REPORT OF THE 2017 ICCAT SWORDFISH DATA PREPARATORY MEETING

(Madrid, Spain 3-7 April, 2017)

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid, April 3 to 7, 2017. Dr Rui Coelho (EU-Portugal), the Species Group ("the Group") coordinator and meeting Chairman, opened the meeting and welcomed participants. Dr Miguel Neves dos Santos (ICCAT Scientific Coordinator) adressed the Group on behalf of the ICCAT Executive Secretary, welcomed the participants and highlighted the importance of the meeting due to the fact that the Atlantic swordfish stocks status has not been assessed for 4 years. The Chairmen proceeded to review the Agenda which was adopted with minor changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. The abstracts of all SCRS documents presented at the meeting are included in **Appendix 4**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1, 9	M. Neves dos Santos
Item 2	R. Foreselledo
Item 3, 4	C. Palma, R. Foreselledo
Item 5.1	A. Hanke, C. Brown, R. Coelho
Item 5.2	H. Andrade, R. Foreselledo, R. Coelho
Item 5.3, 5.4	L. Kell, R. Coelho
Item 6	M. Schirripa, H. Andrade
Item 7	D. Die, L. Kell
Item 8	R. Coelho, D. Die, M. Neves dos Santos

2. Review of historical and new information on biology

Document SCRS/2017/079 presented a Lower Jaw Fork Length (LJFL) to Dorsal Caudal Length (DCL, measured from the beginning of the first dorsal fin to the caudal peduncle) relationship and a LJFL to Dressed Weight (DWT, gilled, gutted, part of head off, fins off) relationship. Data used in this document were gathered by Uruguay's National Observer Program on board the Uruguayan pelagic longline fleet between 1998 and 2012, and on board the Japanese tuna longline fleet operating in Uruguayan jurisdictional waters in the period 2009 – 2011 and 2013. Both relationships were presented by sex as well as a general equation for sexes combined.

Table 1 summarizes the current length-weight, weight-weight and age-at-length relationships for Atlantic swordfish, as well as maturity and fecundity data. This data was based on the 2013 SWO report, with added information for Uruguay (SCRS/2017/079), on and growth from VBGF (Arocha *et al*., 2003). The Group agreed to add the SCRS/2017/079 conversion factors to the ICCAT list of conversion for that region of the Atlantic. **Table 2** summarizes the conversion factors currently in the ICCAT manual. For consistency, the group agreed that those parameters should be used in the stock assessment.

Tables 3 to **6** provide a collection of several biological parameters for swordfish. The Group acknowledged that this can be useful especially for exploring variability of the various parameters across studies, regions and oceans, but that for the current stock assessment the parameters provided in **Table 1** should be used.

3. Review of data held by the Secretariat

The Secretariat presented to the Working Group, the most up-to-date statistical information available in the ICCAT database system (ICCAT-DB) in relation to swordfish (*Xiphias gladius*, SWO) for both Atlantic stocks (SWO-N: north Atlantic; SWO-S: south Atlantic). Both Task I nominal catches (T1NC) and Task II (T2CE: catch and effort, T2SZ: Task II size frequencies; T2CS: reported catch-at-size) were revised by the Group. The available swordfish conventional tagging information was also revised.

3.1 Review of Task I data

The SWO T1NC (SWO-N: northern Atlantic stock; SWO-S: southern Atlantic stock) was revised using a specific format (bookmarked with: unclassified gears, possible gaps, possible erroneous gears, various gear codes with the similar meaning requiring harmonization/merging, possible errors in stock/areas definitions, etc.) aiming towards a full revision and validation of the main SWO catch series between 1950 and 2015. The largest portion of the revision process (fully described in **Appendix 5**) was made by the Group during the meeting (with some corrections provisionally made, pending confirmation from the responsible CPCs) and involved changes in about 5% (~300 records) of the Task I catch records associated with Atlantic SWO. Overall, this revision improved the internal consistency of T1NC for the Atlantic SWO (proper allocation of unclassified gears, gap recovery/completion, reallocation of some catches in the proper stocks/areas, etc.) with better catch series discrimination by fishery (fleet, gear, and, stock/area combinations). Despite the full revision made, the Group considers that various inconsistencies (incomplete series, stock allocation inaccuracies, gear inaccuracies, etc.) still exist, and, there is a margin for T1NC improvements. The revised T1NC catches are presented in **Table 7** (**Figures 1** and **2**). The Group recognised that, this type of full validation processes are essential to improve T1NC and should continue in the future.

The Group called attention to the increasing complexity of the ICCAT gear coding system (ICCAT has nearly 60 gear codes when compared with around 20 codes used by FAO and other t-RFMOs). The Secretariat informed the Group that, the Sub-Committee on Statistics has (since 2015) undertaken the task of improving/simplifying the overall ICCAT coding system overall which includes the gear code component. Since 2016, several gear codes (SURF, SPHL, FARM, and others linked to discards like LLD, GILLD, etc.) were discontinued. During 2017 improvements are expected for the longline (LL) and purse-seine (PS) gear groups.

There was an important debate about the progress made on reporting SWO discards (both dead and alive) in T1NC (required since 2005). The Secretariat informed the Group that, since 2006, the T1NC eForm is structured to report and discriminate landings (L), dead discards (DD), and, live discards (DL). In addition, mortality estimates obtained from live releases (DM) should be communicated to the SCRS. However, very few CPCs have reported (and only for the recent years) these two mandatory "discards" (SWO dead discards shown in **Table 7**, live discards presented in **Table 8**) components of the total biomass removals. With the small amount of DL series available, the Group considers irrelevant (for now) obtaining estimations of DM, aiming to improve the total estimations of SWO stock total biomass production (catches = L + DD + DM). The Group recognised the complexity of obtaining overall estimates of discards (DD, DL and, DM). Nevertheless, reiterated the need to improve the reporting of discards and especially dead discards. Most of the DL information available in the ICCAT T1NC database is related to Japan for the North Atlantic. In 2013, the mortality of live discards of swordfish in particular from the Japan longline fishery was queried. It was suggested that this information could be inferred from the scientific observer program of Uruguay on the Japanese vessels fishing in Uruguayan waters during 2009-2011. At this meeting, a Uruguayan scientist reported size frequency of catches and the fate of discards. Results indicated a high mortality of caught swordfish with a high proportion due to predation by killer whales. This however might be a feature restricted to this fishing area and may not necessarily be applicable to other areas in the Atlantic.

Document SCRS/2107/080 presented data from a small scale artisanal fishery operating with drifting gillnets in the continental shelf waters of Côte d'Ivoire. Specimens of swordfish were counted and measured in two landing places ("Zimbabwé" and Abobo Doumé), from January 2013 to December 2015. Higher catches were reported from "Zimbabwé", specifically 89.198 t in 2013, 43.733 t in 2014 and 28.27 t in 2015; compared to 42.195 t, 24.432 t and 20.082 t reported for Abobo-Doumé. There was seasonality in the catches, with more specimens landed from July to September. Size frequency distribution showed that the specimens landed in "Zimbabwé" were larger. Specimens ranging in size (LJFL) from 90 cm to 220 cm were recorded.

The Group noted the differences in the catches between years, with lower overall values for the more recent years. The author explained that the fishery operates in coastal waters on the continental shelf (vessels with 3-5 day autonomy) and that therefore any changes in the environmental conditions between years will have a high influence on the catches. They also clarified that this is a multi-species fishery that can target small tunas, sharks or swordfish depending on availability of the resources. The Group also questioned the representativity of the 2 landing sites. The authors clarified that those are the 2 main sites for those coastal canoes operating drifting gillnets. The authors also clarified aspects related to the conservation method. The fishing canoes take ice on the 3-5 day trips that is used to refrigerate the fish during the trips.

The Group questioned the Cote D'Ivoire Task I catches that show a continuous time series over a long period, but that has a gap in 2009-2010 with only LL catches, and if those should be reclassified as GILL. An official revision from Côte d'Ivoire arrived during the meeting with the revision (completion) of those series (see **Appendix 5**).

The Group mentioned the importance of having scientific documents involving T1NC revisions to validate and improve the current T1NC held in ICCAT.

3.2 Review of Task II catch/effort

The SWO standard SCRS catalogues (T1NC and T2CE/SZ/CS availability, ranked by importance in the total SWO stock production within the period 1990 to 2015) were updated and presented to the Group (SWO-N in **Table 9**, and SWO-S in **Table 10**). The Secretariat reminded that, these catalogues no longer show (since 2015, as recommended by the SC-STAT) T2CE datasets (character "a") with poor time-area detail (e.g. early based and/or 20 by 20 degrees squares aggregation), available in ICCAT-DB but usually not used in any scientific work. The rationale behind this is to encourage the CPCs to report improved datasets to ICCAT to replace those identified as "poor" in terms of time-area resolution.

In terms of T2CE improvements (when compared with T2CE data available in the 2013 stock assessment session) in both SWO Atlantic stocks, the most important was the complete revision made by Japan to their LL (1968-2015) series. Other updates (including dataset gaps completion) were reported for more recent years (2008 to 2013) by various CPCs (USA, Spain, Chinese Taipei, Morocco, South Africa, and, Venezuela). In general, the tendency to report more detailed T2CE datasets (monthly stratified and in smaller grids [1x1 or 5x5]) continues (**Figure 3**), being the quarterly or yearly based datasets with poor geographical detail nowadays almost residual. There are however, several incomplete T2CE longline series (Belize, Namibia, Korea Rep., and, Vanuatu) affecting both SWO Atlantic stocks, which would require a full revision. The Group recommended to the CPC scientists the use of the standard SCRS catalogues as a tool to identify the missing data.

3.3 Review of Task II size data

The Task II size data of SWO must be reported to ICCAT in two different forms: a) A dataset with the observed size frequencies (T2SZ); b) A dataset with the CPC estimations of the size composition of the catches (T2CS, also known as reported CAS). The SWO standard SCRS catalogues presented in **Table 9** (SWO-N) and **Table 10** (SWO-S) shows the availability of both T2SZ (character "b") and T2CS (character "c"). As for T2CE, these catalogues do not show T2SZ/CS datasets with poor quality (poor time-area detail, size/weight bins larger than 5 cm/kg) available in ICCAT-DB but usually not used in scientific work (like overall CAS matrix estimations). Overall, the tendency to report higher resolution T2SZ/CS datasets has been maintained in the last decade (**Figure 4**). However, for both stocks there is a lack of some important datasets in various years. The Group considers that the Secretariat's ongoing (since 2010) Task II data recovery/improvement work should continue with active participation of the CPC scientists.

Uruguay provided at the meeting a complete revision (1998-2013) of their SWO longline T2SZ series, all in conformity with the SCRS standards (detailed observer samples by month, 5x5 grid, and 1 cm LJFL). Morocco has provided updates to T2SZ LL for 2009 and 2012 (some gaps still missing) which is now stratified by month and in 5 cm LJFL bins. In addition, other revisions are expected (corrections, new data, improvements) for Chinese Taipei, Venezuela, Mexico, Portugal, USA, and possibly some updates from Canada. Together, these new/revised datasets should improve considerably the quality of the stock synthesis assessment (input files) and the overall CAS estimations.

