

9.12 SWO-AT - Atlantic swordfish

The status of the North and South Atlantic swordfish stocks was assessed in 2022, by means of applying statistical modelling to the available data up to 2020. Complete information on the data availability and assessment can be found in the Report of the 2022 ICCAT Atlantic Swordfish Data Preparatory Session (ICCAT, 2022e) and Report of the 2022 ICCAT Atlantic Swordfish Stock Assessment (ICCAT, 2022f). Statistics relevant to Atlantic swordfish are included as **Appendix 5** to this SCRS Report, and recommendations pertinent to Atlantic swordfish are presented in Item 18.

The Commission is scheduled to adopt a management procedure (MP) for North Atlantic swordfish in 2024. As the MP has not yet been chosen, the following text is reflective of stock status and advice as prepared by the Committee in 2022.

MSE development in 2025 requires that an exceptional circumstances (EC) protocol be developed for the stock. The Committee will work with Panel 4, as requested, to develop an EC protocol.

SWO-AT-1. Biology

Swordfish (*Xiphias gladius*) are members of the family Xiphiidae and are in the suborder Perciformes. They can reach a maximum weight in excess of 500 kg. They are distributed widely in the Atlantic Ocean and Mediterranean Sea. In the ICCAT Convention area, the management units of swordfish for assessment purposes are a separate Mediterranean group, and North and South Atlantic groups separated at 5°N.

Swordfish feed on a wide variety of prey including groundfish, pelagic fish, deep-water fish, and invertebrates. They are believed to feed throughout the water column, and from electronic tagging studies, undertake extensive diel vertical migrations.

Swordfish mostly spawn in the western warm tropical and subtropical waters throughout the year, although seasonality has been reported in some of these areas. They are found in the colder temperate waters during summer and fall months. Young swordfish grow very rapidly, reaching about 140 cm lower-jaw fork length (LJFL) by age three, but grow slowly thereafter. Females reach a larger maximum size than males. Tagging studies have shown that some swordfish can live up to 15 years. Swordfish are difficult to age, but about 50% of females were considered to be mature by age five, at a length of about 180 cm. However, the most recent information indicates a smaller length and age at maturity.

The analysis of seasonal movement patterns indicate swordfish generally move towards the equator by winter and return to the temperate foraging grounds in spring and summer. Broader areas of mixing between some eastern and western areas were also suggested. Results obtained by satellite tags also fully confirm the previous knowledge that was available from fishery data.

Beginning in 2018, an ICCAT Swordfish Biology Programme, encompassing all three ICCAT stocks, has been conducting studies on swordfish growth, reproductive biology, and genetic analysis for identification of stock boundaries and mixing. Since programme inception, 4,712 fish have been sampled for otolith, fin spines, gonads and other tissues. The three research areas address key uncertainties important for improving the scientific advice for management of the stocks. Within each of the project areas, important scientific advances have been made:

- Ageing and growth: standards for ageing spines and otoliths; preliminary work on new growth models.
- Reproductive biology: standards for classifying reproductive status of swordfish and preliminary updates to maturity schedules.
- Genetics: identified genetic markers important for stock differentiation; identified key stock mixing areas in the North-East Atlantic; identified subpopulations within the Mediterranean.

These Swordfish Year Programme (SWOYP) biological studies are ongoing and complementary studies by CPCs will contribute to addressing uncertainties in future assessments of stock status.

SWO-AT-2. Fishery indicators

Due to the broad geographical distribution of Atlantic swordfish (**SWO-AT-Figure 1**) in coastal and offshore areas (mostly ranging from 50°N to 45°S), this species is available to a large number of fishing countries. **SWO-AT-Figure 2** shows total estimated catches for North and South Atlantic swordfish. Directed longline fisheries from Canada, EU-Spain, and the United States have operated since the late 1950s or early 1960s, and harpoon fisheries have existed at least since the late 1800s. Other directed swordfish fisheries include fleets from Brazil, EU-Portugal, Morocco, Namibia, and South Africa. The primary bycatch or opportunistic fisheries that take swordfish are tuna fleets from Chinese Taipei, Japan, Korea (Rep.) and EU-France. The tuna longline fishery started in 1956 and has operated throughout the Atlantic since then, with substantial catches of swordfish that are produced as a bycatch of tuna fisheries. The largest proportion of the Atlantic catches is made using surface-drifting longline. However, many additional gears are used, including traditional gillnets off the coast of western Africa.

Trends by area (NE vs. NW Atlantic) in the catch per unit effort (CPUE) indexes were consistent with the seasonal movement patterns observed in the electronic tagging data, as well as in the catches and sex-ratio distributions. Relationships observed for the eastern Atlantic were opposite to those in the western Atlantic. This pattern was correlated with the decadal cycling of the Atlantic Multidecadal Oscillation (AMO) as well as that of the North Atlantic Oscillation (NAO). Including the AMO as a covariate to area specific catchability within the assessment model helped reduce the conflicting directions of the various CPUE trends. Further analysis and hypothesis testing was recommended to determine if the relationship was due to a swordfish temperature preference and change in prey distribution. To support this hypothesis testing the Committee encouraged a group of swordfish scientists to work towards uniting the available North Atlantic swordfish CPUE data into a single dataset so that a more refined, area specific CPUE analyses could be conducted.

For both the North and South Atlantic some of the indices of abundance were affected by changes in gear technology and management that could not be accounted for in the CPUE standardization, and therefore some indices had to be split into consistent time periods. Recent reports note the emergence of a new gear (trap lines) with reported high swordfish catchability and low bycatch that warrants the Species Group's consideration. The impact of the trap line gear should be evaluated as soon as data are available.

Total Atlantic

Catch reports are considered to be nearly complete for 2023, however, few countries, which typically represent a small portion of the catch, have not yet reported their 2023 catches and because of unknown unreported catches, this value should be considered provisional and subject to further revision.

North Atlantic

For the past decade, the North Atlantic estimated catch (landings plus dead discards) has averaged about 10,470 t per year (**SWO-AT-Table 1**). The catch in 2023 (12,611 t) represents 62% of the 1987 peak in North Atlantic landings (20,238 t). These reduced landings have been attributed to ICCAT management measures, a reduction in total longline effort (Taylor *et al.*, 2020), and shifts in fleet distributions, including the movement of some vessels in certain years to the South Atlantic (e.g. EU-Spain longline fleet) or out of the Atlantic. In addition, some fleets, including at least the United States, EU-Spain and EU-Portugal have changed operating procedures to opportunistically target tuna and/or sharks, taking advantage of market conditions and higher relative catch rates of these species previously considered as bycatch in some fleets. Recently, socio-economic factors, and oceanography patterns may have also contributed to the decline in catch. Task 1 and 2 data coverage is generally good; however, the Committee noted the sparse discarding data for most CPCs as well as gaps in the catch and effort data for some CPCs.

Available longline CPUE series were evaluated by the Committee and certain indices were identified as suitable for use in the assessment models (Canada, Chinese Taipei, EU-Portugal, EU-Spain, Japan, Morocco, and USA). Trends in standardized CPUE series by fleets (with terminal years 2019 or 2020) contributing to the stock assessment models are shown in **SWO-AT-Figure 3**. Most of the series have an increasing trend since the late 1990s but show a decrease or plateau in the more recent years. There have been some recent changes in United States regulations (such as time-area closures for other species like Atlantic bluefin tuna, among others) that may have impacted catch rates. The combined index used in the surplus production models (JABBA, used in this assessment; ASPIC, used as a continuity run) is shown in **SWO-AT-Figure 4**.

South Atlantic

The historical trend of catch (landings plus dead discards) can be divided in two periods: until 1980 and after 1980. The first one is characterized by relatively low catches, generally less than 5,000 t (with an average value of 1,824 t). After 1980, landings increased continuously up to a peak of 21,931 t in 1995, levels that are comparable to the peak of North Atlantic harvest (20,238 t in 1987). This increase of landings was, in part, due to progressive shifts of fishing effort to the South Atlantic, primarily from the North Atlantic, as well as other waters. Expansion of fishing activities by southern coastal countries, such as Brazil and Uruguay, also contributed to this increase in catches. The reduction in catch following the peak in 1995 resulted from regulatory changes and was partly due to effort shifting to other oceans and target species. In 2023, the reported catch (8,212 t) was 63% lower than the 1995 reported catch (**SWO-AT-Table 1**).

Available longline CPUE series for South Atlantic swordfish were evaluated by the Committee for the 2022 stock assessment ([ICCAT, 2022f](#)) and certain indices were identified as suitable for use in assessment models (Brazil, Chinese Taipei, EU-Spain, Japan, South Africa, Uruguay). The available indices are illustrated in **SWO-AT-Figure 5**.

Discards

Since 1991, very few fleets have reported dead discards (see **SWO-AT-Table 1**). The volume of North Atlantic reported dead discards reached a maximum of 1,138 t in 2000. Recent reported dead discards for the North Atlantic are significantly lower (101 t in 2021; 71 t in 2022; 75 t in 2023). For the South Atlantic, the reported discards peaked at 147 t in 2010. In 2021, 2022 and 2023 129 t, 85 t, and 110 t of dead discards were respectively reported for the South Atlantic. The Committee continued to express concerns due to the low percentage of fleets that have reported annual dead discards (in t) and in many cases what has been reported is not scaled to the entire fishery.

SWO-AT-3. State of the stocks*North Atlantic*

In 2022, two stock assessment platforms were used to provide estimates of stock status for the North Atlantic swordfish stock as a basis for management advice. They were a Bayesian surplus production model (JABBA - Just Another Bayesian Biomass Assessment) and the integrated assessment model Stock Synthesis (SS).

The Committee noted that the 2022 stock assessment represents a significant improvement in the characterization of uncertainty of current stock status for North Atlantic swordfish using updated information and integration of JABBA. The Committee agreed that management advice for North Atlantic swordfish, including stock status and projections, should be based on JABBA and SS models.

There were important developments to the modelling in 2022. In particular, the SS model provided estimates of the full weight of dead discards due to the size limit (i.e. reported and unreported) in the estimation of stock status. This analysis is consistent with the request of the Commission that the SCRS monitor and analyse the effects of the minimum size limit ([Rec. 17-02](#), paragraph 10). This capacity will also be useful in future MSE simulations.

