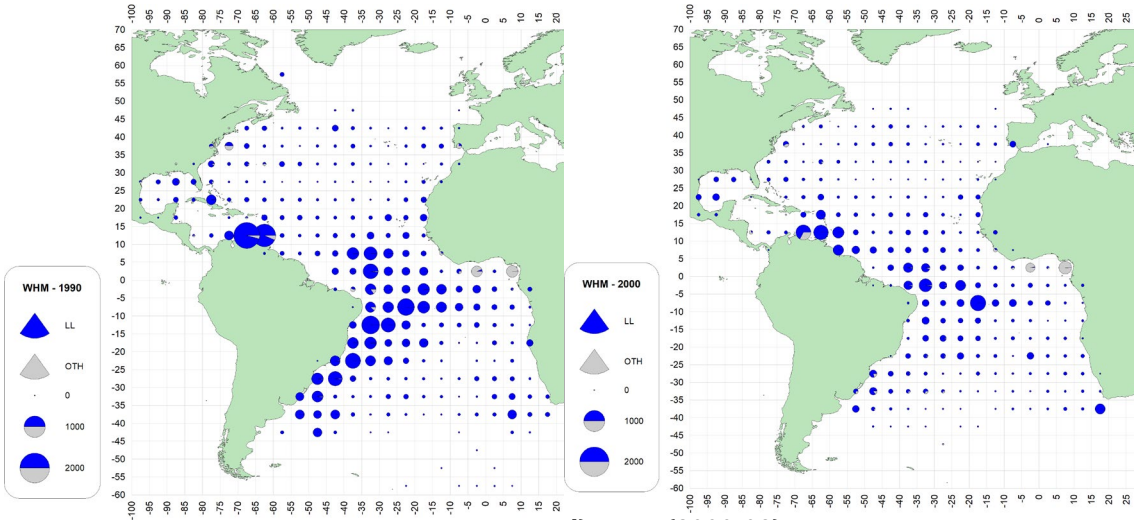
[1] Median of combined estimates from 2 Stock Synthesis models and 1 JABBA model with approximate 95% confidence intervals.
[2] 2023 yield should be considered provisional.
[3] Based on the Kobe plot probability by quadrant.

WHM+RSP-Table 1. Estimated catches (t) of Atlantic white marlin (*Kajikia albida*) and roundscale spearfish (*Tetrapturus georgii*) by area, gear, and flag.