The reason to revise the USA T2SZ in the early period (1960 to 1980) apparently had to do with an improper conversion of the weight (round and/or dressed) size bins (pounds to kilograms) made in the past. The ICCAT-DB has those datasets incorrectly classified as round weight class bins. This error should be corrected by the Secretariat and USA prior to the deadline specified in the intersessional work plan. Other CPCs which could require T2SZ revisions in the future (incomplete series or highly aggregated time-area data) are Brazil, China PR, Korea Rep., Belize, Panama, St. Vincent and Grenadines, UK-Bermuda, and, Côte d'Ivoire. For the case of Brazil, the Group was informed that it would be problematic to recover T2SZ data for the missing years (2013 onwards) as those samples are not available (the on-board observer program has stopped in 2012).

An important discussion involved the lack of information available on size measurements of discarded (both dead and alive) SWO, and how this could affect the estimations of CAS. Except for the last decade, for which USA LL discards (1999, 2010-2015) are available, no other T2SZ datasets exist. The discarded SWO are often small individuals (with some exceptions). The Group recognised the problem but noted that, the amount of individual series of reported dead discards (major ones: Canada, Japan, USA and, Korea) are relatively small and only covers the most recent years (1998 to 2015). Thus, it is expected to have a minor impact on the overall CAS estimations.

3.4 Review of tagging data

The ICCAT conventional tagging database contains nearly 17,300 SWO released individuals (period: 1940-2015) and about 650 recoveries (average recovery ratio of 4%). The detailed dataset was made available to the Group. The Secretariat informed the Group that it does not yet contains the most recent years (2012 to 2015) of the USA conventional tagging on SWO, since there is ongoing a project involving the full redesign of the ICCAT-DB tagging. The SWO (and the rest of the species) update will take place during its development (planned to be finished by the end of 2017).

A summary of the release /recovery by year are presented in **Table 11**. The largest portion of the releases are concentrated in the northwest Atlantic (**Figures 5** and **6**) with only a small (only recent years) tagged in the southeast Atlantic (Uruguay tags). The SWO apparent movement (straight displacement between release and recovery positions) obtained from the conventional tagging (**Figure 7**), despite a higly unbalanced geographical dispersion of the releases, do show very scarce North/South and West/East displacements.

4. Review of Catch-at-size (CAS), Catch-at-age (CAA) and Weight-at-age (WAA)

The Secretariat presented to the Group the preliminary version of the substitution tables (SWO-N and SWO-S stocks) which form the basis of the overall CAS (and consequently CAA/WAA) estimations. The CAS overall estimation process has two main components (tasks):

i) Update the latest CAS (1978-2011) adopted in the 2013 stock assessment, with all the new and revised information (T1NC, T2SZ, T2CS) arriving since then;
ii) Build, for the first time, the CAS for the newest years (2012-2015).

By default, the Secretariat always drops the last two years of (i) (2010 and 2011) and completely rebuilds those years in (i), once the statistics for those years are usually partial and incomplete.

The level of substitutions (proportion of the T1NC without size information in a given year/fleet/gear/catch type) between 2006 and 2015 in each stock, can be seen in **Figure 8** (SWO-N) and **Figure 9** (SWO-S). The inclusion of new and revised T2SZ and T2CS datasets (see section 3.3) and the new CAS expected from Japan (2013 to 2015) will reasonably reduce those substitution ratios, and thus, improve the overall CAS estimations for the assessment in both stocks.

The Group revised the current CAS methodology (procedures, substitution rules, raising criteria, etc.) used, and proposed some improvements to the substitution rules of both stocks (**Table 12** for SWO-N, **Table 13** for SWO-S). The most important change involved the reduction of dependency on the the Chinese Taipei sizes on the substitutions of the longline fisheries lacking size data (for both stocks). Now, surface longline fisheries without size data will be replaced by surface longline fisheries of Spain and/or Portugal, depending on the year and geographical location. The lack of size information on some important gillnet fisheries necessitates the maintaining of the current substitution rules for gillnets for both SWO-N and SWO-S. On the line of other species groups, the Group also decided not to highly aggregated size datasets (yearly based size, large LJFL size bins like 10 cm, etc.).

5. Indices of abundance

5.1 North

The CPUE indices data are compiled in **Table 14** and illustrated in **Figure 10.** Descriptions of the index characteristics were developed and summarized in **Table 15.**

Document SCRS/2017/053 provided a standardized CPUE for the North and size distribution of North and South Atlantic swordfish from the Portuguese pelagic longline fishery. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self-sampling), from 1995 to 2016. The size distribution of the catch indicated some increasing trends in the North Atlantic and no major trends in the South. In general the nominal CPUE trends increased during the period, with some annual variability. The standardized catch rates showed similar trends with an overall increase over the time period, with some oscillations.

The Group requested further details regarding the form of the model used in the 2013 assessment and that future updates, from all CPCs, include a comparison with the CPUE series provided at the last assessment. The quantity of swordfish catch that occurred between 0 and 10 degrees north latitude (the area straddling the stock boundary) was requested and it was also suggested that nominal indices be developed for this zone with a view to determining the importance of this area to the assessment of both stocks. It was noted by the author that the effort in the southern portion of this area precluded the calculation of a nominal series there.

Given that the analysis was developed from some combination of logbook, port sample and observer data, it was determined that, based on the quality of the data, the observer data is preferred while self-sampling by crew would be second best though this only occurred for 2 to 3% of the trips. It was noted that the observer data should be preferred over the logbooks because it provided more detail on the features of the fishing operation but this detail was not used in the standardization. Though this detail was present for recent years, it was not available for the entire time period thus precluding its usefulness. The size composition of the catch was shown to be bimodal in some areas which could be attributed to gender since females tend to be larger than similarly aged males.

The doubling of the index over seven years was considered too rapid a change for the population and the possibility of a change in catchability due to gear changes (the introduction of light sticks or a switch from Spanish to Florida style longlines) was discussed. Though the gear effects could be included in the standardization, it was thought that there is not enough overlap in time where the alternative methods were used to estimate the gear effect because improved fishing techniques are generally adopted quickly. Some evidence in the literature suggests that the light sticks do not influence catch rates and thus their use can be ignored. It was also discussed that other indices like that of the U.S.A. also doubled indicating it is not an abnormal occurrence. Other factors that were considered included the rationalization of the fleet as a consequence of a decline in the market value of the catch which caused smaller operators to drop out of the fishery leaving larger more efficient companies. It was suggested that the analysis include vessel effects in an attempt to quantify the impact on the index of vessels dropping out. Another consideration, which could be accounted for in the model, was that a spatial shift in the distribution of the fishing due to increasing fuel costs may account for the doubling of the index.

Evidence from the size composition of the catch indicated that the average weight had doubled and this doubling in weight was perceived as a doubling in abundance. So it was suggested that the analysis be conducted with count (number) rather than weight as the response, however this does not address the possibility that the index age range is shifting over time. Given that the indices are to be included in a biomass dynamic model, it was discussed whether it was appropriate to use count as the response and it was noted that originally the biomass dynamic model was developed using count rather than weight data. The source of the shift in the size frequency was discussed with a change in selectivity of the gear or recruitment failure being proposed as plausible explanations. Concern was expressed that in either case, a surplus production model would be incapable of modeling these sources of variation.

The Group discussed the use of the Lognormal distribution and suggested possibly using the Negative Binomial distribution. The authors answered that this was not appropriate given that the response was CPUE in weight rather than counts, and therefore it is not appropriate to use a discrete distribuion as the Negative Binomial with continuous data. The error on the annual estimates was considered to be too consistent to be correct and verification was requested. The use of a targeting variable that involved the weight of swordfish relative to the weight of the blue shark and swordfish catch was viewed as a potential problem since the weight of swordfish was also used as the response. Due to the part-whole correlation, any trend in the targeting variable over time was thought to affect the estimation of the year effects; however models with and without the targeting variable (used as a sensitivity analysis) were presented in the paper. Lastly the Group reviewed the areas used in the model and questioned whether the areas developed for the South Atlantic stock were appropriate and how they were created. The authors noted that the paper only provides standardized CPUEs for the North Atlantic and not for the South.

Document SCRS/2017/63 provided an updated standardized index of swordfish (*Xiphias gladius*) abundance for the Moroccan longline fishery operating south of the Moroccan Atlantic coastal waters from 2005 to 2016. The analysis was based on 1311 trips coming from 20 vessels and indicated an increasing trend in relative abundance since 2014.

The Group noted that box and whisker plots of the log(CPUE) by month did not demonstrate any strong seasonal trends. It was postulated that the lack of a strong seasonal signal was likely a function of this being a tropical fishery. Regarding the fit of the model, the Group noted patterns in the residuals and evidence of heteroscedasticity that still needs to be addressed by the analyst. The presence of a month by year interaction in the model was noted and the Group inquired about the method of estimating the year effects in the presence of this interaction. It was noted that lsmeans were used. The Group volunteered to assist with the estimation and requested that the model standardization code be provided to facilitate this process. Provided that the month by year interaction could be assumed to be random, casting it as a random effect would also be feasible. This assumption could be verified by examining the BLUPs estimated by a GLMM. It was also requested that the author provide size frequency data associated with the fishery even if they are not available in every year.

It was discussed if there were any trips where no swordfish were caught and it was indicated that all trips were successful. The choice of effort was unclear as both effort in days and effort in hooks were available and linearly related with no apparent fluctuation by trip. This concern appeared to account for the similarity of the annual estimates to the nominal values. The lack of a targeting effect in the model was also of interest because this often accounts for variability in catch rates. Consequently, it was requested that the species composition of the fishery be provided. The author confirmed that there had been no targeting changes and bycatch was small. Interest in the composition of the gangion lines revealed that they were exclusively monofilament.

Document SCRS/2017/070 provided standardized catch indices of Atlantic swordfish, *Xiphias gladius*, from the United States pelagic longline observer program for the period from 1992 to 2015 in the Western Atlantic Ocean. A generalized linear model including year, month, area, sea surface temperature, bait type, and hook type was fit to the catch rates. In the 2013 assessment this index was split into two time periods to account for a change due to a switch to circle hooks. Subsequent analyses of the datasets indicated that the available information on hook type was sufficient to include it as a model factor to account for regulatory changes from predominately J hooks to circle hook and, in some regions, weak circle hooks.

The Group discussed the value of the experimental sets in estimating catchability associated with the change in hook type and whether to include the experimental data in the analysis. It was determined that the experimental sets were not required to estimate the hook effects. There was also of interest in the data from areas that were closed to fishing that were not used in the analysis and their importance to the overall perception of the trend in relative abundance. The author indicated that these data were a small fraction of the total and had to be excluded for modeling reasons and it was deemed likely that their omission did not change the interpretation of relative abundance. It was suggested that the excluded data could form an area in the model to allow one to estimate their significance relative to the others. Alternatively it was suggested that the analyst consider developing an index for just the closed area so that the Group would have an index for juveniles. However, there may be sufficient juvenile data in the other areas to provide information on relative juvenile abundance.