Based on the combined results from the two stock assessment model platforms (Stock Synthesis and JABBA), the North Atlantic swordfish stock biomass was above B_{MSY} (median $B_{2020}/B_{MSY} = 1.08$ and 95% CI of 0.71 and 1.33) and fishing mortality was below F_{MSY} (median $F_{2020}/F_{MSY} = 0.80$ and 95% CI of 0.64 and 1.24) in 2020 (**SWO-AT-Figure 6**). The median MSY was estimated as 12,819 t with 95% CI of (10,864 t and 15,289 t).

The joint Kobe phase plot shows that JABBA model results provide wider range of uncertainty than the Stock Synthesis results. Probabilities of the stock being in each quadrant of the Kobe plot (**SWO-AT-Figure 9**) were 63% in the green (not overfished not subject to overfishing), 22% in the yellow (overfished but not subject to overfishing) and 15% in the red (overfished and subject to overfishing). The results point to a stock status of not overfished (37% probability of overfished status), with no overfishing (15% probability of overfishing taking place). The estimate of stock status in 2020 was very similar to the estimated status from the previous assessment in the terminal year (2015).

South Atlantic

In 2022, two stock assessment platforms were used to assess the South Atlantic swordfish stock. These were a Bayesian surplus production model (JABBA) and Stock Synthesis. While Stock Synthesis was explored in 2022, only the JABBA model was used for providing advice.

The Committee acknowledged the progress made to implement a Stock Synthesis model for the South stock for the first time, but revision of size data and further model development are still required before it can be fully used for management advice. As such, the Stock Synthesis model was considered preliminary, and the Committee agreed that stock status estimates and projections for management advice should be done using only the JABBA model. For the purpose of comparison of model results across platforms only, results from Stock Synthesis are presented in **SWO-AT-Figure 7** to illustrate the overall consistency among models.

Both models were consistent and suggested a decline in stock biomass as the fishing mortality increased in the 1990s. The final JABBA results estimated that B_{2020} was also below B_{MSY} (median = 0.77, 95% CIs = 0.53-1.13) while F_{2020} was marginally above F_{MSY} (median = 1.03, 95% CIs = 0.67-1.51) (**SWO-AT-Figure 8**). The JABBA's MSY_{2020} was estimated to be 11,481 t.

The southern swordfish stock biomass is overfished, and overfishing is occurring. The JABBA base case assessment indicates a 56% probability that the stock is within the red quadrant of the Kobe plot (**SWO-AT-Figure 10**).

SWO-AT-4. Outlook

North Atlantic

Based on the currently available information to the Committee, both the JABBA and Stock Synthesis base models were projected to the year 2033 under constant total allowable catch (TAC) scenarios of 9,000 to 16,000 t, as well as a zero-catch scenario.

For the projections, catches for 2021 and 2022 are assumed to be constant at 10,476 t (the catch value for 2020 at the time of the assessment). Different levels of constant catch are projected for the period 2023-2033 (**SWO-AT-Table 2**). The combined Stock Synthesis and JABBA projections show that a 13,200 t constant catch, which is the current TAC level ([Rec. 22-03](#), extended in [Rec. 23-04](#)), will have a 60% probability of being in green quadrant in 2033. However, given that the estimated MSY (that is inclusive of dead discards) is 12,819 t and $B_{2020}/B_{MSY}=1.08$, catches above MSY will result in biomass declines over the projection period (**SWO-AT-Figure 11**). Under 2021 catch (9,729 t), there was an 84-87% probability of the stock being in green quadrant by 2033 (**SWO-AT-Table 2**).

South Atlantic

The 2022 stock assessment's stock status results are similar to the 2017 stock assessment ([ICCAT, 2017b](#)), but updated information used in the 2022 stock assessment resulted in estimates of a less productive stock ($MSY_{2020} = 11,481$ t; $MSY_{2015} = 14,570$ t). Specifically, a new surplus production function associated with a prior for the intrinsic growth rate was objectively derived using biological information, and updated CPUE indices.

Results of projections from the 2017 stock assessment indicated that if catches remained below 11,000 t, there was a 60% chance of the stock falling within the green quadrant by 2020. The average catch for the period 2016-2020 was 10,125 t, yet the assessment still indicates a 56% probability that the stock is within the red quadrant in 2020 (**SWO-AT-Figure 10**). The Committee notes that this apparent inconsistency can be explained by the lower productivity (see above) of the stock determined in the 2022 stock assessment.

Projections were conducted for the base case JABBA model under constant TAC scenarios of 6 to 15 thousand tons, as well as a zero-catch scenario (**SWO-AT-Figure 12**). Projections were implemented in 2023 and catches for 2021 and 2022 were assumed to remain constant (9,826 t) at the average from the previous three years. Using this three-year average (9,826 t) assumed in the 2022 stock assessment, the South Atlantic swordfish stock has a 55% probability of being in the green quadrant of the Kobe plot by 2033 (**SWO-AT-Table 3**).

SWO-AT-5. Effect of current regulations

For the North Atlantic, the most germane recommendations can be found in [Rec. 23-04](#), which replaces [Rec. 22-03](#) and extends and amends [Rec. 17-02](#). Should an MP be adopted in 2024, it is expected that a new recommendation would replace these. In the South, relevant recommendations can be found in [Rec. 22-04](#), modifying [Rec. 21-03](#).

Catch limits

[Rec. 17-02](#) set the TAC for North Atlantic swordfish for 2018 at 13,200 t. This TAC has remained in place for 2024 ([Rec. 23-04](#)). The reported catch from 2018-2023 has averaged 10,407 t and has not exceeded the TAC in any year.

[Rec. 17-03](#) set the TAC for South Atlantic swordfish at 14,000 t for 2018, this TAC was in place from 2018 to 2022 ([Rec. 21-03](#)). [Rec. 22-04](#) set the TAC for South Atlantic swordfish at 10,000 t for 2023-2026. The reported catch from 2018-2023 averaged 9,303 t and did not exceed the enforced TACs in any year.

Minimum size limits ([Rec. 17-02](#))

There are three minimum size options that are applied to the entire Atlantic: 125 cm LJFL/25 kg with a 15% tolerance (of the number of swordfish *per landing*); or 119 cm LJFL/15 kg with zero tolerance and evaluation of the discards; and for dressed fish, cleithrum to keel length of 63 cm.

Since the implementation of the minimum landing sizes in 2000, the proportion of swordfish less than 125 cm LJFL reported in the landings (in numbers) has been generally decreasing in the North Atlantic and stable in the South. In the North Atlantic, the estimate was 33% in 2000 and decreased to 23% in 2015. In the South Atlantic the estimate was 18% in 2000, had a maximum of 19% in 2006 and decreased to 13% in 2015. The Committee notes that these estimates are based on low sample sizes, are uncertain and may be biased. They will remain uncertain until CPCs fully report size samples from the entire catch. A figure of the estimated absolute biomass and numbers of fish as well as estimated proportions of undersized fish in the catch that are discarded in the North Atlantic is shown in **SWO-AT-Figure 13**. The decreasing trend can be due to a decrease in encounter rate of undersized fish due to changes in fleet behaviour, or a decrease in recruitment over time, or a combination of both.

The Committee also noted high values of hooking mortality (ranging between 78-88%) on small swordfish (<125 cm LJFL) by surface longline fisheries targeting swordfish (**SWO-AT-Figure 14**). The post-release mortality of specimens discarded alive from commercial fishing gear is unknown. Evaluating other strategies to reduce fishing mortality on juvenile swordfish will need complete datasets on fishing effort and size data over the entire Atlantic and should take into account the effects of these strategies on other species. In view of the Commission objective to reduce fishing mortality on small swordfish, the Committee therefore recommends that future work should be carried out to determine more precisely the spatial distribution and magnitude of fishing effort, the size and sex distribution of undersized swordfish in the Atlantic, using high resolution observer data.

SWO-AT-6. Management recommendations

North Atlantic

The Committee recommends that the Commission adopt one of the MSE-tested management procedures (MPs) (see item 19.27 Response to the Commission's request), and that the TAC be set based on that MP for 2025 and beyond.

SWO-AT-Table 2 from the 2022 stock assessment shows the probabilities of maintaining $B > B_{MSY}$, maintaining $F < F_{MSY}$, and maintaining the stock in the green quadrant of the Kobe plot over a range of TAC options for North Atlantic swordfish over a period of 10 years. The combined Stock Synthesis and JABBA projections show that a 13,200 t constant catch, which is the current TAC level ([Rec. 23-04](#)), will result in a 60% probability of being in the green quadrant in 2033 (**SWO-AT-Table 2**). However, given that the estimated MSY (that is inclusive of dead discards) is 12,819 t, catches above MSY will result in biomass declines over the projection period (**SWO-AT-Figure 11**).

The Committee also recognizes that the above advice does not fully account for removals associated with the actual mortality of unreported dead and live discards, quota carryovers (15% in the North Atlantic), quota transfers across the North, and South stock management boundaries nor the total cumulative quota, which includes catch allocated to “other CPCs” and would fall above the TAC if achieved. The Committee emphasizes that the importance of this uncertainty be taken into consideration by the Commission when adopting a TAC.

South Atlantic

SWO-AT-Table 3 shows the probabilities of maintaining $B > B_{MSY}$, maintaining $F < F_{MSY}$, and maintaining the stock in the green quadrant of the Kobe plot over a range of TAC options for South Atlantic swordfish over a period through 2033. The current TAC of 10,000 t ([Rec. 22-04](#)) will result in a 52% probability of being in the green quadrant in 2033 (**SWO-AT-Table 3**). The reported catch for 2023 was 8,212 t. Catch levels less than 10,000 t will accelerate rebuilding.

The Committee also recognizes that as was the case for the northern stock, the above advice does not fully account for removals associated with the mortality of unreported dead and post release mortality of live discards, quota carryovers (30% in the South Atlantic) nor quota transfers across the North and South stock management boundaries. The Committee emphasizes the importance of these uncertainties and recommends that the stock be closely monitored in the upcoming years to confirm rebuilding.