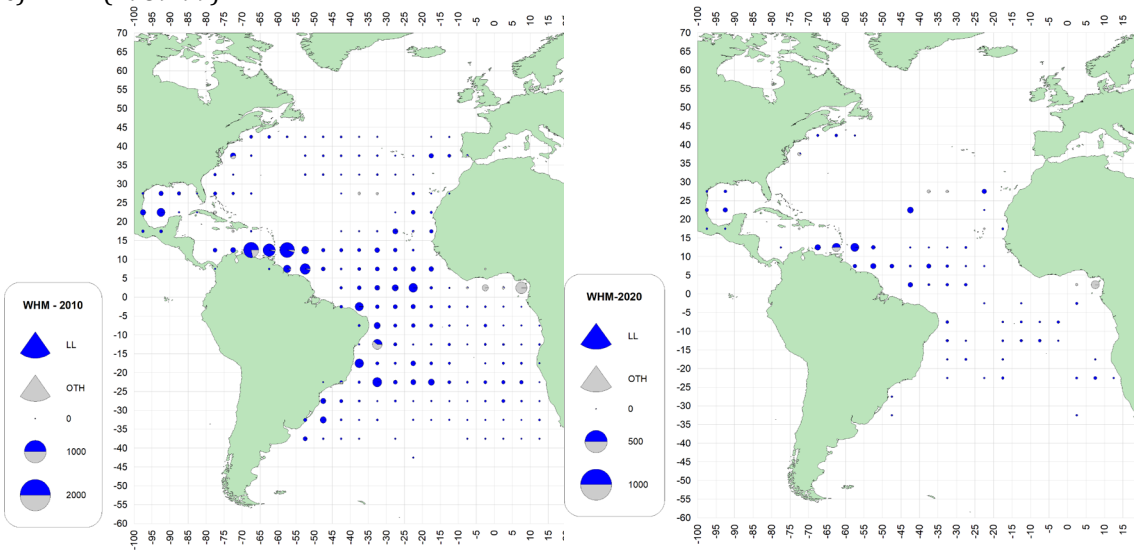
			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
TOTAL	A+M		2092	1880	1629	1513	1945	1786	1535	1028	1012	845	843	770	618	749	716	757	508	530	467	648	452	529	477	462	465	287	223	178	164	204
Landings		Longline	2065	1720	1535	1367	1717	1638	1403	970	834	756	759	692	538	631	608	634	421	414	373	465	373	481	434	408	200	196	175	136	120	145
		Other surf.	64	36	56	62	189	85	89	86	139	71	55	60	65	81	84	95	68	85	62	56	61	35	29	36	20	27	31	31	38	39
		Sport (HL+RR)	30	22	24	14	6	6	2	4	6	1	1	1	2	1	2	2	6	4	6	116	7	3	4	5	10	3	7	3	2	6
Discards		Longline	43	101	65	70	32	57	41	17	30	17	27	17	12	36	21	24	12	27	24	11	11	10	9	12	34	60	10	8	4	13
		Other surf.	0	0	0	0	1	0	0	1	4	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Landings	CP	Barbados	26	43	15	41	33	25	25	24	15	15	18	16	33	22	24	26	6	3	5	6	6	10	14	17	22	12	14	10	10	8
		Belize	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Brazil	91	105	75	105	217	158	106	172	407	266	80	244	90	52	55	53	35	75	71	352	102	121	67	47	62	76	46	0	0	17
		Canada	4	4	8	8	8	5	5	3	2	1	2	5	3	2	2	1	2	1	2	3	5	3	1	2	1	1	1	2	1	1
		China PR	9	11	9	11	15	30	2	20	23	8	6	9	6	10	5	9	8	3	4	2	0	0	0	3	2	3	2	2	2	2
		Costa Rica	0	0	0	0	0	3	14	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Curaçao	0	0	0	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**
		Côte d'Ivoire	0	0	1	2	1	5	1	2	2	3	1	1	1	1	3	2	1	1	0	1	1	1	1	1	1	0	0	0	1	1
		EU-España	26	36	151	93	101	119	186	61	6	22	64	58	51	46	35	16	113	5	35	42	99	125	96	118	11	11	44	56	47	15
		EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
		EU-Portugal	0	0	0	0	1	1	0	0	1	5	19	30	22	2	35	40	11	18	25	10	9	7	11	13	0	0	1	9	1	4
		El Salvador	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**
		Gabon	0	0	1	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	
		Ghana	1	2	1	3	7	6	8	21	2	1	1	1	0	1	4	4	3	1	1	1	1	1	1	1	0	0	0	0	0	**0**
		Grenada	0	0	0	0	0	0	1	15	8	14	33	10	12	11	17	14	0	0	0	0	0	37	15	9	11	19	14	1	5	7
		Guatemala	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**
		Honduras	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**
		Japan	92	57	112	58	56	40	83	56	16	33	36	34	39	21	34	43	41	31	42	24	6	8	9	10	6	11	7	8	3	11
		Korea Rep	43	23	59	23	35	39	0	0	0	11	40	7	0	113	96	78	43	43	0	0	0	0	0	0	0	0	0	0	0	**0**
		Liberia	0	0	1	1	3	8	4	3	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
		Maroc	0	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	0	0	**0**
		Mexico	7	11	3	1	3	6	11	13	16	15	28	25	16	14	14	19	20	28	36	30	20	26	20	12	16	9	10	12	8	8
		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	**0**