Previously, the U.S. provided an index based on dealer data and the Group requested clarification as to why these data were not used in the current analysis, noting that the dealer data provided a longer index. The rationale for the change was related to the ability of the observer data to account for changes in the gear configuration (estimate the circle hook effect) and their better size composition and discard information. Upon review of the model summary table there appeared to be an error in the deviances in that more complex models had higher deviance than less complicated models.

Document SCRS/2017/074 presented fishery independent indices of spawning biomass of swordfish in the Gulf of Mexico utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2015 in the Gulf of Mexico. Indices were developed using the occurrence of larvae sampled with neuston gear using a zero-inflated binomial model, including the following covariates: time of day, month, area sampled, year, gear and habitat score. The habitat score was based on the presence/absence of other ichthyoplankton taxa and temperature and salinity at the sampling station.

The Group recognized the value of the addition of a fishery-independent index to the stock assessment and noted that larval indices developed from the same survey have been used in the assessments of western Atlantic bluefin tuna for many years, and for the most recent of western Atlantic skipjack. However, there were numerous concerns. Unlike the case of WBFT, where the Gulf of Mexico has been considered the main spawning ground, the importance of the Gulf of Mexico for North Atlantic swordfish spawning is unclear. Although some of the larvae in the samples were clearly spawned in the Gulf, it could not be ruled out that other larvae may have drifted into the Gulf from other areas. Another major concern was the low proportion of positive catch, and overall low numbers of swordfish larvae in the survey. This is likely a primary contributor to the high variability of the index, and further calls into question its utility as an index of spawning stock biomass.

Given these concerns, the Group did not support its use in this stock assessment. However, given the potential benefit of this type of study should such problems be overcome, the Group made a number of recommendations for improving the index. These recommendations included the use of an interaction term of habitat category and sampling area variables in the model, the use of other types of zero-inflated models, such as zero-inflated negative binomial, and looking at the new sampling technique employed by NOAA in the Gulf of Mexico surveys (which has proven successful at increasing larval BFT catch rates by an order of magnitude) to determine if the new sampling approach also increases larval SWO catch rates. It was also recommended that the use of more data sources from other areas, in addition to those from the Gulf of Mexico, would be extremely useful in addressing concerns about representativeness of spawning, sample size/frequency of occurrence, and relevance to overall spawning stock biomass of the stock. Specific potential future work was identified, including: 1) evaluating larval data from the southeastern and northeastern Atlantic coast of the United States and from Canadian larval surveys to determine if indices could be developed, 2) survey data in other months, and other, non-survey data in the Gulf that contain information concerning larval swordfish occurrence, will be evaluated for the potential for incorporation of these data into the index by removing any biases associated with different sampling methodologies.

Document SCRS/2017/072 reported Length based indicators of Atlantic swordfish and bluefin tuna stock status were provided for the fraction of the catch that are mega spawners, mature and of optimal size for harvest. The indicators were shown to provide an additional perspective on stock status and were a useful diagnostic tool that could identify fishing in regions and/or with gears that put the population at risk.

The Group thought that indicators useful to consider in conjunction with the stock assessment outputs particularly for the southern stock which has fewer indices on which to base an assessment. It also noted the variety of size transformations and life history parameters available, and stressed the importance of consistency, as appropriate, in the various data processing and modelling aspects of the stock assessment. It was pointed out that estimates of uncertainty in life history parameters are available and could be incorporated, and that it was important to take into account demographics and differences across the Atlantic.

The Group also discussed the implied yield and sustainability benefits of altering selectivity (e.g. reducing mortality on juveniles and mega-spawners, increasing the proportion of the catch taken within 10% of the optimal length). There was some question as to whether or not it would be feasible to achieve such selectivity changes, especially considering that the high mortality rate of swordfish on longline would reduce the benefits of discarding fish outside some specific size range. It was suggested that this might be at least partially achieved with time-area closures, if time-areas with relatively high proportions of juveniles or mega-spawners could be identified. Again, demographics would be an important consideration. The closure of the USA LL fishery off the east coast of Florida, enacted to protect juvenile swordfish, was pointed to as an example of such an action. Given the existing ICCAT restrictions on the retention of juvenile swordfish, there was speculation that fishermen may already be making adjustments in how/where they fish, in order to reduce juvenile catches – and it was suggested that it may be possible to detect such practices using available data.

Document SCRS/2017/064 provided a relative index of Atlantic swordfish abundance based on Canadian pelagic longline data was provided for the period from 2002 to 2016 using set level data and from 1962 to 2016 using trip level data. The standardizations were based on the number of swordfish caught and involved fitting general additive mixed effects models that controlled for the effect of hooks, bait, Julian day, month, shark and tuna caught, area and vessel. The area specific index indicates a decline in relative abundance to levels comparable with the years prior to the institution of a rebuilding plan in 1999.

The author explained that there is a gap in the available data for the period 1971-1978, as a consequence of USA regulations restricting permissible mercury levels on international and inter-state trade; although fishing may have continued at some level during this period, landings were not recorded. Nevertheless, fishing practices were generally similar before and after this gap, and the standardization was done across the entire series. Therefore, this should be considered as a single series when used in assessment models. A new approach for the standardization of these data was included in this document, considering year and month as smoothers.

The Group discussed whether or not this was an appropriate standardisation technique. It was noted that this may be useful when there is an expectation that there is a functional relationship between the CPUE and these variables. Although this approach smooths the variability which may be due to process/sampling error over the range of the variable, it may however also smooth variability due to real differences in abundance. On this basis, the Group expressed concern that treating year and month as smoothers may not be appropriate, and requested that a new index be developed without this treatment. It was also noted that, in any case, the estimates for the period 1971-1978 (for which there were no CPUE data) should not be used. The Group also requested that the effort variable (hooks) be incorporated in the model as an offset, rather than a continuous variable.

Document SCRS/2017/075 providing an updated CPUE standardization of the Atlantic swordfish caught by Japanese longliners in both the North and South Atlantic was reviewed by the Group. The Northern stock CPUE showed an increasing trend in the period between 2006 and 2011, and a sudden drop between 2012 and 2013 whereas the CPUE for the Southern stock indicated that the abundance has not changed since the mid-2000s.

The Group discussed the use of adding a constant to the CPUE when there was no catch and the effect this would have on the model if there were a large proportion of zeros. It was verified that the proportion of zeros in the North dataset (Area 5) was 0.177 and 0.42 in the South data set. Concern was expressed regarding the small number of categories (2) in the hooks per basket variable (a proxy for shallow and deep setting) and the possibility of including more categories was queried to reflect other fishing depths. The authors indicated that the 2 categories were assumed to reflect operation style rather than vulnerability to the gear related to the depth of hooks.

It was noted that the confidence intervals of the series were quite different between the North and South and have particularly small values in the South. It was indicated that in the South area analysis, the datasets were larger than in the Northern area and that the size of confidence intervals are inversely proportional to the amount of data. Clarity regarding the use of multiple Year interactions in the model for the South was requested and the authors indicated that the interactions were considered fixed and used to account for quarter and gear effects changing annually. The lack of analysis of deviance tables was noted and it was requested that these be included in the revised document so that it would be possible to identify which variables are of greatest importance to the model fit.

Lastly, the Group discussed if in the North Atlantic, the data were from the fleet that targets bluefin tuna and whether regulations affecting bluefin tuna fishing opportunities may also have affected swordfish catch. It was confirmed by the authors, that swordfish is a bycatch species in the North Atlantic and that the bluefin tuna regulations changed the operational season of the fleets. The Group suggested that the effect of this change in the operational season on the index be explored in future updates but for the current assessment the index will be split between 2010 and 2011.

5.2 South

One document concerning exploratory analyses of CPUE of Uruguay and one study of standardization methods were presented in the Data Preparatory meeting. In addition three data sets of relative abundance indices (Brazil, Japan and Uruguay) were made available to the Group. The Group noticed that in the last stock assessment (2013) three other indices (Chinese Taipei, South Africa and Spain) were also provided. There were concerns due to low number of available standardized CPUE series for the South Atlantic swordfish. However the Group was informed that Spanish scientists were working on the CPUE data, and that they would be able to provide standardized indices before the stock assessment meeting to be held in July 2017 (see workplan for the intersessional period with the agreed deadlines). In addition the Group decided to contact scientists from Chinese Taipei and South Africa to ask them if they can also provide standardized CPUEs before the stock assessment meeting (noting the deadlines established in the workplan for the intersessional period).

The CPUE indices data are compiled in **Table 16** and illustrated in **Figure 11.** Descriptions of the index characteristics were developed and summarized in **Table 17.**

Document SCRS/2017/067 provided results from an exploratory study to compare standardized CPUE series calculated following three different approaches concerning the inclusion of year in the models, specifically as main fixed effect only, as main fixed effect and fixed effect interactions, or as main fixed effect and in random effect interactions. Overall, the results of the 3 approaches were similar. However, results of simulations studies indicate that time trends of the standardized CPUE may change if the interactions with year are included in the models as random or as fixed effect.

The Group believed that this was an interesting analysis, and noted that the most commonly used approach to deal with the year interactions is to include them as a random interaction.

Document SCRS/2017/068 presented standardized CPUEs of SWO from Brazilian longlines calculated based on four alternative approaches. Those comparative approaches were carried out to cope with the complexity of the datasets from the Brazilian fleet that include national and leased vessels. Fishing target of part of the fleet has changed across the years, the longline type has changed and the quality of the data has also likely changed due to the onboard observer program for leased boats only.

The Group decided to use the standardized CPUE calculated based on the approach four (as detailed in the paper) in the stock assessment. In these calculations, the time series was split in two parts; before and after the start of the onboard observer program. The Group noticed that the temporal trend of the updated standardized CPUE (2017 Data Preparatory meeting) and of the previous standardized CPUE (2013 Stock Assessment) were very different. Differences were probably due to the explanatory variables included in the analyses concerning "target" effect. Number of hooks per basket (hpb) was used as a proxy of fishing target to calculate the updated 2017 CPUE while and index based on cluster analysis was used as a proxy of the fishing targetting to calculate the previous standardized CPUE in 2013.

Document SCRS/2017/075 provided an update of the SWO CPUE series for Japan. Japanese scientists were not present in the Data Preparatory meeting but the paper was shown and discussed by the Group. A constant was added to the nominal CPUE and a lognormal GLM was used to calculate the standardized catch rate. Some questions were raised by the Group concerning the proportion of zeros, the levels of factor HPB and the very narrow confidence intervals. The authors were contacted during the meeting and provided answers to those questions. The proportion of zero catches are relatively high (0.42). The Group believed that the addition of a constant when the proportion of zeros is high is not appropriate, and therefore decided to request alternative models to take into account those large proportion of zero catches.