ATLANTIC SWORDFISH SUMMARY TABLE		
	<i>North Atlantic</i>	<i>South Atlantic</i>
Maximum Sustainable Yield	12,819 t (10,864 t-15,289 t) ¹	11,481 t (9,793 t-13,265 t) ²
Current (2023) TAC	13,200 t	10,000 t
Current (2023) Yield ³	12,611 t	8,212 t
Yield in last year used in assessment (2020) ⁴	10,668 t	9,020 t
B_{MSY} (CI)	57,919 t (23,666 t-153,156 t) ⁵	74,641 t (60,179 t-92,946 t) ²
F_{MSY}	0.15 (0.08-0.23) ⁵	0.15 (0.12-0.19) ²
Relative Biomass (B_{2020}/B_{MSY})	1.08 (0.71-1.33) ⁵	0.77 (0.53-1.11) ²
Relative Fishing Mortality (F_{2020}/F_{MSY})	0.80 (0.64-1.24) ⁵	1.03 (0.67-1.51) ²
Stock Status (2020)	Overfished: NO	Overfished: YES
	Overfishing: NO	Overfishing: YES
Management Measures in Effect	Country-specific TACs Rec. 22-03 , amended in Rec. 23-04 : Minimum size 125/119 cm LJFL ⁶	Country-specific TACs Rec. 22-04 : Minimum size 125/119 cm LJFL ⁷

¹ Median from base case JABBA and Stock Synthesis models; range corresponding to the lowest and highest 95% CIs from the two models.

² Median and 95% CIs from base case JABBA model.

³ Provisional and subject to revision.

⁴ Based on catch data available in July 2021 for the stock assessment session.

⁵ Median and 95% quantiles from base case Stock Synthesis and JABBA models.

⁶ Associated alternatives listed in [Rec. 17-02](#).

⁷ Associated alternatives listed in [Rec. 17-03](#).

SWO-Table 1. Estimated catches (t) of swordfish (*Xiphias gladius*) 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		34460	35036	35351	31267	26336	27134	27851	25139	23728	24978	25133	25564	25724	27935	24272	24814	24247	23914	24376	21382	20678	21097	21112	20833	19434	20377	19384	19274	19040	20021				
ATN		15001	17105	15222	13025	12329	11622	11453	10011	9654	11444	12071	12380	11528	12306	11110	12146	11672	12709	13080	12378	10780	10752	10051	10295	9066	10245	10445	9785	10333	12611				
Landings	ATN	18258	21221	18528	18524	14027	15502	15278	14238	14104	16444	17082	17163	16156	16296	16270	16628	16298	17105	16386	17934	9770	10245	10011	10537	10379	10109	8922	8288	8728	10111				
	Longline	14183	13264	13822	12234	11062	10717	10623	8673	8274	10314	11410	11243	10718	11413	10704	11176	12264	11124	10703	11176	12264	11124	10703	11176	11413	10704	11124	9913	10403	11997				
	Other reef	428	715	812	570	782	376	303	432	260	486	341	516	409	546	465	485	441	331	121	513	463	391	483	684	4722	600	587	517	459	536				
	Other	17639	21284	18259	18259	13748	14853	14948	14302	13576	11714	12538	13615	13684	13518	11980	12601	12087	10584	10255	8958	9736	10047	10461	10281	10313	10233	9975	8814	9312	8570	8082			
Discaus	ATN	1132	387	438	228	292	632	223	220	220	303	263	262	223	289	360	277	277	291	291	139	269	149	149	149	149	149	27	40	20	40				
	Longline	308	526	562	439	476	525	1137	896	607	618	313	523	215	273	235	151	148	360	391	199	156	167	105	149	152	304	113	99	68	74				
	Other reef	0	0	0	26	12	9	4	1	6	8	5	7	10	8	8	9	7	15	9	10	0	0	0	0	0	0	0	0	2	3	1			
	Other	0	0	0	21	10	6	6	0	0	0	0	0	0	0	0	0	0	145	74	140	140	0	0	0	0	0	0	0	0	0	0			
Landings	ATN	CP	Bahamas	0	0	0	33	16	16	12	13	19	10	21	25	44	39	27	39	30	13	23	21	16	21	29	30	21	18	10	12	13	8	9	
	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	11	106	186	141	141	136	184	141	111	77	131	121	70	77	80	77		
	Canada	1676	1610	739	1089	1115	1119	968	1079	939	1285	1203	1538	1404	1348	1334	1300	1346	1551	1489	1505	1604	1579	1548	1188	782	995	1334	1377	1342	1293	1342	1293		
	China PR	86	104	133	40	337	304	22	102	54	316	56	103	72	85	54	90	73	92	60	80	141	135	87	92	44	38	105	44	38	105	44	38	105	
Landings	ATN	CP	Costa Rica	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	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	0	0	0	0	0	0	0	0	0	0	
	Cote d'Ivoire	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	0	0	0	
	EU-France	6185	7176	5547	5140	4004	3996	4305	3968	3957	4386	3376	5321	5448	5564	4365	4949	4147	4899	5622	4084	3730	4013	3916	3588	3186	3112	3397	3235	3717	4057	4637	4957	4957	
Landings	ATN	CP	EU-France	46	84	597	164	110	144	122	0	74	169	102	178	92	46	14	15	35	16	94	44	28	66	90	79	80	82	90	103	130	163	163	
	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	0	0	0	0	
	EU-Ireland	0	0	0	15	15	132	81	35	35	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-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	0	0	0	0	0	0	0	0	0	
Landings	ATN	CP	EU-Portugal	1399	1617	1703	903	773	777	732	735	766	1032	1320	900	949	778	747	898	1054	1203	882	1438	1241	1420	1460	1871	1691	2292	2070	2165	1720	1967	1967	
	EU-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	0	0	0	
	FR-Saint Pierre and Miquelon	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	0	0	0	
	Great Britain	3	1	4	5	11	0	2	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	
Landings	ATN	CP	Guatemala	1	4	15	15	42	84	36	88	36	30	26	45	73	36	30	26	45	73	36	30	26	45	73	36	30	26	45	73	36	30	26	45
	Iceland	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	0	0	0	
	Japan	933	1043	1243	1301	1391	1089	1675	1869	935	1275	1035	656	869	935	779	1063	1063	935	779	1063	1063	935	779	1063	1063	935	779	1063	1063	935	779	1063	1063	935
	Korea Rep	16	16	19	15	0	0	0	0	0	0	51	65	175	157	3	0	0	0	0	0	64	35	0	0	9	19	9	9	14	13	17	20	13	17
Landings	ATN	CP	Labrador	36	28	28	28	28	28	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
	Malta	36	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	
	Mexico	14	10	22	14	34	37	27	34	32	44	41	31	237	341	34	32	35	38	40	33	32	31	36	64	44	30	21	25	22	26	26	26		
	Norway	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	0	0	0	
Landings	ATN	CP	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	0	0
	Philippines	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	0	0	0	
	Russian Federation	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	0	0	0	
	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	0	0	0	0	
Landings	ATN	CP	St Vincent and the Grenadines	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	0	0
	Tanzania and Tobago	180	150	138	110	130	138	41	75	92	78	83	91	19	29	48	30	14	16	26	17	13	36	3	6	8	6	6	1	2	4	4	4	4	
	UK-Bermuda	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
	UK-Britain 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	0	0	0	0	
Landings	ATN	CP	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	0	0	0
	USA	3366	4036	3359	2987	3038	2908	2803	2213	2384	2213	2384	2213	1873	2409	2384	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	2213	
	Yamalo	62	56	55	20	37	20	44	21	34	45	45	33	55	22	30	11	13	28	18	25	24	24	34	57	28	36	35	16	13	17	31	31	31	
	China Taipei	307	489	521	509	386	285	347	299	310	257	300	140	172	103	82	89	88	192	166	115	78	115	148	78	162	115	144	66	145	170	170	170	170	
Landings	ATN	CP	Guinea	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	0	
	Cuba	50	86	7	7	7	7	7	7	7	10	3	2	2	0	0	0	0	0	0	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	0	0	0	0	
	Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																			

			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		
Ducardo	ATN	CP	Cuba	422	778	45	60	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		
		Mixed flag (FR+EE)	0	0	0	0	0	4	0	0	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	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Togo	14	14	64	0	0	0	0	0	0	9	10	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	11	26	6	3	0	3	1	3	0	1	1	0	0	0	0	0	0	0	0	0	0	
		Canada	0	0	0	5	52	35	50	26	33	79	45	106	38	61	39	9	15	8	111	39	12	8	11	21	5	2	2	3	2	3	3	
		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	1	1	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	0	
		EU-Portugal	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	0	
		Japan	0	0	0	0	0	0	398	567	319	263	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	4	3	
Ducardo	ATN	CP	Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	46	19	0	2	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	1	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	0	
		USA	708	526	388	446	433	494	490	308	263	282	275	227	185	220	205	148	138	223	217	120	137	137	90	111	140	267	91	90	59	55	55	
		China Taipei	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	0	
		Brazil	0	0	0	0	0	0	0	0	0	0	0	0	91	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		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	1	1	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	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	0	0	0	0	0	0	0	
		Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	70	23	0	0	0	0	0	0	0	0	0	0	0	0
Ducardo	ATN	CP	South Africa	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	0	0	21	1	10	6	1	0	0	0	0	0	21	1	10	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		China Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	117	0	45	43	2	111	26	69	57	126	85	110	110	
		China Taipei	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	0	
		China Taipei	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	0	
		China Taipei	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	0	
		China Taipei	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	0	
		China Taipei	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	0	
		China Taipei	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	0	
		China Taipei	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	0	

SWO-AT-Table 2. Joint probabilities of the North Atlantic swordfish stock being below F_{MSY} (top, overfishing not occurring), above B_{MSY} (middle, not overfished) as well as the joint probability of being above B_{MSY} and below F_{MSY} (bottom, green zone) in a given year for a given catch level based on 30,000 iterations of the MVLN approximation for Stock Synthesis and JABBA MCMC iterations.