		Philippines	0	0	0	0	1	12	0	0	0	0	0	0	0	0	1	1	2	2	1	2	2	0	0	0	0	0	0	0	0	**0**
		S Tomé e Príncipe	21	21	30	45	40	36	37	37	37	37	21	33	29	35	36	37	38	39	40	41	42	17	15	13	1	10	11	20	27	54
		Senegal	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	1	1	0	0	**0**
		South Africa	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		St Vincent and Grenadines	0	0	0	0	0	0	1	0	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	8	5	9	0	0	1
		Trinidad and Tobago	11	18	8	32	10	13	4	2	5	12	6	6	5	12	10	11	15	14	39	33	38	32	20	0	0	0	0	0	0	0
		UK-Bermuda	1	1	1	1	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		UK-British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		USA	13	7	12	8	5	5	1	3	6	1	1	1	1	0	2	2	2	2	1	4	2	3	1	2	3	2	6	2	2	1
		Uruguay	3	0	1	24	22	16	21	20	1	9	2	5	9	3	6	5	5	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Venezuela	236	286	270	177	310	228	178	182	215	168	138	159	196	133	64	130	118	160	123	78	99	120	184	187	78	64	44	42	53	59
	NCC	Chinese Taipei	1350	907	566	441	506	465	437	152	178	104	172	56	44	54	38	28	20	28	15	7	7	10	10	5	6	2	2	4	1	1
	NCO	Cambodia	0	0	0	0	0	1	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	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Missed flags (FR+ES)	11	9	7	7	9	8	12	13	12	13	13	11	10	9	10	12	12	37	0	0	0	0	0	0	0	0	0	0	0	
		NEI (BIL)	0	0	0	0	0	0	34	77	4	30	134	42	37	170	204	199	0	11	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	214	237	285	359	526	499	322	180	11	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		St Lucia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	0	1	1	1	1	0	0	
		Togo	0	0	0	0	0	1	1	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Vanuatu	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	
Discards	CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	2	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
		Canada	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	3	1	1
		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
		EU-France	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**
		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	2	1	1	0	0	1
		Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	**0**
		Mexico	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**
		UK-Bermuda	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
		USA	42	100	65	70	33	58	41	18	33	17	27	17	10	8	10	14	8	23	21	10	11	8	3	5	2	2	1	1	1	1
		Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	54	1	0	0	10
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	2	2	1	3	3	1	1	0
	NCO	NEI (BIL)	1	1	0	0	0	0	1	0	0	0	0	0	1	10	11	11	2	2	2	1	0	0	4	6	3	0	3	2	0	