Document SCRS/2017/077 presented an analysis of CPUE and size frequency comparing Uruguayan and Japanese (JPN) fleets operating in the Southwestern Atlantic. For the comparison, only sets inside the Uruguayan EEZ were considered. Also, the Uruguayan fleet was split into two fleets, one operating with a simple monofilament branch line (URU_MF), and a second one operating with a reinforced branch line with a terminal section next to the hook made of stainless steel (URU_AL). Results show that mean CPUE of the URU_MF fleet was 2 and 3 times higher than the URU_AL and JAP fleets respectively. In contrast, the largest swordfish were captured by the JPN fleet with a mean LJFL of 171cm, URU_MF 157 cm and URU_AL 152 cm. For the three fleets females were larger than males. CPUE was also analyzed by latitude and mean sea surface temperature (mSST), observing that CPUE increases with mSST, with higher CPUE values occurring between 18 and 22 °C. A similar pattern was observed for the Latitude, with an increasing trend to higher latitudes and higher values between 34° to 36° S.

Document SCRS/2017/078 provided an update of the standardized CPUE of swordfish caught by the Uruguayan longline fleet operating in the Southwestern Atlantic in the period 2001-2012. Standardized CPUE were estimated based on the analysis of data of National Onboard Observer Program. A total of 1,706 fishing sets were analyzed. Approximately 8% of catches were zero. Delta lognormal approach and Generalized Linear Mixed Models (GLMMs) were used to calculate the standardized CPUE. Explanatory variables included in the models were Year, Quarter, Area, Sea Surface Temperature and Gear. Overall standardized CPUE decreased across the years.

5.3 Trends and correlations in the CPUE indices

The CPUE time series for the North are plotted in **Figure 12**, along with a lowess smoother fitted to year using a general additive model (GAM) in order to help compare trends by stock. The fits are not intended to generate a combined index but is to explore patterns in the residuals that may suggest which other processes may be of importance. Tukey described this approach as residuals and reiteration, where by removing a striking pattern more subtle patterns can be explored.

The overal trend for the Northern indices is an initial decline followed by an increase from 2000 and another decline with an increase in recent years. To look at deviations from the overall trend the residuals from the fits are compared in **Figure 13**. This may allow conflicts between indices (e.g. highlighted by patterns in the residuals), autocorrelation within indices which may be due to year-class effects or the importance of factors not included in the standardisation of the CPUE to be identified.

Next the correlation between the indices was evaluated for the Northern Indices in **Figure 14**, the lower triangle shows the pairwise scatter plots between the indices with a regression line, the upper triangle the correlation coefficients and the diagonal the range of observations. A single influential point may cause a strong spurious correlation therefore it is important to look at the time series and scatter plots as well as the correlation coefficients. Also a strong correlation could be found by chance if two series only overlap for a few years.

If indices represent the same stock components then it is reasonable to expect them to be correlated. If indices are not correlated or negatively correlated, i.e. they show conflicting trends, this may result in poor fits to the data and bias in the estimates. Therefore the correlations can be used to select groups that represent a common hypotheses about the evolution of the stock (ICCAT 2016, 2017). **Figure 15** shows the results from a hierarchical cluster analysis using a set of dissimilarities.

Next the cross-correlations are plotted in **Figure 16**, i.e. the correlations between series when they are lagged (i.e. by -10 to 10 years). The diagonals show the autocorrelations as an index if lagged against itself. A strong negative or positive cross-correlation could be due to series being dominated by different age-classes.

The corresponding figures are plotted in **Figures 17 to 21** for the Southern Indices.

All analysis was conducted using R and FLR and the diags package which provides a set of common methods for reading these data into R, plotting and summarising them (http://www.flr-project.org/).

5.4 Alternative indices

The Group discussed a length-based indicator of abundance that was presented during the meeting. The indicator was an estimate of relative biomass for the northern swordfish stock. The Group recognized that this and similar indicators may offer an alternative to CPUEs in data poor situations (such as the southern swordfish stock).

The Group agreed that exploration into using these indicators was worthy of further effort and offered a viable alternative to traditional CPUE indicators. A second length-based indicator presented at the WGSAM, NZ50 (Goodyear, 2015), also may offer a second alternative as an indicator of fishing mortality.

6. Available modeling approaches

6.1 Surplus Production Models (ASPIC)

Model assumptions
Catchability is constant; therefore, any changes in catchability have to be modeled within the CPUE series. Recruitment and M are constant over time. There is an immediate response of the stock to F.
Selectivity has not changed over the time period of the model. All fish in the population are mature.

Model Inputs
Catch and CPUE series.

Model outputs
Trajectories of F and B. Trajectories of relative F and B. Catchability *q* for each CPUE series. Confidence intervals. Carrying capacity K, B_1/K, r. Projections

Diagnostics
Sum of Squares. Residual plots of fits to CPUEs. Retrospective patterns.

Key parameters
B1/K, r.

Uncertainties
The Group discussed how uncertainty is handled within ASPIC. It was agreed that this assessment model does not allow for the inclusion of uncertainty of the model inputs (e.g. CV of the CPUE series). In prior assessments, uncertainty in the CPUE series were incorporated by making separate runs using the median and upper and lower 95% confidence intervals, bootstrapping the results, and combining the bootstrap outputs. New approaches to deal with uncertainties within ASPIC have been developed and will be presented to the Group in the near future.

The Group noted that other approaches to deal with uncertainty was by fixing some of the input parameters at different values and assessing the sensitivity of the model results to the different initial condition (e.g. fixing B1/K at 0.3, 0.4, 0.5, and 0.6). Running the model using different production functions was also deemed as being a way to assess uncertainty.

Model strengths and weaknesses
Because of the limited data requirements, this model is easier to be supported by the Secretariat. ASPIC is easy to use and many national scientists are familiar with its use. It is considered to be useful for data limited situations. ASPIC is fast to run and facilitates simulation testing. Because of the limited data requirements, it allows the use of longer time series where data from earlier periods are usually poor. It only estimates few parameters but these are typically the ones needed to provide management advice. ASPIC quickly produces diagnostics, bootstrap results, and projections. However, ASPIC does not necessarily reflect the true dynamics of the stock/fishery and it cannot take into consideration any variability in recruitment or changes in catchability. The model cannot accommodate changes in management regulations, like changes in minimum size, so this needs to be taken into account in the CPUE series. ASPIC often cannot resolve indices of abundance with conflicting trends.

It was acknowledged by the Group that the surplus production model ASPIC has been used to assess SWO for the past 20 years. One of the reasons was the need for continuity in the assessment methodology after ICCAT implemented the SWO rebuilding plan in 1996 (Rec. 95-11). The Group discussed the need to apply some caution when using this modeling approach. In particular, when considering the assumption of constant catchability at different levels of biomass and the possibility of hyperstability and hyperdepletion. However, it was pointed out that hyperstability is more related to purse seine fisheries and, therefore, less applicable to the Atlantic swordfish case. The Group recognized the problems that arise when the available CPUEs have conflicting trends. Although this problem can be alleviated by estimating a combined CPUE (as was done in previous assessments with ASPIC), this approach can potentially create biased results. Thus, the Group engaged in an extensive discussion on the potential methods that can be used to estimate the combined index, and some of the potential benefits and shortcomings of this type of index. It was pointed out that since all indexes most probably do not have the same selectivity, a combined index could represent the entire stock and be more appropriate for a biomass model. It was acknowledged by the Group that many fleets have operated over a reduced area and fishing season, and that these changes can create problems when trying to estimate a combined index. In addition, the Group agreed that problems with CPUE series, like known changes in catchability over time, have to be dealt with outside the model as the model does not have the flexibility to accommodate this type of problems.

The Group agreed that it would be important to use ASPIC in the upcoming assessment, particularly given the need to have a continuity case and, therefore, it recommended its use for both the North and South Atlantic SWO stocks.

6.2 Bayesian Surplus Production model 2 (BSP2)

BSP2 offers an implementation that models process error in the dynamics equations and observation error in predicted states (i.e. a state-space model). The model coded in JAGS and STAN is also available for comparison. The software can accommodate a variety of different priors for key parameters including carrying capacity (K), the maximum rate of population increase (r), and the ratio of stock biomass in the initial year to carrying capacity (Bo/K). The software enables Bayesian integration for computation of marginal posterior probability distributions for parameters and management variables and outputs for inclusion in Kobe plots. Bayes factors can be computed to evaluate the relative credibility of different production functions and different model runs (e.g. different priors and catch history scenarios) when different model variants are fitted to the same abundance index data.

Model assumptions
A one year lag adequately characterizes the influence of annual stock biomass on future surplus production as in any production model including ASPIC. Abundance indices are related to stock biomass via a constant of proportionality whereby there is no hyperdepletion or hyperstability in the index. Surplus production can be described by either the Schaefer model or the Fletcher generalized production function.

Model inputs
Catch series. CPUE. Priors for K, r, B0/K, process error deviates. A fixed value for the prior standard deviation in process error deviates. A CV for each abundance index that is constant over time, and if judged appropriate an additive CV by year for each abundance index. A fixed value for the autocorrelation in process error deviates for years following the last year of data. Specification for the type of surplus production function (Schaefer, Fletcher-Schaefer) and the parameter value for the inflection point.

Model outputs
Posterior distributions for estimated parameters (r, K, Bo/K, sigma (index) if estimated, q(index)), stock biomass, MSY, annual F, F/FMSY, B, B/BMSY, replacement yield, and importance draws of F/Fmsy and B/Bmsy for Kobe plots.

Diagnostics
Plots of posterior median process error deviates by year, together with probability intervals by year. Plots of the fit of the posterior median stock biomass to abundance index data. Plots of post model pre-data distributions, priors, and posteriors. Graphical and numerical diagnostics for importance sampling, as importance sampling is running.

Uncertainties
Uncertainties in estimated parameters, model variables, shown in posterior distributions, standard deviations, coefficients of variation, probability intervals. Bayes factors can be computed from the average importance ratio by run and can be used to weight output distributions from different runs to show the uncertainty in stock status and variables of interest resulting from uncertainty in model structure.

Key parameters
r, K, B0/K, BMSY/K.

Strength and weaknesses
The model is not age structured, so it cannot handle changes in vulnerability at age. It uses available life history data to develop a prior distribution for r. Training is required to run the software proficiently. Because the code is written in VisualBASIC, which is no longer maintained by Microsoft, some users may have difficulty getting the software to run from the source code. As with other surplus production models, it may be biologically inaccurate and therefore might not reflect the true dynamics of the stock.