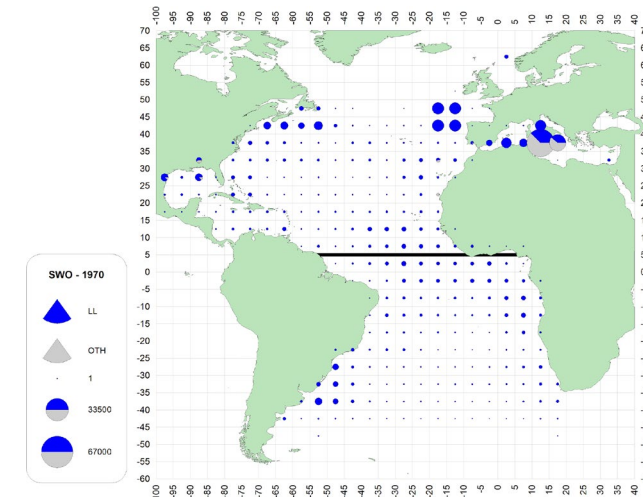
Probability $F < F_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0t	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
9000t	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%	94%
10000t	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
11000t	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%	85%
12000t	79%	79%	79%	79%	79%	80%	80%	80%	79%	79%	79%
12500t	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%	76%
12600t	75%	75%	75%	75%	75%	75%	75%	76%	75%	75%	75%
12700t	74%	74%	74%	74%	74%	74%	74%	74%	74%	74%	74%
12800t	74%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
12900t	73%	72%	72%	72%	72%	72%	72%	72%	71%	71%	71%
13000t	72%	71%	71%	71%	71%	70%	70%	70%	69%	69%	68%
13100t	71%	70%	70%	69%	69%	68%	68%	67%	66%	66%	65%
13200t	70%	69%	69%	68%	67%	66%	65%	64%	63%	62%	61%
13300t	69%	68%	67%	66%	65%	63%	62%	61%	59%	58%	56%
13400t	68%	66%	65%	64%	62%	60%	59%	57%	55%	53%	51%
13500t	66%	65%	63%	61%	59%	57%	55%	53%	51%	48%	46%
13600t	65%	63%	61%	59%	56%	54%	51%	49%	46%	43%	41%
13700t	63%	61%	59%	56%	53%	50%	47%	44%	41%	38%	36%
13800t	62%	59%	56%	53%	50%	46%	43%	40%	37%	34%	32%
14000t	58%	55%	51%	47%	43%	39%	35%	32%	29%	27%	25%
15000t	38%	31%	25%	21%	25%	32%	32%	31%	31%	30%	29%
16000t	20%	15%	12%	11%	10%	10%	10%	9%	9%	9%	9%

Probability $B > B_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0t	75%	84%	90%	94%	96%	97%	98%	98%	99%	99%	99%
9000t	75%	78%	80%	82%	83%	84%	85%	86%	86%	87%	87%
10000t	75%	77%	79%	80%	81%	82%	83%	83%	83%	84%	84%
11000t	75%	76%	77%	78%	79%	79%	80%	80%	81%	81%	81%
12000t	75%	75%	76%	76%	77%	77%	77%	77%	77%	77%	77%
12500t	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
12600t	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%	75%
12700t	75%	75%	74%	74%	74%	74%	74%	74%	74%	74%	74%
12800t	75%	74%	74%	74%	74%	74%	74%	74%	74%	73%	73%
12900t	75%	74%	74%	74%	73%	73%	73%	73%	73%	72%	72%
13000t	75%	74%	74%	73%	73%	73%	72%	72%	72%	71%	71%
13100t	75%	74%	73%	73%	72%	72%	71%	70%	69%	68%	67%
13200t	75%	74%	73%	72%	72%	71%	70%	69%	67%	66%	65%
13300t	75%	74%	73%	72%	71%	70%	69%	68%	67%	66%	65%
13400t	75%	74%	73%	72%	70%	70%	68%	67%	65%	64%	62%
13500t	75%	74%	72%	71%	70%	68%	67%	65%	63%	61%	59%
13600t	74%	74%	72%	71%	69%	67%	65%	63%	61%	58%	55%
13700t	74%	73%	72%	70%	68%	66%	64%	61%	58%	55%	52%
13800t	74%	73%	71%	70%	67%	65%	62%	59%	55%	52%	48%
14000t	74%	73%	71%	68%	65%	62%	58%	54%	50%	45%	41%
15000t	74%	71%	66%	59%	47%	44%	42%	41%	39%	38%	36%
16000t	74%	69%	59%	48%	36%	27%	21%	18%	16%	15%	14%

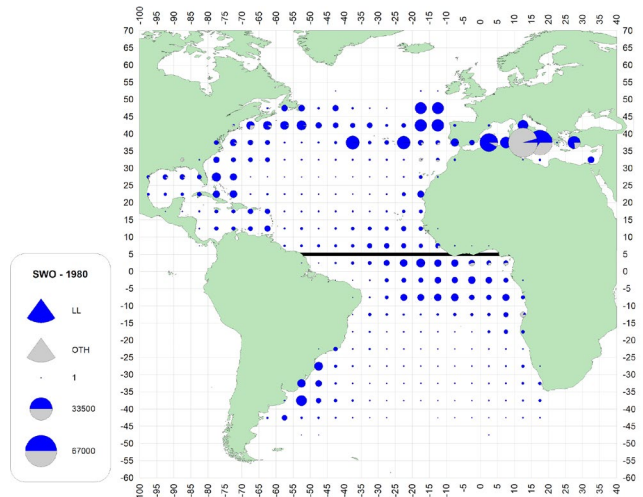
Probability $F < F_{MSY}$ and $B > B_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0t	75%	84%	90%	94%	96%	97%	98%	98%	99%	99%	99%
9000t	75%	78%	80%	82%	83%	84%	85%	86%	86%	87%	87%
10000t	75%	77%	79%	80%	81%	82%	83%	83%	83%	84%	84%
11000t	75%	76%	77%	78%	79%	79%	80%	80%	80%	81%	81%
12000t	74%	75%	75%	76%	76%	76%	77%	77%	77%	77%	77%
12500t	73%	73%	74%	74%	74%	74%	74%	75%	75%	75%	75%
12600t	73%	73%	73%	73%	74%	74%	74%	74%	74%	74%	74%
12700t	72%	72%	73%	73%	73%	73%	73%	73%	73%	73%	73%
12800t	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%	72%
12900t	71%	71%	71%	71%	71%	71%	71%	71%	70%	70%	70%
13000t	70%	70%	70%	70%	70%	69%	69%	69%	68%	68%	67%
13100t	70%	69%	69%	69%	68%	67%	67%	66%	66%	65%	64%
13200t	69%	68%	68%	67%	66%	65%	64%	63%	62%	61%	60%
13300t	68%	67%	66%	65%	64%	63%	61%	60%	59%	57%	56%
13400t	67%	66%	64%	63%	61%	60%	58%	56%	54%	53%	51%
13500t	66%	64%	62%	61%	59%	57%	55%	53%	50%	48%	46%
13600t	64%	62%	60%	58%	56%	53%	51%	48%	46%	43%	40%
13700t	63%	61%	58%	55%	53%	50%	47%	44%	41%	38%	36%
13800t	61%	59%	56%	53%	49%	46%	43%	40%	37%	34%	32%
14000t	58%	55%	51%	47%	43%	39%	35%	32%	29%	27%	25%
15000t	38%	31%	25%	21%	22%	32%	30%	29%	27%	26%	25%
16000t	20%	15%	12%	11%	10%	10%	10%	9%	9%	9%	9%

SWO-AT-Table 3. Estimated projection probabilities (%) for the reference case model for South Atlantic swordfish. Projection probabilities are provided for $F \leq F_{MSY}$ (top); $B \geq B_{MSY}$ (middle); $F \leq F_{MSY}$ and $B \geq B_{MSY}$ (bottom). Stochastic projections were conducted over the period 2023-2033 with a range of fixed TACs (6,000 – 15,000 t), including a zero catch-scenario. The 2021 and 2022 catches are assumed to be 9,826 t, which is the mean of the 2018-2020 reported catch.