a) WHM (1970-79) b) WHM (1980-89)

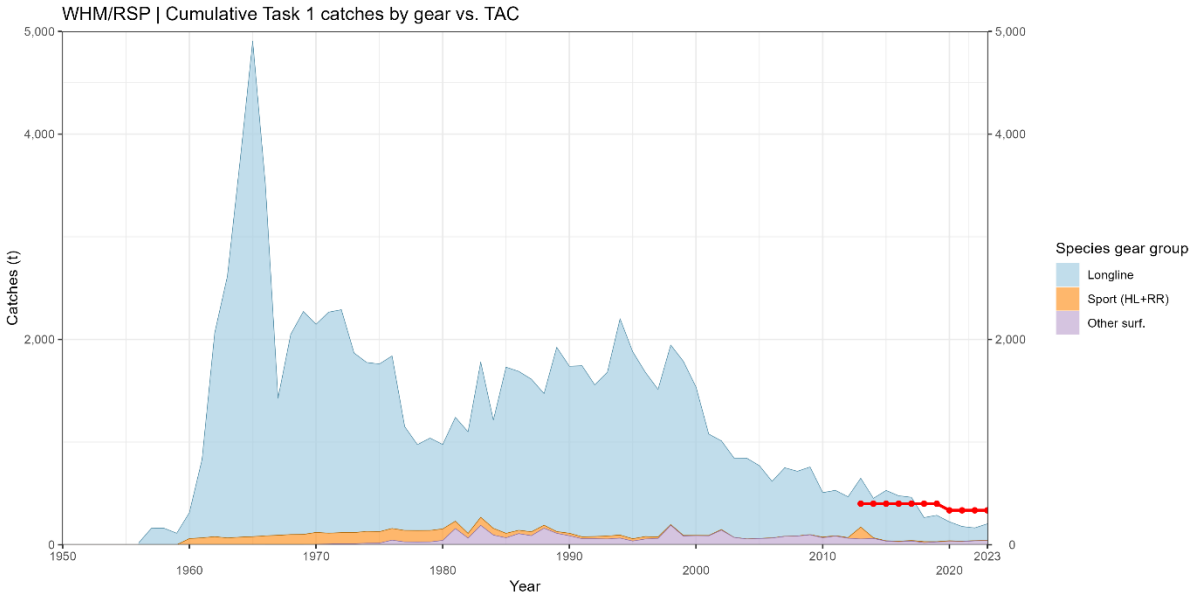


c) WHM (1989-99) d) WHM (2000-09)

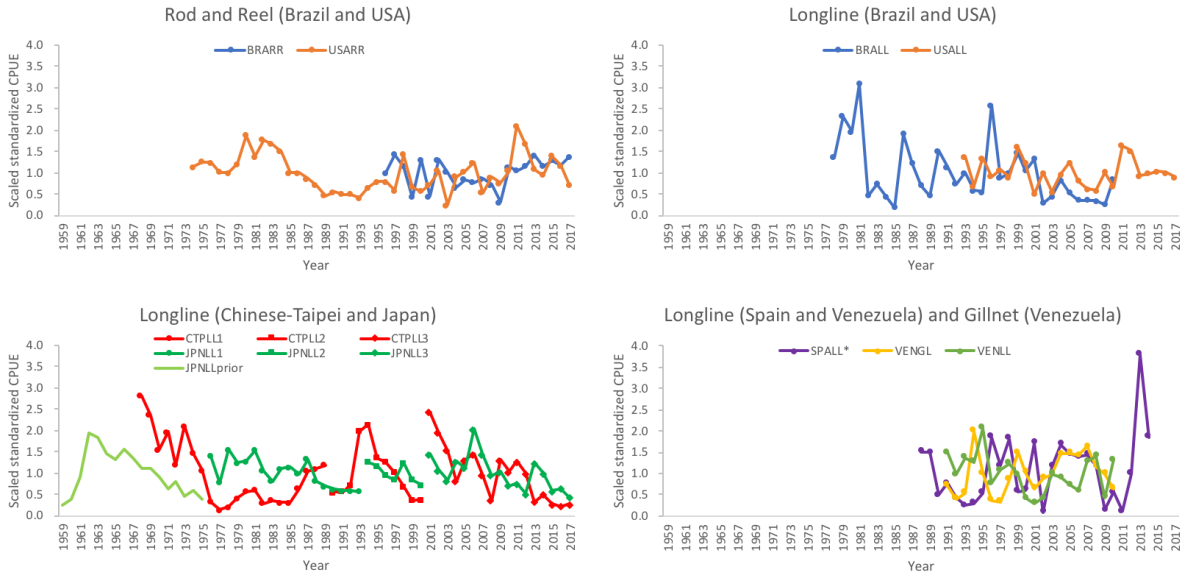


e) WHM (2010-19) f) WHM (2020-22)