The Group recognized that BSP2 is in essence a surplus production model and as such, it has all the restrictions and advantages of other production models like ASPIC. The Group discussed some of the advantages of using Bayesian modeling approaches, one of them being the capability of obtaining probability statements for outputs of interest in the form of 'posteriors'. In addition, Bayesian estimation methods enable additional information and data to be brought to bear to form prior distributions for model parameters, and these priors can help to constrain the estimation to enable more useful and biologically accurate results to be obtained. The model uses a prior for r that incorporates key biological information. One important factor of BSP2 that the Group identified is that it allows evaluation of the influence of priors and catch inputs on the model outputs. In addition, BSP2 results more rigorously accounts for parameter and structural uncertainties in the evaluation of stock productivity.

The Group was concerned about the lack of an updated manual for BSP2, and the fact that BSP2 is not in the ICCAT software catalog, and noted that national scientists are not yet familiar with its use. The Group recommended that a training course be made available for national scientists interested in this particular model approach. The Group agreed that the BSP2 model offers more flexibility and more options than ASPIC, and that it was used in the 2013 assessment. It was therefore recommended to run both models in parallel to compare model behavior and better understand their differences. The Group also asked how the prior for r was developed. Even though this particular prior has been used in the past, the Group recommended that the prior for r be updated using more recently developed methodology and recent updates in estimates of swordfish life history parameters.

The Group recommended the use of the BSP2 model in the upcoming assessment for both the North and South Atlantic SWO stocks.

6.3 Stock Synthesis (SS)

Model assumptions
The structure of Stock Synthesis (SS) allows for building of simple to complex models depending upon the data available. As a result, the SS modeling framework is designed to allow the user to control the majority of the assumptions that go into the model. SS assumes that the observational data are a random and unbiased sample of the fishery and/or survey they are intended to represent. The overall model contains subcomponents which simulate the population dynamics of the stock and fisheries, derive the expected values for the various observed data, and quantify the magnitude of difference between observed and expected data.

Model inputs
Stock Synthesis provides a statistical framework for calibration of a population dynamics model using a diversity of fishery and survey data. SS is most flexible in its ability to utilize a wide diversity of age, size, and aggregate data from fisheries and surveys. It is designed to accommodate both age and size structure in the population and with multiple stock sub-areas. Selectivity can be cast as age specific only, size-specific in the observations only, or size-specific with the ability to capture the major effect of size-specific survivorship. While SS can accommodate a multitude of data types two are required, those being a catch time series and an index of abundance. Conversely, a model can be built that incorporates multiple areas, seasons, sexes, growth and growth morphs, as well as tagging data. Environmental data can also be used to modulate most any parameter within the model. Size and age structure, size-at-age, ageing error and bias, and sex ratio can also be incorporated.

Model outputs
The SS model output is commensurate with the complexity of the model configuration and observational data. All estimated parameters are output with standard deviations. Derived quantities include typical management benchmarks such as MSY, F_{MSY} and B_{MSY}, and SPR. Typical matrices of numbers-at-age, growth, age-length keys are also provided.

Diagnostics
Diagnostics are routinely examined through either the graphical and numeric r4SS R package or the accompanying spreadsheet, graphical as well as numeric. Diagnostics are generally a display of residuals of the fit to the observational data and derived quantities. Numerical output is also available in the form of the Hessian matrix, correlation matrix, and a parameter trace output. When run in the MCMC mode the posteriors are also output.

Uncertainty
Uncertainty can be captured in at least three ways: parameter standard deviation, the creation of bootstrap data files, or through MCMC techniques. The ADMB C++ software in which SS is written searches for the set of parameter values that maximize the goodness-of-fit, then calculates the variance of these parameters using inverse Hessian and MCMC methods. A management layer is also included in the model allowing uncertainty in estimated parameters to be propagated to the management quantities, thus facilitating a description of the risk of various possible management scenarios, including forecasts of possible annual catch limits.

Key parameters
Key parameters of SS are dependent upon the model configuration created. However, since it is age-structured the rate of natural mortality is most critical. The steepness parameter is also critical as it dictates the rate of compensatory population growth.

Strength and weaknesses
SS can utilize a great number of different types of data sources to build a custom model within a consistent framework. This is its greatest strength as it allows the user to build a model with flexibility equal to that of the data. Pre-processing of data is less than some other frameworks as it is fully integrated within the model structure. Similar to a BSPM, SS has full Bayesian capability. Unlike VPA, it can be run without a catch-age-matrix by using only lengths or without lengths entirely. Consequently, no age slicing is needed. It allows for ways to explain changes in observations data that are due to changes in management or environment. Nearly all parameters can be made time varying in several ways. Forecasting is done within the integrated framework of the model construction. Some of the limitations of SS include a limited number of proficient users within the SCRS. Furthermore, because of its ability to create very complex models it can be slow to run relative to ASPIC or VPA, but only if it highly parameterized (i.e. run time depends on model complexity). The framework is capable of many options, so the user must be aware of model parsimony.

The Group considered that the SS model was probably the most flexible of all models reviewed during the meeting. Perhaps the most useful feature of the SS framework is that it “brings the model to the data” rather than vice versa (i.e. it can be made as simple or complex as the data allows). SS can be configured to run from a simple surplus production model to a fully integrated model. Therefore, data inputs and output are dependent on the model configuration. This model might also allow the SCRS to estimate and evaluate the robustness of Limit Reference Points. The Group discussed the need to improve the way that fleets are defined taking advantage of the flexibility of the model. For example, one approach could be to use size samples from the different fleets to grouped fleets that have similar selectivities. It was also discussed that the migration pattern of SWO might deem necessary to split a fleet from a given flag into two or more fleets (e.g. a fleet that fishes on the spawning grounds and also on the feeding grounds where large females are more abundant).

The Group agreed to recommend that SS be used as one of the models in the upcoming assessment for the North Atlantic stock and dependent on available resources for the Southern stock as well.

6.4 FLR Biomass Dynamic (BIODYN)

Advice for North Atlantic is based on a biomass dynamic stock assessment model, which has been extensively tested using Multifan-CL using cross-testing by generating data from Multifan-CL (Kell *et al*., in press a) and its performance as part of a management procedure has also been evaluated using MSE. The software used is the R package mpb (http://www.flr-project.org/) and was used to perform assessment advice for North Atlantic albacore (Kell *et al*., in press b) and bigeye (Ortiz de Zárate *et al*., in press).

The package includes ASPIC for which it provides an R interface that includes an extensive suite of diagnostic and simulation tools.

It is proposed to run the mpb package to provide assessments for both the Northern and Southern stocks. The first step is the agreement on hypotheses to test; then to check for convergence; identify violation of assumptions; use simulation methods such as the jack knife or bootstrap to investigate problems with the data and model specifications; and then to conduct hindcasting to evaluate prediction ability.

6.5 Other documents

A presentation was made showing how steepness could be derived from life history parameters (SCRS/P/2017/005) using the approach of Mangel *et al*., 2010. As pointed out by Simon *et al*., 2012 the approach requires the specification of the fecundity at age in absolute numbers and natural mortality rate at age. The latter is often fixed based on a variety of assumptions, however, there are serious issues concerning the estimation of these quantities for bony fish, specifically during the early life period. Therefore the Group recommend that the authors revisit their analysis and include estimates of uncertainty in the key processes, particularly as this is required in order to develop priors.

The intrinsic population growth rate (r) of the surplus production function used in the biomass dynamic model and the steepness (h) of the stock-recruitment relationship used in age-structured population dynamics models are two key parameters in fish stock assessment. Both can be estimated using life history parameters. For example in the BSP model a prior is used for “r” based on a Monte-Carlo simulation using assumptions about natural mortality, growth, fecundity and recruitment. It is important therefore that any priors or fixed parameters used across assessment models are consistent, particularly as normal practice of the SCRS is to combine estimates of different assessment methods in the Kobe phase plots and matrices.

Specific recommendations to the authors are:

- M0: Explore other procedures (e.g. Simon *et al*., 2012)
- Sensitivity to additional functional forms of M (e.g. Lorenzen)
- Uncertainty both in the functional form and in the parameters used
- Need for consistency in the life history parameters used in this study and other analysis going on for this assessment (e.g. development of priors for BSP)

Document SCRS/2017/073 presented preliminary results of proxies for relative habitat size of swordfish stocks worldwide. The simple calculations are based on historical CPUE records of the Japanese longline fleet for the period 1950-2012. The habitat size proxy is simply proportional to the number of 5º5º boxes with positive CPUE for swordfish.

The Group noted that this is a preliminary work still ongoing. Additional proxies for habitat size calculations are also discussed. The authors will continue to work on this issue with the main goal of providing informative priors for K (Kell and Mosqueira, in press).

7. Other matters

MSE/HCR NSWO

The SCRS Chair provided a summary of the MSE process in ICCAT and how it relates to N SWO. This included the draft schedule of MSE work proposed for N SWO in Annex 7.2 to the *Report for Biennial Period 2016-2017, Part I (2016), Vol. 1* which calls for a 2017 assessment for NSWO, a review of performance indicators in 2018 and an evaluation of alternative HCRs through MSE in 2019. The Chair also pointed out that he will provide whatever feedback the Group provides on MSE as related to NSWO to the 2017 meeting of SWGSM.

The Group reviewed the list of indicators now included in Rec. 16-01 and concluded that:

- Current list is comprehensive and can be applied to N SWO.
- Keeping a consistent list across species improves communication and facilitates analyses. There may be, however, a need to add some additional stock-specific indicators.
- For SWO it may be better for the indicators that refer to Biomass to be expressed as Spawning stock biomass.
- The column on "unit of measurement" should be modified to be consistent with the variable indexed. In cases where the indicators are a ratio, it should be clarified that the indicators have no units.
- Future performance indicators could include those that are relevant to all stocks as well as those that are particular to certain stocks.

The Chair of the t-RFMO Working Group on MSE provided a summary of the work of the Group in the past year. He also provided a summary of the MSE process and its challenges. He stressed the need to clearly follow a structured process in the development of MSE, and to maintain a regular dialogue between decision makers and scientists. In particular to have a guillotine for steps in the process e.g. when developing operating models after which no new data or hypotheses can be included. He also presented some of the benefits of MSE vs management based on classical stock assessment processes. Emphasis was put on the importance of developing the set of operating models (OM) to be used by the MSE. In the t-RFMOs OMs have been largely derived using assessment models, although the t-RFMO Working Group also recognised that ensuring management is robust also requires OMs to be conditioned on ecological processes that affect the behaviour of management systems. Particularly as the focus is on the future, not on fitting historical data as when conditioning an OM on a stock assessment. This is a less data, and more hypothesis-orientated approach. The t-RFMO Working Group also recognised the importance of selecting and eliminating unrealistic OM scenarios, and the need for this to be standardised, and clearly documented so that the t-RFMOs can learn from each other. Work is ongoing by the Working Group to identify the key OMs by conducting analysis of the parameters and assumptions which generate the most uncertainty in current stock status and population dynamics.

An important benefit of the MSE process is to identify needs on data collection and improvement of knowledge to reduce the uncertainty and hence risk.