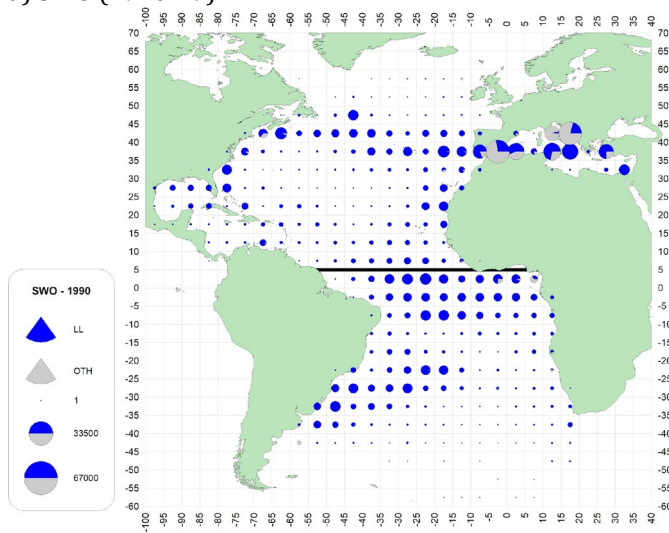
Probability $F \leq F_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6000	95%	97%	98%	98%	99%	99%	99%	99%	100%	100%	100%
6500	92%	94%	96%	97%	98%	98%	99%	99%	99%	99%	99%
7000	88%	91%	93%	95%	96%	97%	97%	98%	98%	98%	98%
7500	82%	86%	89%	91%	93%	94%	95%	96%	96%	97%	97%
8000	75%	80%	83%	86%	88%	90%	91%	92%	93%	94%	95%
8500	68%	72%	76%	79%	82%	84%	85%	87%	88%	89%	90%
9000	59%	64%	68%	71%	74%	76%	78%	80%	81%	83%	84%
9500	51%	55%	59%	62%	65%	67%	69%	71%	72%	74%	75%
9826	46%	50%	53%	56%	58%	60%	62%	64%	65%	67%	68%
10000	43%	47%	49%	52%	54%	57%	59%	60%	62%	64%	65%
10500	35%	38%	40%	42%	44%	46%	48%	49%	50%	52%	53%
11000	29%	31%	32%	33%	35%	36%	37%	38%	39%	40%	40%
11500	23%	24%	25%	25%	26%	27%	27%	28%	28%	29%	29%
12000	18%	18%	19%	19%	19%	19%	19%	20%	20%	20%	20%
12500	13%	14%	14%	14%	14%	14%	14%	13%	13%	13%	13%
13000	11%	10%	10%	10%	10%	10%	9%	9%	9%	9%	9%
13500	8%	8%	7%	7%	7%	6%	6%	6%	6%	6%	5%
14000	6%	6%	5%	5%	5%	4%	4%	4%	4%	3%	3%
14500	5%	4%	4%	3%	3%	3%	3%	2%	2%	2%	2%
15000	4%	3%	3%	2%	2%	2%	2%	2%	1%	1%	1%
Probability $B \geq B_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	21%	48%	74%	90%	96%	99%	99%	100%	100%	100%	100%
6000	21%	33%	46%	59%	70%	77%	83%	88%	92%	94%	95%
6500	21%	32%	44%	56%	66%	74%	80%	85%	88%	91%	93%
7000	21%	31%	41%	52%	62%	70%	75%	80%	85%	88%	90%
7500	21%	30%	39%	48%	57%	65%	70%	76%	80%	83%	86%
8000	21%	29%	37%	45%	53%	60%	65%	70%	74%	78%	81%
8500	21%	28%	34%	41%	48%	54%	59%	64%	68%	72%	75%
9000	21%	27%	32%	38%	44%	49%	53%	58%	61%	65%	68%
9500	21%	26%	31%	35%	39%	44%	48%	51%	55%	58%	60%
9826	21%	25%	29%	33%	36%	40%	43%	47%	50%	52%	55%
10000	21%	25%	29%	32%	35%	39%	41%	45%	47%	49%	52%
10500	21%	24%	27%	29%	31%	34%	36%	38%	40%	41%	43%
11000	21%	23%	25%	26%	28%	29%	30%	32%	33%	34%	35%
11500	21%	22%	23%	24%	24%	25%	25%	26%	26%	27%	27%
12000	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
12500	21%	20%	19%	19%	18%	18%	17%	17%	16%	16%	16%
13000	21%	19%	18%	17%	16%	15%	14%	13%	13%	12%	12%
13500	21%	18%	17%	15%	14%	12%	11%	10%	10%	9%	9%
14000	21%	18%	15%	13%	12%	10%	9%	8%	7%	7%	6%
14500	21%	17%	14%	12%	10%	8%	7%	6%	6%	5%	4%
15000	21%	16%	13%	10%	8%	7%	6%	5%	4%	3%	3%
Probability $F \leq F_{MSY}$ and $B \geq B_{MSY}$											
TAC (t)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
0	21%	48%	74%	90%	96%	99%	99%	100%	100%	100%	100%
6000	21%	33%	46%	59%	70%	77%	83%	88%	92%	94%	95%
6500	21%	32%	44%	56%	66%	74%	80%	85%	88%	91%	93%
7000	21%	31%	41%	52%	62%	70%	75%	80%	85%	88%	90%
7500	21%	30%	39%	48%	57%	65%	70%	76%	80%	83%	86%
8000	21%	29%	37%	45%	53%	60%	65%	70%	74%	78%	81%
8500	21%	28%	34%	41%	48%	54%	59%	64%	68%	72%	75%
9000	21%	27%	32%	38%	44%	49%	53%	58%	61%	65%	68%
9500	21%	26%	31%	35%	39%	44%	48%	51%	55%	58%	60%
9826	21%	25%	29%	33%	36%	40%	43%	47%	50%	52%	55%
10000	20%	25%	28%	32%	35%	39%	41%	45%	47%	49%	52%
10500	20%	23%	26%	29%	31%	33%	35%	38%	40%	41%	43%
11000	20%	22%	24%	25%	27%	28%	30%	31%	32%	33%	35%
11500	18%	19%	21%	22%	23%	23%	24%	24%	25%	26%	26%
12000	16%	16%	17%	18%	18%	18%	18%	18%	19%	19%	19%
12500	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%	13%
13000	10%	10%	10%	10%	9%	9%	9%	9%	9%	9%	8%
13500	8%	8%	7%	7%	7%	6%	6%	6%	6%	5%	5%
14000	6%	6%	5%	5%	5%	4%	4%	4%	4%	3%	3%
14500	5%	4%	4%	3%	3%	3%	3%	2%	2%	2%	2%
15000	4%	3%	3%	2%	2%	2%	2%	2%	1%	1%	1%



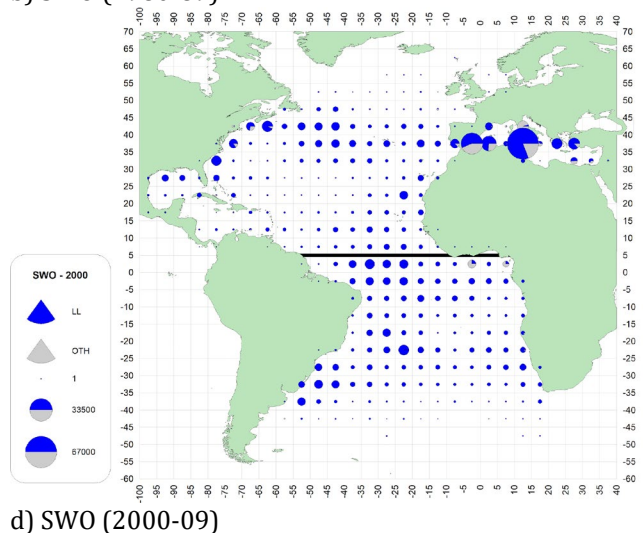
a) SWO (1970-79)



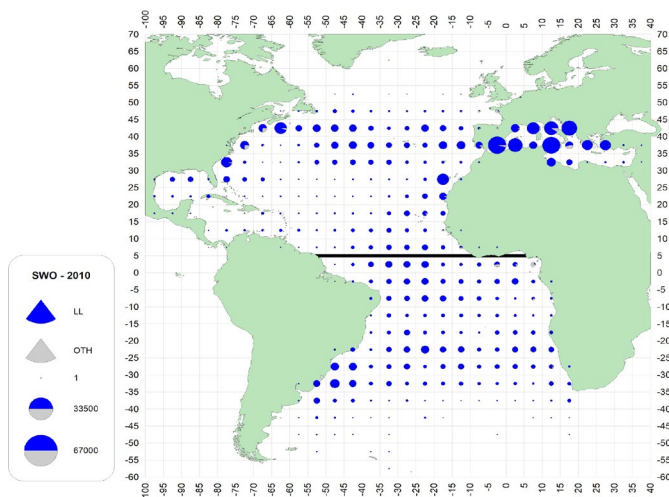
b) SWO (1980-89)



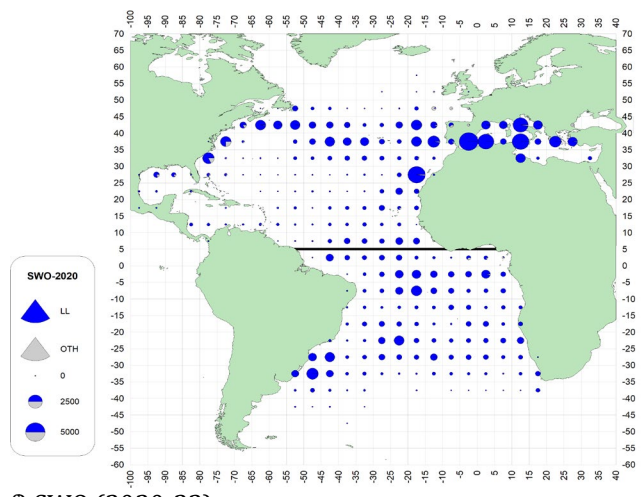
c) SWO (1990-99)



d) SWO (2000-09)

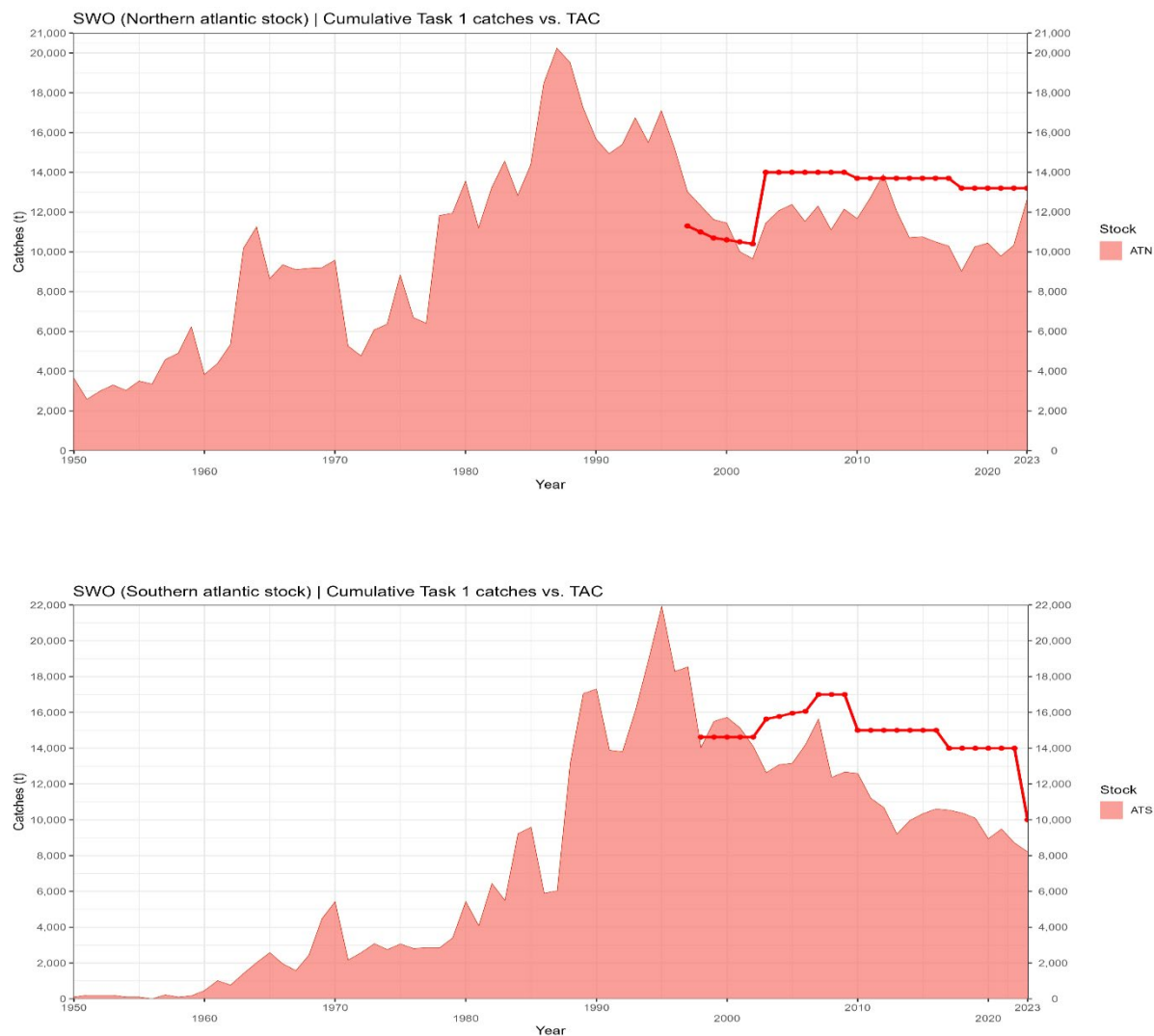


e) SWO (2010-19)