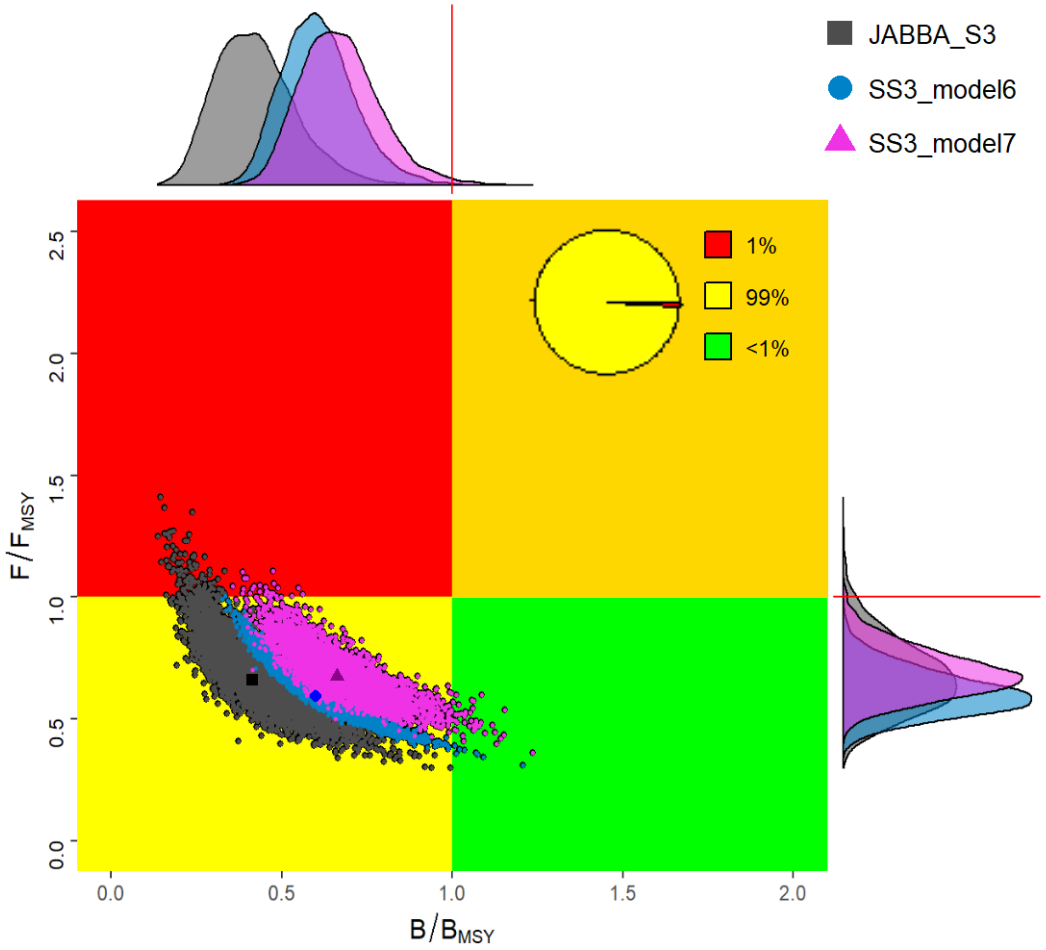
WHM-Figure 1. Geographic distribution of white marlin total catches by decade (last decade only covers 3 years).