A presentation was made to demonstrate the superior performance of a management system based on HCRs (SCRS/P/2017/006) rather than on the traditional management system based on periodic stock assessments. The authors recreated the history of information available on N SWO to the Group and the results of the historic assessments. The authors then simulated how history would have been re-written if management had been based on one of two alternative HCRs. The performance of the HCRs were better in terms of sustainability (lesser probability of been outside the green) and if had been applied in the past would have avoided the need for long term recoveries and/or the stock being severely depleted. Ultimately this presentation demonstrated to be an effective alternative vehicle of communicating the theory behind the superior performance of HCRs. It has to be noted that these conclusions are conditional on the assumption that the estimated status of N SWO corresponds to the real status.

EBFM
The Chair of the SCRS informed the Group on the work conducted by the t-RFMO EBFM initiative and by the ICCAT Sub-committee on Ecosystems that is relevant to the Group. He mentioned specifically the need for the Group to help the ICCAT Sub-committee on Ecosystems in its quest to develop an ecosystem report card which contains information about indicators of target species and of their environment. As of now, all indicators developed for the MSE, are related to the state of the target species and or the desirability of the levels of harvest for such target species. There are no indicators related to impacts of fishing on by-catch species, ecosystems and demography (i.e. considering the differences within the population). The Group agreed that although such indicators are important in the context of EBFM, as far as MSE is concerned it is better to continue to focus on the indicators included in the list of Rec. 16-01.

SWO hooking mortality - comments on the efficiency of the minimum landing size for SWO
Document SCRS/2017/052 revised data on hooking (at-haulback) mortality of swordfish from the Portuguese pelagic longline fishery. The overall at-haulback mortality for swordfish was very high (85.2%) and there was a relation with higher mortality rates for smaller sized specimens. Specifically, the hooking mortality was 87.8% for specimens smaller than 125cm LJFL and 88.1% for specimens smaller than 119cm LJFL. This study focuses only in one fishery and fleet, even thought the data are widespread along a wide Atlantic area. Additionally, this study focuses only on the short term immediate mortality, while the overall mortality might be higher due to the potential post-release mortality.

The Group noted that the results raise the question as to whether the minimum retention sizes currently in place in ICCAT are effective if the main objective is to protect juvenile swordfish. The Group also noted that there are local management regulations to avoid fishing in areas of high concentration of small SWO, which appear to have been effective. However, to implement this in the Atlantic wide area would require a more detailed analysis of the fishing effort distribution for SWO. This is dependent on whether or not time/areas can be identified with relatively high concentrations of juveniles.

In view of the objective to protect small swordfish, the Group recommended that future work should be carried out to revise the size/sex distribution of swordfish in the Atlantic, possibly using high resolution observer data, so that alternative management measures may be considered.

8. Recommendations and workplan

8.1 Recommendations

To WGSAM on CPUE standardization. To provide guidelines on how and when to include interactions between year and other factors in the CPUE standardization. To ask for guidance on how to interpret measures of variance associated with the index in the presence of different model structures, especially in the context of the use of these measures of variances in the process of population modeling (e.g. in the weighting of different CPUEs).

To CPCs on discards. Current information on discards of SWO (both dead and alive) are still very scarce in the ICCAT databases and inconsistently reported by CPCs. The Information on the sizes of discards, and the numbers discarded scaled to the total effort (data for both discarded dead and released alive) should be reported in order to quantify discarding in all months and areas. These data must be reported as required by ICCAT Recs. 13-02 and 15-03.

To CPCs on submission of Task I and II data. All CPCs catching swordfish (directed or by-catch) should report catch, size samples (by sex), catch-at-size (by sex) and effort statistics by as small an area as possible, and by month. Recognizing the differential growth and distribution between sexes, collecting size distribution information by sex is particularly important. The Group strongly reiterates the need for respecting deadlines and providing the data in the ICCAT standard formats, even when no analytical stock assessment is scheduled, as required by ICCAT Recs. 13-02 and 15-03. Missing or incomplete historical data should also be provided.

To the SWGSM on MSE. The MSE calendar for NSWO is only achievable if resources are available and invested to facilitate the MSE process, including supporting the dialog process, the development of MSE analyses and methods. To ensure the success of this endeavor the Commission should consider providing these resources.

To the SWGSM on EBFM. It is important to consider socio-economic indicators that are relevant to specific stakeholders, e.g. those related to recreational and artisanal fishers which may not just be described by the simple "total yield" performance indicators presently proposed. Examples could be average CPUE or number of people employed. However, ICCAT does not currently have access to employment data.

To SCRS plenary on research funding. Given uncertainties in the SWO stock boundaries (N vs South, N vs Med), the Group continues to recommend synthesizing existing information and to collect additional new data in order to more properly identify these limits. This will include tissue samples for population genetics and satellite tagging. The costs for the initial part of the study would be $180,000[*]. The Group will continue to evaluate research needs in the intersessional period until the SCRS plenary.

8.2 Workplan for the inter-sessional work until the SWO 2017 ICCAT Assessment

30 April 2017	Corrections to Task 1 and 2 through 2015. *Action: National Scientists.*
	CPUEs from individual CPCs - Updates and corrections of CPUE series from Individual CPCs. *Action: National Scientists (North Atl -Canada and Japan to provide updates based on WG comments; Spain to present updated CPUE series with a supporting document; South Atl - Japan to provide updated series based on WG comments; Spain to present an updated CPUE series with supporting document*).
	Data for combined North Atlantic CPUE - Scientific collaboration based on raw data for combined CPUE update (submit to Miguel Santos and/or Mauricio Ortiz - full confidentiality of data will be maintained). *Action: Collaboration among National Scientists (Priority: National Scientists that have collaborated in the previous work - Portugal, Spain, Japan, USA, Canada, Morocco).*
7 May 2017	Final feedback and decision to inclusion provided on the updated CPUE indexes. *Action: National Scientists.*
15 May 2017	Final Task 1, Task II CAS, CAA, CATDIS produced and made available. *Action: Secretariat.*
	Combined CPUE for the North Atlantic (continuity from previous SA, using raw data). *Action: Collaboration between scientists.*
	Combined CPUE for the South Atlantic (continuity from previous SA, using standardized CPUE data). *Action: Secretariat.*
	Agree on choice of reference points and specifications for projections *Action: National Scientists.*
July 3-7, 2017	SWO Stock assessment meeting
	Describe the models run (with support from SCRS documents), agree on alternative runs and candidate base models
	• Review results brought to the meeting and identify additional runs
	• Develop Kobe matrices
	• Write and adopt detailed report of the meeting
	• Write and adopt initial draft of executive summary
	• Ensure base model inputs, outputs and executables are placed in the appropriate owncloud folders. (*Action. data raporteur*) - final diagnostics may take some extra days.
Sep 25 – 29, 2017	SWO Species Group Meeting • Review task I and II data through 2016 • Finalize the executive summary and any other pending issues • Revise and compile the final SWO Recommendations and workplan for 2018

[*] ($80,000 for a population genetics study and 20*$5,000 (=100,000USD) for deployment of 20 popup satellite archival tags). The funds could be spread over a two year period, over the ICCAT bi-annual funding period, as follows: 100,000USD in 2017/18 and 80,000USD in 2018/19.

8.3 Workplan for 2018 (*preliminary*)

A preliminary list of recommended work where continued efforts are required was developed. More discussion on the workplan should take place at the SWO stock assessment meeting and SWO Species Group meeting.

Life history: An understanding of the species biology, including age, growth and reproductive parameters is crucial for the application of biologically realistic stock assessment models and, ultimately, for effective conservation and management. Given the current uncertainties that still exist in those biological parameters, the Group recommends more studies on SWO life history are carried out. Those should be integrated with an ICCAT SWO research plan. The Group will discuss during 2017 a tentative budget for the 2018-2002 ICCAT bi-annual funding period to carry out those studies.

Size/Sex distribution study: The Group recommends that a detailed size and sex distribution study is started in order to better understand the spatial and seasonal dynamics of swordfish in the Atlantic. This study should be carried out in a cooperative manner between scientists, involving as many fleets as possible and preferably using detailed fishery observer data. This is particularly important if future alternative management measures are considered, for example when considering spatial/seasonal protection areas for juveniles. Additionally, such study would also provide a contribution for the stock delimitation work.

Larval index work: An initial SWO larval index was presented in the SWO data preparatory meeting. The Group recognized the value of adding fishery-independent indexes to the stock assessment, but there were still concerns about the surveyed area. Therefore the Group recommended to include this work into the SWO workplan to determine if those issues can be solved and this or other fishery independent indexes can be improved and used in the future.

PSAT tag data request: The Group encourages all CPCs to provide their swordfish PSAT tag data to an ad hoc study group. At a minimum the data should include the temperature and depth by hour, date and one degree latitude*longitude square. This will contribute to support the improvement of CPUE standardization through the removal of environmental effects as well as for the better definition of stock boundaries.

9. Adoption of the report and closure

The report was adopted by the Group and the meeting was adjourned.

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Table 1. Summary of the current length-weight, weight-weight and age-at-length relationships for Atlantic swordfish.

Current Size-Weight relationship
Weight = alpha * $Size^{beta}$

Stock	alpha	beta	Weight (kg)	Size (cm)	Size Range (cm)	Reference
NW-ATL	4.59E-06	3.137	Dress	LJFL		Turner, 1987
CN-ATL	4.20E-06	3.2133	Round	LJFL	80 - 253	Mejuto *et al*.,1988
NE-ATL	3.43E-06	3.2623	Round	LJFL	93 - 251	Mejuto *et al*., 1988
SW-ATL	1.24E-05	3.04	Gutted	**EYFL**		Amorin *et al*., 1979
SE-ATL	4.35E-06	3.188	Gutted	LJFL	89 - 266	Mejuto *et al*., 1988
S-ATL	5.17E-06	3.16	Gutted	LJFL		Rey Gonzales-Garces, 1979
SW-ATL	8.00E-07	3.4966	Gutted	LJFL	75 - 255	Hazin *et al*., 2002
SW-ATL	2.49E-06	3.24	DWT	LJFL	105 - 203	SCRS/2017/079
SW-ATL (Males)	4.61E-06	3.12	DWT	LJFL	110 - 203	SCRS/2017/079
SW-ATL (Females)	1.69E-06	3.32	DWT	LJFL	105 - 198	SCRS/2017/079

Current Weight to Weight relationships
Weight_pred = alpha*Weight_inp

Stock	alpha	beta	function	Weight_pred	Weight_inp	Reference
NW-ATL	1.33			Round	Dress	Turner, 1987
CE-ATL	1.3158			Round	Dress	Mejuto *et al*., 1988
SW-ATL	0.8009	1.015	ln(GWT/alpha)/beta	Round	Gutted	Amorin *et al*., 1979
SE-ATL	1.14			Round	Gutted	Mejuto *et al*., 1988
Med	1.12			Round	Gutted	Anon., 2004
N-ATL	0.75	1.04	ln(GWT/alpha)/beta	Round	Gutted	Rey, Gonzales-Garces, 1979