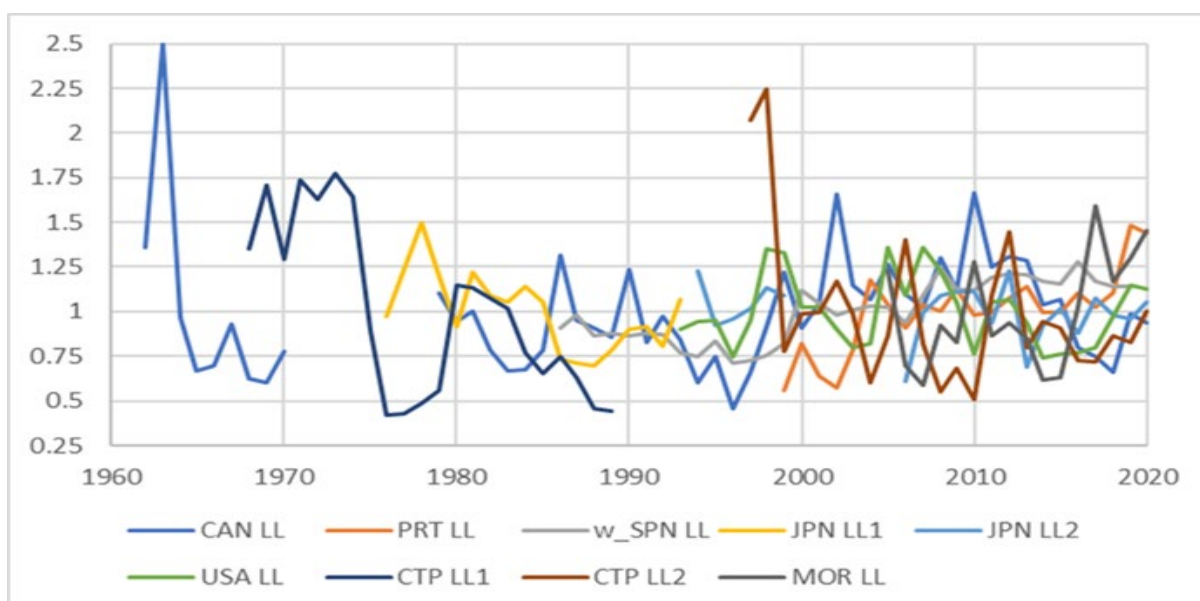


f) SWO (2020-22)

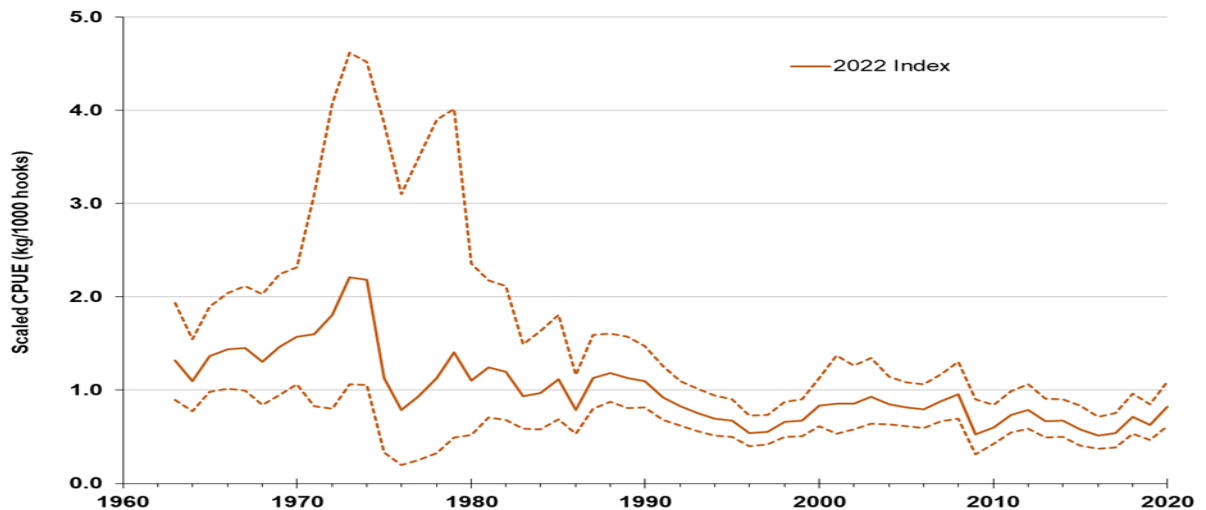
SWO-AT-Figure 1. Geographic distribution of swordfish cumulative catch (t) by gear, in the Convention area, shown on a decadal scale. The maps are scaled to the maximum catch observed during 1970-2022 (the last decade only covers 3 years).



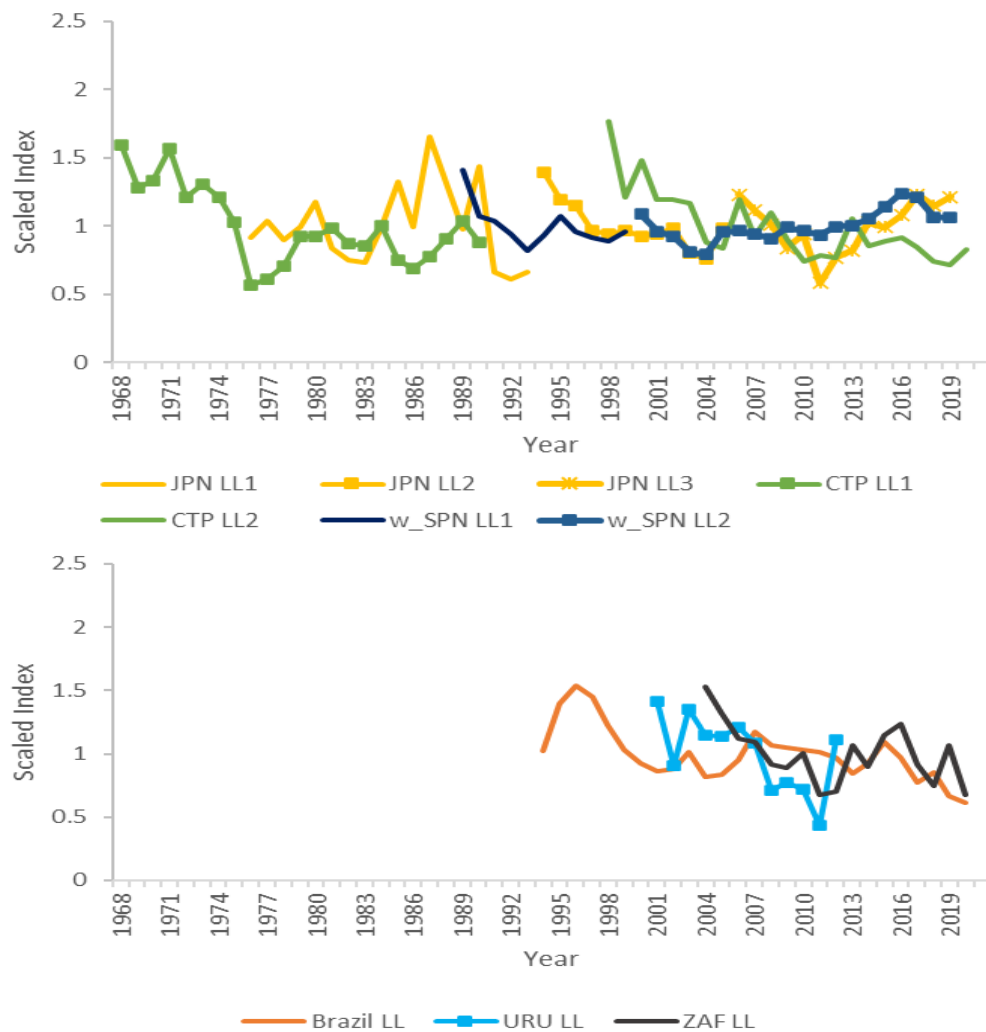
SWO-AT-Figure 2. North (top) and South (bottom) Atlantic swordfish catches (t, landings and dead discards) and TAC (t), for the period 1950-2023. The dotted red lines indicate the TAC.