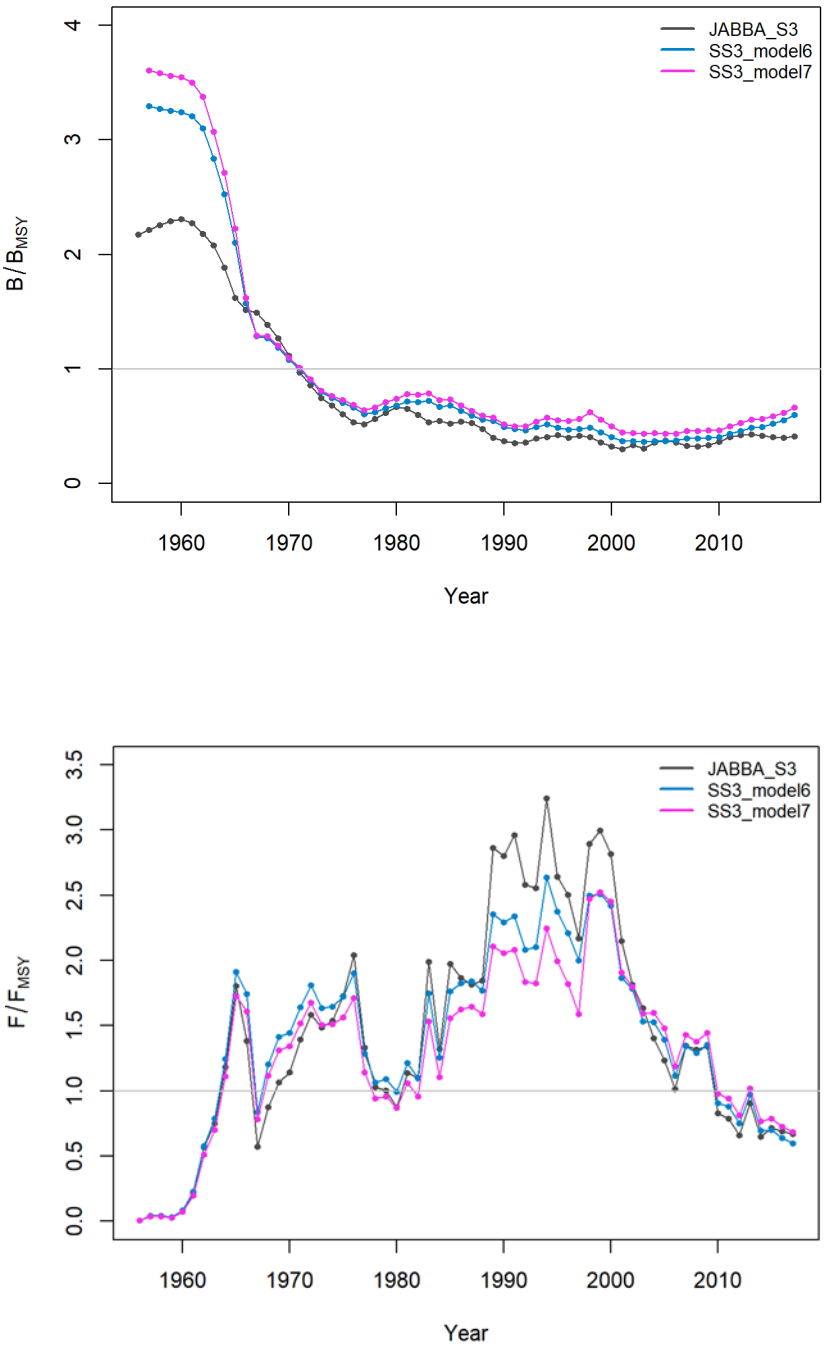
WHM-Figure 2. Total catch of white marlin and roundscale spearfish reported in Task 1 for the period 1956-2023. The dotted red line represents the landing limits.



WHM-Figure 3. Standardized CPUE series used in the 2019 white marlin stock assessment. Spanish longline index* is used only for sensitivity analysis by JABBA.



WHM-Figure 4. Combined Kobe phase plots and pie chart from 2 Stock Synthesis runs (models 6 and 7, blue and pink, respectively) and 1 JABBA run (grey) in 2019 Atlantic white marlin stock assessment. The green quadrant corresponds to the stock not being overfished and no overfishing occurring and the red quadrant to the stock being overfished and overfishing occurring. The marginal densities plots for stock relative to B_{MSY} and harvest rate relative to F_{MSY} are also shown (top and right of large panel) are individual probabilities of Stock Synthesis and JABBA runs overlaid.



WHM-Figure 5. Historical estimates of biomass over biomass at MSY ratio (upper panel) and fishing mortality overfishing mortality at MSY ratios (lower panel) for the final base cases of JABBA (S3, black) and Stock Synthesis (models 6 and 7, blue and pink, respectively) models for the Atlantic white marlin.