Current Size to Size relationships
Size_pred = alpha * Size_inp

Stock	alpha	beta	function	Size_pred	Size_inp	Reference
N-ATL	7.821534	1.089696	alpha+beta*Szinp	LJFL	EFL	Rey, Gonzales-Garces, 1979
N-ATL	10.30726	1.255833	alpha+beta*Szinp	LJFL	OPFL	Rey, Gonzales-Garces ,1979
SW-ATL	14.8075	1.40863	alpha+beta*Szinp	LJFL	DCL	SCRS/2017/079
SW-ATL (Males)	13.4247	1.41905	alpha+beta*Szinp	LJFL	DCL	SCRS/2017/079
SW-ATL (Females)	17.1196	1.39147	alpha+beta*Szinp	LJFL	DCL	SCRS/2017/079

Current Age at length			
Gender	Stock	Relationship	Reference
Male	N ATL	$L_t = \left[300^{3.921} - (300^{3.921} - 0.0001^{3.2678})e^{-0.00465(3.921)t}\right]^{1/3.921}$	Arocha *et al.*, 2003
Male	N ATL	[SECRETARIAT will add VBGF from paper]	Arocha *et al.*, 2003
Female	N ATL	$L_t = \left[375.49^{2.976} - (375.49^{2.976} - 0.0001^{2.976})e^{-0.00734(2.976)t}\right]^{1/2.976}$	Arocha *et al.*, 2003
Female	N ATL	$l_t = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ L_∞ = 312.3 cm LJFL k = 0.0926 t_0 = - 3.762	Arocha *et al.*, 2003
Combined	N ATL	$L_t = \left[464.54^{3.2678} - (464.54^{3.2678} - 0.0001^{3.2678})e^{-0.023(3.2678)t}\right]^{1/3.2678}$	Arocha *et al.*, 2003
Combined	N ATL	$l_t = L_\infty\left(1 - e^{-k(t-t_0)}\right)$ L_∞ = 325.0 cm LJFL k = 0.08 t_0 = - 4.3	Arocha *et al.*, 2003
	S ATL	$W_t = 305.56 \times \exp\left[-4.6335 \times \exp\left(-0.3058\,t\right)\right]$ $L_t = 44.2237 \times W_t^{0.29257}$	Anon., 1989
	N-S ATL	$W_t = 305.56 \times \exp\left[-4.6335 \times \exp\left(-0.3058\,t\right)\right]$ $L_t = 44.2237 \times W_t^{0.29257}$	Anon., 1989
Current Biological Parameters			
	Stock	Relationship	Reference
Maturity	N ATL	50% of females are mature at 179 cm (5 yrs)	Arocha *et al.*, 1996
	N ATL	50% of females are mature at 156 cm	Mejuto and Garcia-Cortes, 2014
	S ATL	50% of the females are mature at 156 cm	Hazin *et al.*, 2002
Natural Mortality	N ATL S ATL	0.2 for all ages	
Fecundity	N ATL	3.9 x 10^6 eggs per female	Arocha *et al.*, 1996

Table 2. Atlantic swordfish conversion factors proposed by the Secretariat (2013).

Weight-size relationship RWT(kg) alpha * Size(LJFL cm)^{beta}						
Stock	alpha	beta	Weight (kg)	Size	Size Range (cm)	Reference
N-ATL	4.45373E-06	3.203784011	Round	LJFL	80-253	
S-ATL	2.46E-06	3.313974115	Round	LJFL	89-266	Mejuto *et al*., 1988 & Hazin *et al*. 2002

Size to size conversion factors alpha+beta*Size_inp					
Stock	alpha	beta	size pred (cm)	size inp (cm)	Reference
ATL	7.821534	1.089696	LJFL	EFL	Rey, Gonzales-Garces, 1979
ATL	10.307257	1.255833	LJFL	OPFL	Rey, Gonzales-Garces, 1979

Weight to Weight conversion factors Weight_pred = alpha* Weight_inp				
Stock	alpha	Weight pred (kgs)	Weight inp (kgs)	Reference
N-ATL	1.324565	Round	Dress	Turner 1987 & Mejuto *et al*., 1988
S-ATL	1.14	Round	Gutted	Mejuto *et al.*, 1988

Table 3. Life history parameters for growth studies (FishBase.org).

CODE	GENUS	SPECIES	Loo_cm	Length_type	K	t0	Sex	M	Temp_C	Lm	theta	Country	Locality	Questionable	Captive
SWO	Xiphias	gladius	185	FL	0.22	-1.97	M	NA	NA	NA	3.87	Spain	western Mediterranean	No	No
SWO	Xiphias	gladius	194	OT	0.34	-1.22	M	NA	19	NA	4.11	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	203	OT	0.21	NA	M	NA	19	NA	3.94	Greece	NA	No	No
SWO	Xiphias	gladius	203	OT	0.21	-2	M	NA	19	NA	3.94	Greece	Hellenic Seas	No	No
SWO	Xiphias	gladius	203	OT	0.24	-1.21	M	NA	19	NA	4	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	213	OT	0.09	-0.62	M	NA	27	NA	3.59	Taiwan	NA	No	No
SWO	Xiphias	gladius	220	OT	0.25	-1.51	F	NA	19	NA	4.08	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	224	FL	0.13	-3	M	NA	NA	NA	3.81	Australia	off eastern coast	No	No
SWO	Xiphias	gladius	226	OT	0.21	-1.17	F	NA	19	NA	4.03	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	236	OT	0.17	NA	F	NA	19	NA	3.98	Greece	NA	No	No
SWO	Xiphias	gladius	236	OT	0.17	-2.1	F	NA	19	NA	3.98	Greece	Hellenic Seas	No	No
SWO	Xiphias	gladius	238.6	NA	0.18	-1.4	NA	NA	NA	NA	4.01	NA	Mediterranean, Black Sea and Azov Sea (all GSA)	No	No
SWO	Xiphias	gladius	249	FL	0.13	NA	M	NA	NA	NA	3.91	Australia	Eastern Australia	No	No
SWO	Xiphias	gladius	252.2	OT	0.13	-2.43	NA	NA	19	NA	3.93	Turkey	Aegean and Mediterranean Seas	No	No
SWO	Xiphias	gladius	256	FL	0.1	NA	NA	NA	NA	NA	3.83	NA	Southwest Pacific	No	No
SWO	Xiphias	gladius	264	FL	0.12	-2.27	F	NA	NA	NA	3.92	Spain	western Mediterranean	No	No
SWO	Xiphias	gladius	267	FL	0.12	-1.68	F	NA	25	NA	3.93	USA	Atlantic coast	No	No
SWO	Xiphias	gladius	277	FL	0.07	-3.94	M	NA	25	NA	3.73	USA	Atlantic coast	No	No
SWO	Xiphias	gladius	291.2	OT	0.19	NA	NA	NA	NA	140	4.21	Algeria	Beni Saf	No	No
SWO	Xiphias	gladius	296	FL	0.08	-3.7	F	NA	NA	NA	3.85	Australia	off eastern coast	No	No
SWO	Xiphias	gladius	301	OT	0.04	-0.75	F	NA	27	NA	3.56	Taiwan	NA	Yes	No
SWO	Xiphias	gladius	302.9	OT	0.07	-4.81	F	NA	NA	NA	3.81	Brazil	Southern region	No	No
SWO	Xiphias	gladius	309	OT	0.12	NA	NA	NA	18	160	4.07	Japan	Pacific	No	No
SWO	Xiphias	gladius	323	FL	0.08	NA	F	NA	NA	NA	3.93	Australia	Eastern Australia	No	No
SWO	Xiphias	gladius	365	NA	0.23	NA	NA	NA	12	NA	4.49	Canada	Atlantic	Yes	No
SWO	Xiphias	gladius	640	FL	0.15	NA	NA	0.2	24.8	NA	4.8	Canada	Growth: off Canada (Gulf Stream); M: Gulf of Mexico	Yes	No

Table 4. Age related parameters (FishBase.org).

CODE	GENUS	SPECIES	Sex	Wmax	Lmax_cm	Tmax	Country	Locality	Weight_unit
SWO	Xiphias	gladius	UNSEXED	133	219	10	Turkey	Aegean and Mediterran	g
SWO	Xiphias	gladius	MALE		190	6	Greece	Aegean Sea, 1986-88	
SWO	Xiphias	gladius	FEMALE		210	9	Greece	Aegean Sea, 1987-92	
SWO	Xiphias	gladius	UNSEXED	550	NA	NA	Canada	Gulf Stream	kg
SWO	Xiphias	gladius	MIXED		225	9	Greece	Hellenic Seas, 1986-87	
SWO	Xiphias	gladius	FEMALE		NA	19	Australia	off eastern coast	
SWO	Xiphias	gladius	UNSEXED		220	NA	Brazil	Sao Paulo, 1974-1977	
SWO	Xiphias	gladius	MALE		NA	10	Taiwan	Taiwan	
SWO	Xiphias	gladius	FEMALE		NA	12	Taiwan	Taiwan	
SWO	Xiphias	gladius	FEMALE		NA	10	Spain	western Mediterranean	

Table 5. Length-weight parameters (FishBase.org).

CODE	GENUS	SPECIES	Score	a	b	Doubtful	Sex	Length_cm	Length_type	r	n	Country	Locality
SWO	Xiphias	gladius	NA	0.00003	2.94		UNSEXED	68.0 - 210.0	OT	0.93	284	Indonesia	south of Java, Bali and Nusa Tenggara, 2010
SWO	Xiphias	gladius	NA	0.0124	3.04	yes	UNSEXED					Brazil	
SWO	Xiphias	gladius	NA	0.00751	3.06		MIXED	54.0 - 215.0	OT	0.97	974	Greece	Aegean Sea, 1986-88
SWO	Xiphias	gladius	NA	0.00742	3.07		MALE		OT			Greece	
SWO	Xiphias	gladius	NA	0.00862	3.13	yes	MALE		FL	0.939	126	New Zealand	2001
SWO	Xiphias	gladius	NA	0.00537	3.14		MIXED	71.5 - 207.0	OT	0.97	241	Greece	Hellenic Seas, 1986-87
SWO	Xiphias	gladius	NA	0.0056	3.15		UNSEXED	90.0 - 226.0	OT	0.985	31	Brazil	Central coast, 1993-2000
SWO	Xiphias	gladius	NA	0.00475	3.171		MIXED	90.0 - 206.0	FL		960	Greece	Hellenic Seas, 1986-87
SWO	Xiphias	gladius	NA	0.00397	3.19		FEMALE		OT			Greece	
SWO	Xiphias	gladius	NA	0.00776	3.21	yes	MIXED		FL	0.929	121	New Zealand	2002
SWO	Xiphias	gladius	NA	0.00271	3.3		UNSEXED	81.0 - 281.0			166	USA	Western Atlantic
SWO	Xiphias	gladius	NA	0.0023	3.33		UNSEXED	80.0 - 249.0	FL		252	Cuba	Northwest Zone
SWO	Xiphias	gladius	NA	0.00175	3.343	yes	UNSEXED	51.0 - 215.0	OT	0.959	430	Reunion	
SWO	Xiphias	gladius	NA	0.00431	3.38	yes	FEMALE		FL	0.951	265	New Zealand	2001
SWO	Xiphias	gladius	NA	0.00135	3.447		MIXED	52.5 - 219.0	OT		794	Turkey	Aegean and Mediterranean Seas, 1993-1996
SWO	Xiphias	gladius	NA	0.0008	3.497	yes	MIXED	75.0 - 250.0	OT	0.969	188	Brazil	Northeastern region
SWO	Xiphias	gladius	NA	0.00049	3.64	yes	UNSEXED	84.0 - 254.0	TL		242	Cuba	Northwest Zone

Table 6. Maturity related parameters (FishBase.org).