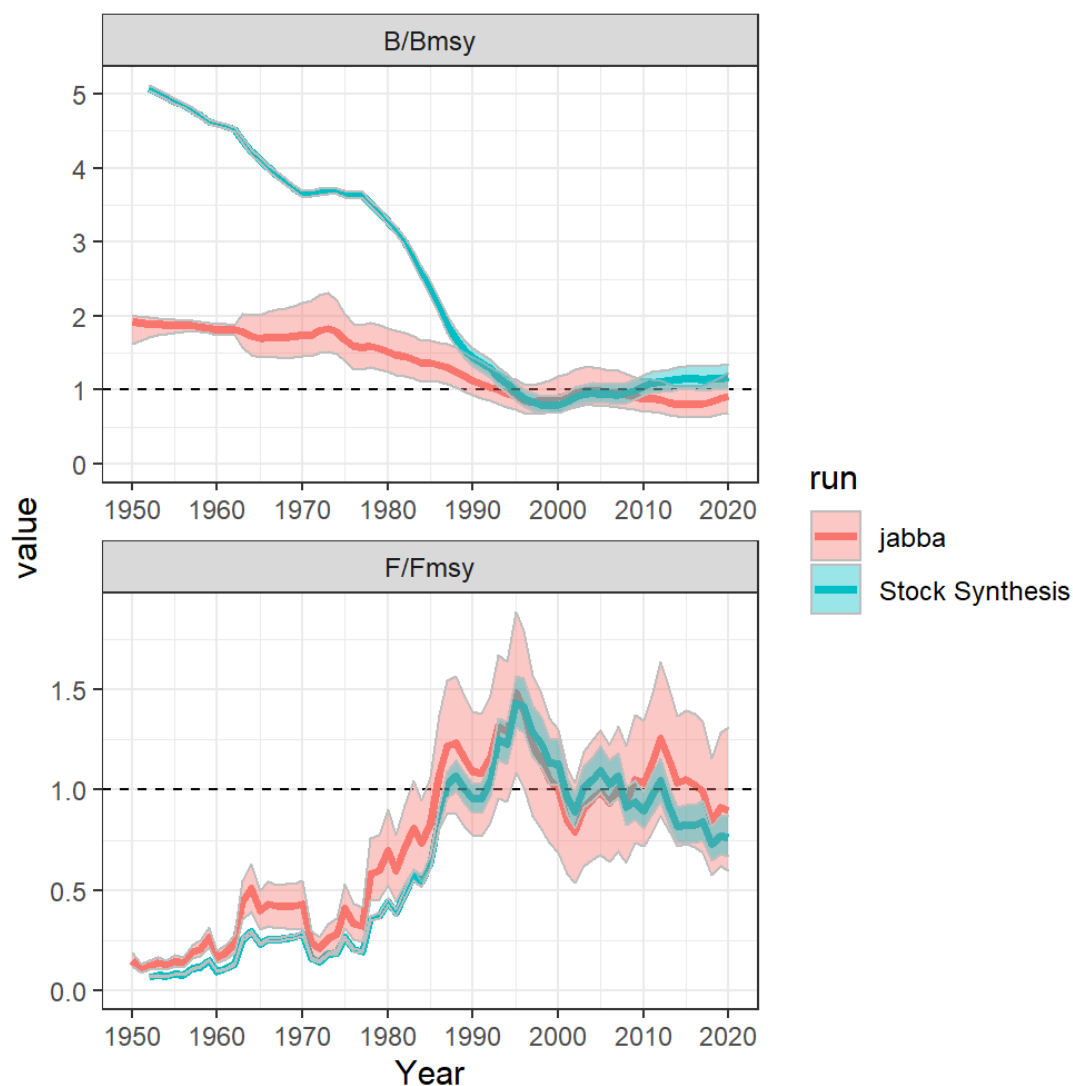
SWO-AT-Figure 3. Standardized CPUEs series provided by CPCs for the North Atlantic swordfish for the base continuity production model. The CPUE series were scaled to their mean for comparison purposes.



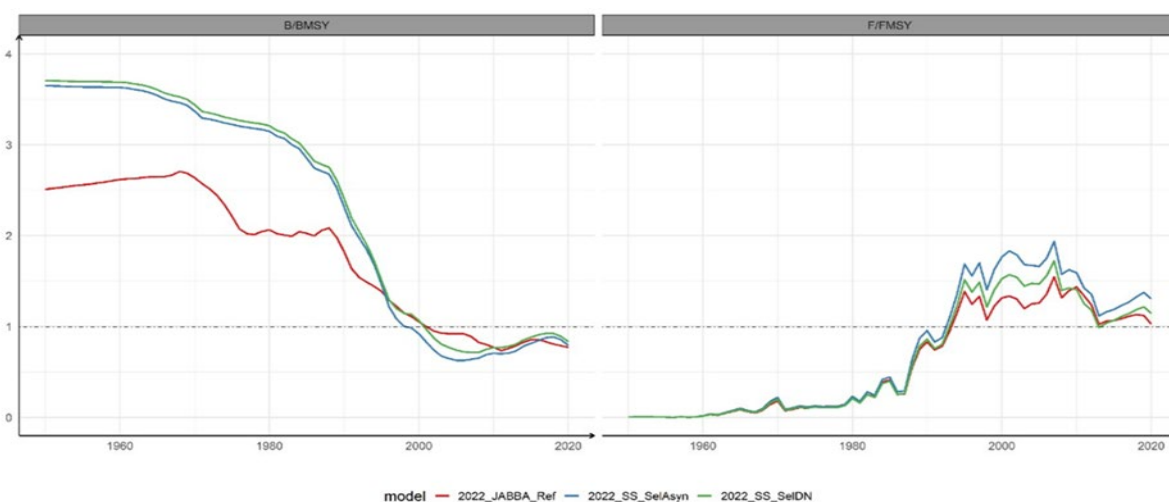
SWO-AT-Figure 4. Standardized combined biomass CPUE index for North Atlantic and 95% confidence intervals, used in the 2022 stock assessment as the continuity run for the production models.



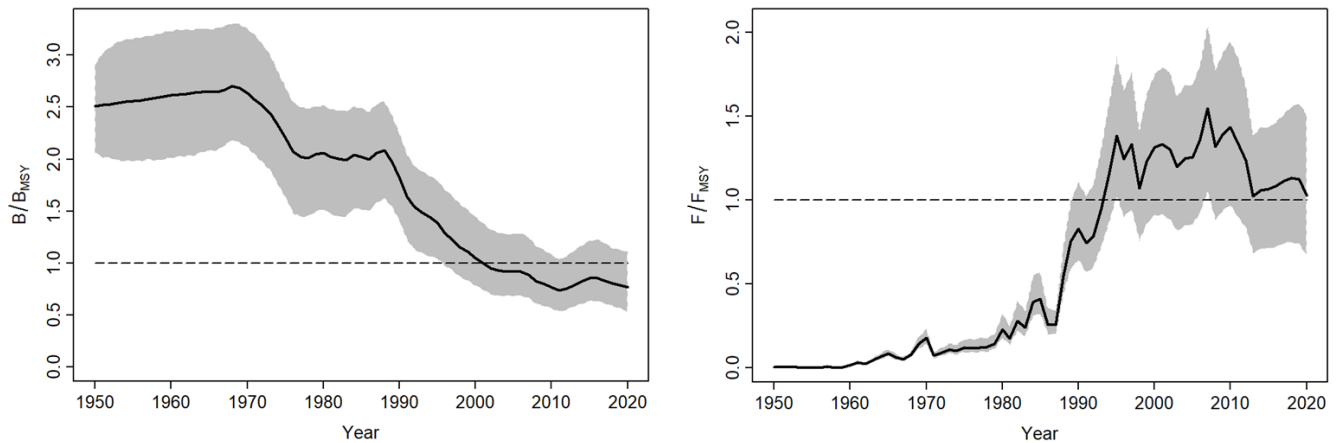
SWO-AT-Figure 5. Standardized CPUEs series that were used in the 2022 assessment of South Atlantic swordfish. Indices that were split (JPN, EU-SPN and CTP) are shown on the top, and the rest (BRA, URU and ZAF) are shown at the bottom. The CPUE series were scaled to their mean for comparison purposes.



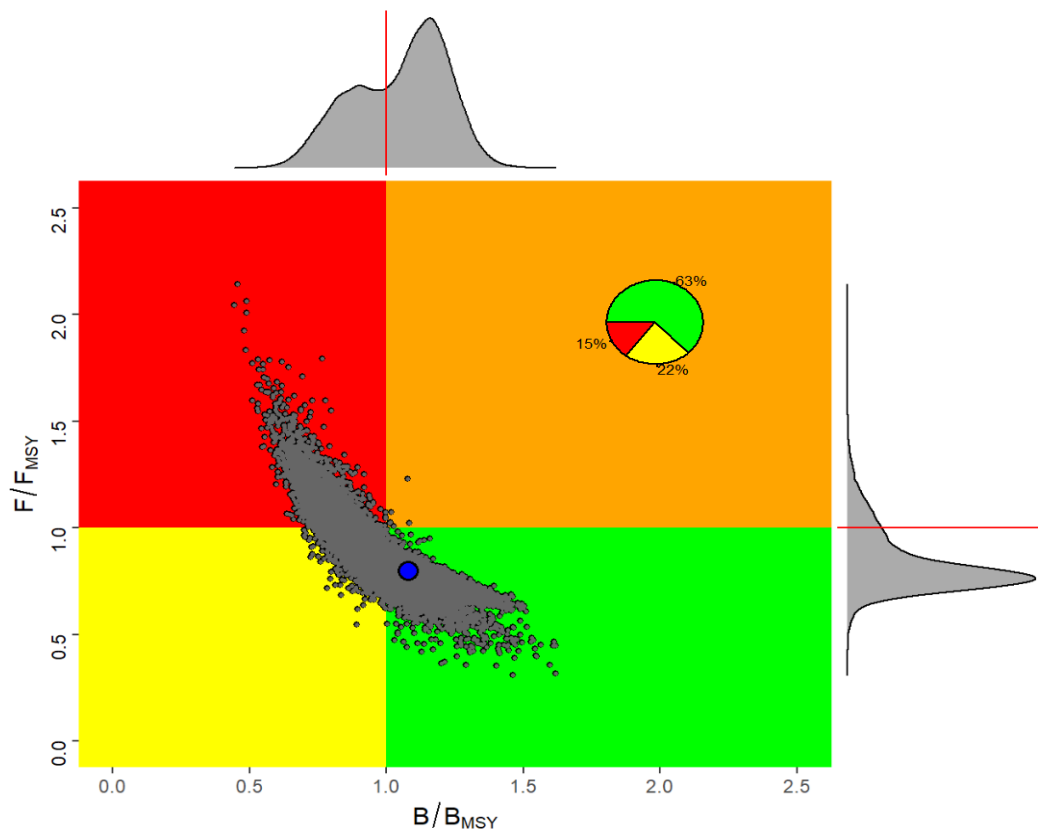
SWO-AT-Figure 6. Results from the two models used for management advice in the North Atlantic swordfish assessment: JABBA and Stock Synthesis. Trends in relative biomass (top) and fishing mortality (bottom). Uncertainty intervals are approximations of 95% credibility intervals.



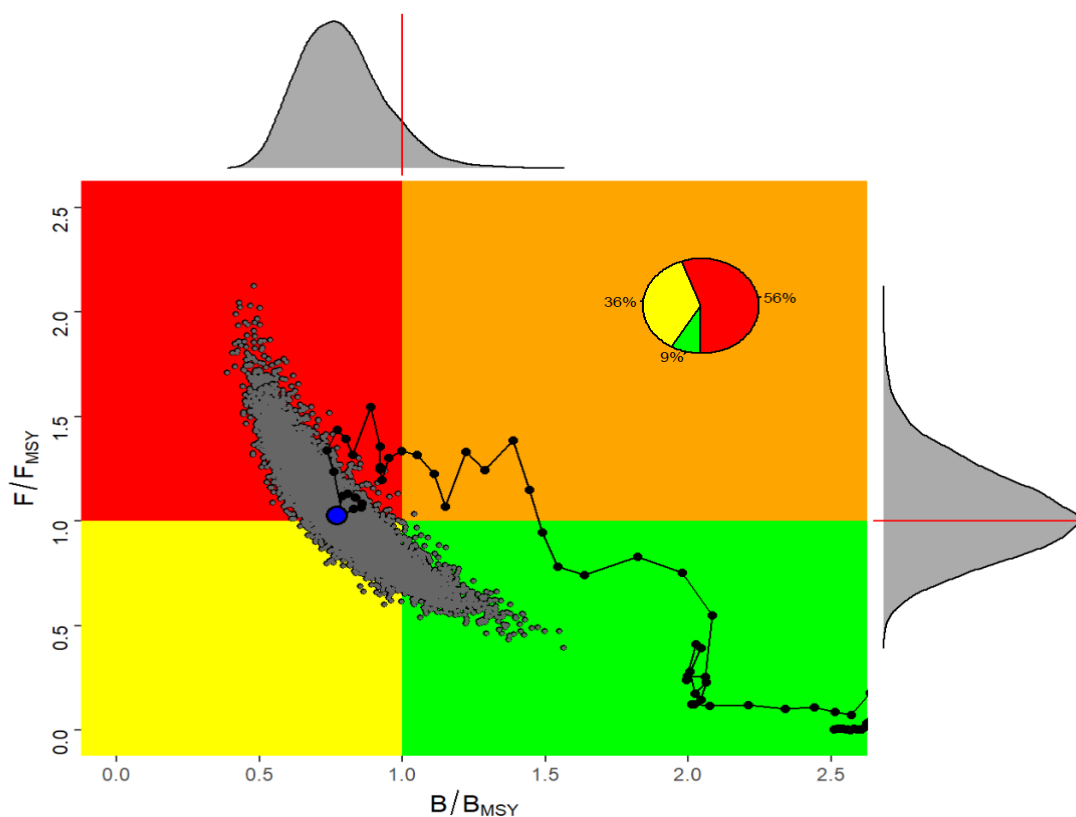
SWO-AT-Figure 7. Comparisons of B/B_{MSY} and F/F_{MSY} between JABBA base case and two SS runs for the South Atlantic swordfish stock.



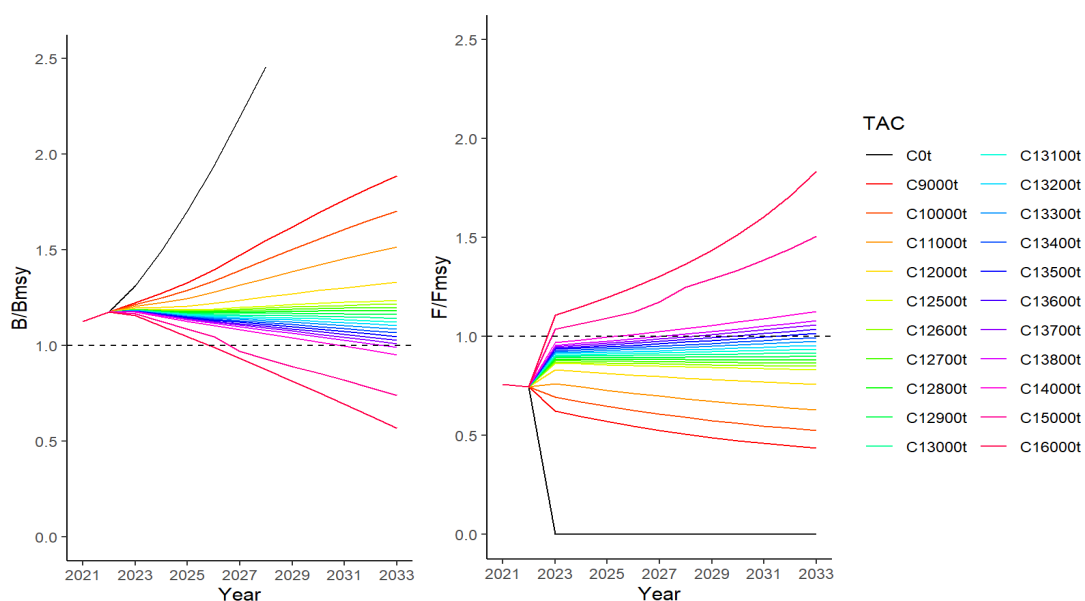
SWO-AT-Figure 8. South Atlantic swordfish biomass and fishing mortality rates relative to MSY levels, from the JABBA base case model. Grey areas represent 95% credibility intervals.



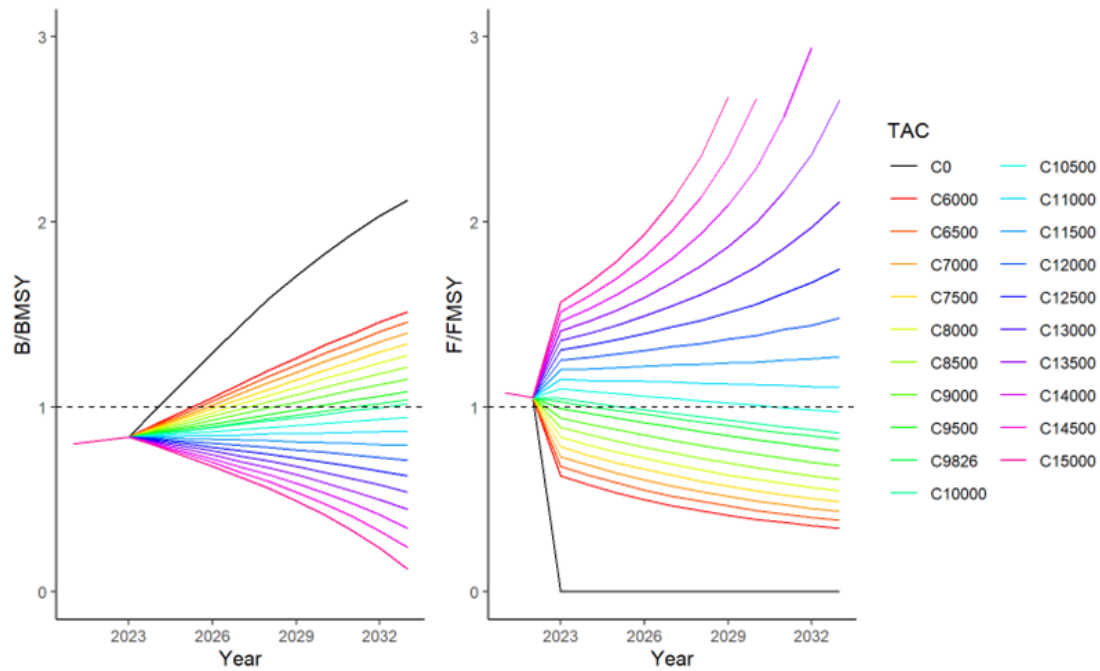
SWO-AT-Figure 9. Joint Kobe plot for the Stock Synthesis and the JABBA reference case models for the North Atlantic swordfish stock. For the Stock Synthesis run, the benchmark is calculated from the year-specific selectivity and fleet allocations and based on 15000 MVLN iterations for Stock Synthesis and 15000 Markov chain Monte Carlo (MCMC) iterations for JABBA. The blue point shows the median of 30,000 iterations for SSB_{2020}/SSB_{MSY} or B_{2020}/B_{MSY} and F_{2020}/F_{MSY} for the entire iterations from Stock Synthesis and JABBA. Grey points represent the 2020 estimates of relative fishing mortality and relative spawning stock biomass for 2020 for each of the 30,000 iterations. The upper graph represents the smoothed frequency distribution of SSB_{2020}/SSB_{MSY} or B_{2020}/B_{MSY} estimates. The right graph represents the smoothed frequency distribution of F_{2020}/F_{MSY} estimates. The inserted pie graph represents the percentage of each 2020 estimate that fall in each quadrant of the Kobe plot. All SSB for Stock Synthesis showed the values at the end of years. The blue dot is the median of the 2020 stock status.



SWO-AT-Figure 10. Kobe plot for the JABBA reference base case model for South Atlantic swordfish. The solid blue circle is the estimated median point with the respective uncertainties in the terminal year (2020). The pie chart represents the probabilities of stock being in the different colour quadrants (red 56%, yellow 36%, green 9%). The blue dot represents the 2020 stock status.



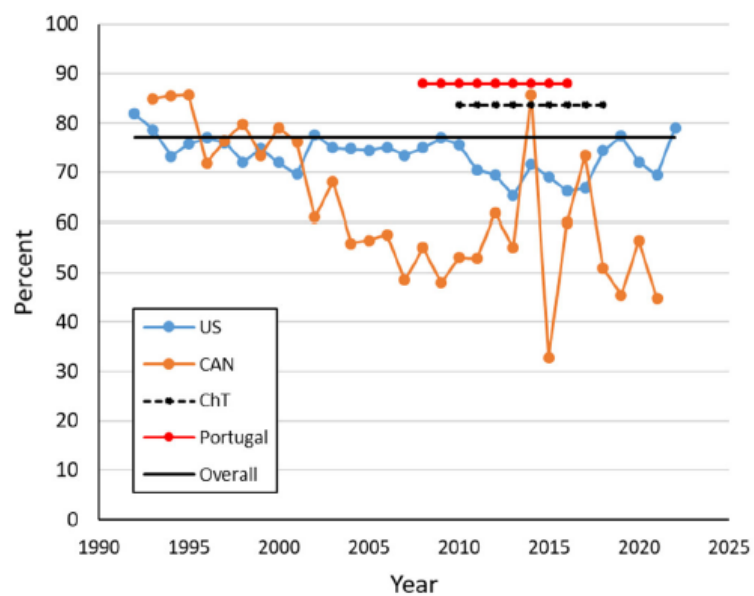
SWO-AT-Figure 11. Joint projections from Stock Synthesis and JABBA of biomass (or spawning stock biomass) at 0, 9-16 thousand t constant TACs for the North Atlantic swordfish stock for the period 2023-2033.



SWO-AT-Figure 12. Median trends of relative biomass (B/B_{MSY}) for the projected South Atlantic swordfish stock derived from the JABBA base case model at 0, 6-15 thousand t constant TACs for the period 2023-2033.



SWO-AT-Figure 13. Estimated total discards due to the minimum size regulation in absolute biomass and numbers (top row) and in biomass and numbers as a proportion of the catch (bottom row) for years 1992 to 2020, as estimated by Stock Synthesis.



SWO-AT-Figure 14. Direct observations of at-haulback mortality of fish below the minimum size limit in four longline fleets operating in the North Atlantic.