CODE	GENUS	SPECIES	Lm_cm	Lm_lo_cm	Lm_up_cm	Age_lo	Age_up	tm	Sex	Country	Locality	Length_type
SWO	Xiphias	gladius		150	170	5	6	NA	UNSEXED	NA	Pacific	
SWO	Xiphias	gladius		156	250	NA	NA	NA	FEMALE	Brazil	Northeastern region	
SWO	Xiphias	gladius	110	NA	NA	NA	NA	NA	MALE	Australia	Australia	OT
SWO	Xiphias	gladius	221	NA	NA	NA	NA	NA	FEMALE	Australia	Australia	OT

Table 6. (continued).

CODE	GENUS	SPECIES	Loo_cm	Length_type	K	t0	Sex	M	Temp_C	Lm	theta	Country	Locality	Questionable	Captive
SWO	Xiphias	gladius	185	FL	0.22	-1.97	M	NA	NA	NA	3.87	Spain	western Mediterranean	No	No
SWO	Xiphias	gladius	194	OT	0.34	-1.22	M	NA	19	NA	4.11	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	203	OT	0.21	NA	M	NA	19	NA	3.94	Greece	NA	No	No
SWO	Xiphias	gladius	203	OT	0.21	-2	M	NA	19	NA	3.94	Greece	Hellenic Seas	No	No
SWO	Xiphias	gladius	203	OT	0.24	-1.21	M	NA	19	NA	4	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	213	OT	0.09	-0.62	M	NA	27	NA	3.59	Taiwan	NA	No	No
SWO	Xiphias	gladius	220	OT	0.25	-1.51	F	NA	19	NA	4.08	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	224	FL	0.13	-3	M	NA	NA	NA	3.81	Australia	off eastern coast	No	No
SWO	Xiphias	gladius	226	OT	0.21	-1.17	F	NA	19	NA	4.03	Greece	Aegean Sea	No	No
SWO	Xiphias	gladius	236	OT	0.17	NA	F	NA	19	NA	3.98	Greece	NA	No	No
SWO	Xiphias	gladius	236	OT	0.17	-2.1	F	NA	19	NA	3.98	Greece	Hellenic Seas	No	No
SWO	Xiphias	gladius	238.6	NA	0.18	-1.4	NA	NA	NA	NA	4.01	NA	Mediterranean, Black Sea and Azov Sea (all GSA)	No	No
SWO	Xiphias	gladius	249	FL	0.13	NA	M	NA	NA	NA	3.91	Australia	Eastern Australia	No	No
SWO	Xiphias	gladius	252.2	OT	0.13	-2.43	NA	NA	19	NA	3.93	Turkey	Aegean and Mediterranean Seas	No	No
SWO	Xiphias	gladius	256	FL	0.1	NA	NA	NA	NA	NA	3.83	NA	Southwest Pacific	No	No
SWO	Xiphias	gladius	264	FL	0.12	-2.27	F	NA	NA	NA	3.92	Spain	western Mediterranean	No	No
SWO	Xiphias	gladius	267	FL	0.12	-1.68	F	NA	25	NA	3.93	USA	Atlantic coast	No	No
SWO	Xiphias	gladius	277	FL	0.07	-3.94	M	NA	25	NA	3.73	USA	Atlantic coast	No	No
SWO	Xiphias	gladius	291.2	OT	0.19	NA	NA	NA	NA	140	4.21	Algeria	Beni Saf	No	No
SWO	Xiphias	gladius	296	FL	0.08	-3.7	F	NA	NA	NA	3.85	Australia	off eastern coast	No	No
SWO	Xiphias	gladius	301	OT	0.04	-0.75	F	NA	27	NA	3.56	Taiwan	NA	Yes	No
SWO	Xiphias	gladius	302.9	OT	0.07	-4.81	F	NA	NA	NA	3.81	Brazil	Southern region	No	No
SWO	Xiphias	gladius	309	OT	0.12	NA	NA	NA	18	160	4.07	Japan	Pacific	No	No
SWO	Xiphias	gladius	323	FL	0.08	NA	F	NA	NA	NA	3.93	Australia	Eastern Australia	No	No
SWO	Xiphias	gladius	365	NA	0.23	NA	NA	NA	12	NA	4.49	Canada	Atlantic	Yes	No
SWO	Xiphias	gladius	640	FL	0.15	NA	NA	0.2	24.8	NA	4.8	Canada	Growth: off Canada (Gulf Stream); M: Gulf of Mexico	Yes	No

Table 7. Estimated catches (t) of swordfish (*Xiphias gladius*) in the Atlantic stocks by area/gear/flag.

			1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
TOTAL AT			3746	2781	3193	3503	3134	3602	3359	4802	4996	6403	4287	5397	6111	11608	13288	11230	11301	10684	11620	13684	15004	7432	7346	9152	9115	11901	9508	9264	14593	15231	18881	15155	19662
	SWO-N		3646	2581	2993	3303	3034	3502	3358	4578	4904	6232	3828	4381	5342	10190	11258	8652	9349	9107	9172	9203	9578	5266	4766	6074	6362	8839	6696	6409	11827	11937	13558	11180	13215
	SWO-S		100	200	200	200	100	100	1	224	92	171	459	1016	769	1418	2030	2578	1952	1577	2448	4481	5426	2166	2580	3078	2753	3062	2812	2855	2766	3294	5323	3975	6447
Landings	ATN	Longline	1445	966	966	1203	305	619	374	1010	875	1428	1042	2060	3202	9193	10833	7759	8503	8679	8985	9003	9484	5243	4717	5929	6267	8778	6663	6370	11125	11177	12831	10549	13019
		Other surf.	2201	1615	2027	2100	2729	2883	2984	3568	4029	4804	2786	2321	2140	997	425	893	846	428	187	200	94	23	49	145	95	61	33	39	702	760	727	631	196
	ATS	Longline	0	0	0	0	0	0	1	124	92	71	359	816	769	1418	2030	2578	1952	1577	2348	4281	5426	2164	2580	3078	2753	3062	2812	2840	2749	3265	5179	3938	6364
		Other surf.	100	200	200	200	100	100	0	100	0	100	100	200	0	0	0	0	0	0	100	200	0	2	0	0	0	0	0	15	17	29	144	37	83
Discards	ATN	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	0	0	0	0	0	0	0	0
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	ATS	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	0	0	0	0	0	0	0	0
		Other surf.	0	0	0	0	0	0	0	0	0	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	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Belize	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Canada	1290	1523	1890	1990	2573	2722	2761	3102	3219	4014	2328	1913	2092	7482	7099	4674	4433	4794	4393	4257	4883	0	0	0	2	21	15	113	2314	2970	1885	561	554
		China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	48	99	150	283	304	294	168	316	265	272	471	246	164	338	134	182	260
		Cuba	0	0	0	0	0	0	0	0	0	300	300	300	400	125	134	171	175	336	224	97	134	160	75	248	572	280	283	398	281	128	278	227	254
		Côte 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
		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
		EU.Denmark	0	0	0	0	0	0	0	0	0	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.España	1445	966	966	1203	305	619	374	1000	832	1100	722	1700	2300	1000	1800	1433	2999	2690	3551	3502	3160	3384	3210	3833	2893	3747	2816	3309	3622	2582	3810	4014	4554
		EU.France	0	0	0	0	0	0	0	100	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0
		EU.Ireland	0	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	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
		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	100	0	0	0	0	6	0	1	0	0
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	6	15	11	12	11	8	11	21	37	92	58	32	38	17	29	15	13	11
		EU.Rumania	0	0	0	0	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
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	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	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Grenada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		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	0	0	0	0	0	0	0	0	0	0
		Guyana	0	0	0	0	0	0	0	0	0	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	0	0	0	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	10	43	28	20	54	106	311	700	1025	658	280	262	130	298	914	784	518	1178	2462	1149	793	946	542	1167	1315	1755
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	27	46	24	22	40	159	155	374	152	172	335	541	634	303	284	136	198
		Liberia	0	0	0	0	0	0	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	38	34
		Maroc	0	0	0	0	0	0	0	0	0	0	0	6	12	6	118	100	61	34	43	20	17	33	43	18	15	15	12	7	11	208	136	124	91
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	3	0	0	0	2	0	0	0	0
		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	0	0	12	0
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	300	200	600	400	200	0	0	0	0	0	0	0	0	0	0	0
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	171	24	25	91	22	76	26	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
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		St. Vincent and 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	0
		Sta. Lucia	0	0	0	0	0	0	0	0	0	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	0	0	0	0
		U.S.A.	911	92	137	110	156	161	223	366	710	690	458	408	424	1250	1384	1227	614	474	274	170	287	35	246	406	1125	1700	1429	912	3684	4619	5625	4530	5410
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	8	22	21	11	24	24	28	26	17	32	19	15	23	10	21	0	69
		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	0	0
		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	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	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	0	0	0	0
		Venezuela	0	0	0	0	0	0	0	0	0	0	0	0	8	13	12	8	11	21	18	100	23	52	27	23	24	52	43	15	46	182	192	24	25
	ATS	Angola	100	200	200	200	100	100	0	100	0	100	100	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Argentina	0	0	0	0	0	0	0	0	0	0	281	111	196	400	508	400	200	79	259	500	400	63	100	48	10	10	111	132	4	0	0	0	20
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Benin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	24
		Brazil	0	0	0	0	0	0	0	0	0	0	0	440	251	125	125	125	125	62	100	181	162	154	121	161	465	514	365	396	372	521	1582	655	1019
		Cambodia	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	1	5	3	1	95	166	488	828	1281	779	807	1104	802	935	745	675	625	1292	702	528	520
		Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	63	101	164	122	559	410	170	148	74	66	221	509	248	317	302	319	272	316	147	432
		Côte 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.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	3	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	0	0	0	0	0	0
		EU.Lithuania	0	0	0	0	0	0	0	0	0	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	0	0
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	200	0	0	0	0	0	0	0	0	0	0	110	5	55
		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	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	0	0	0
		Japan	0	0	0	0	0	0	1	124	92	71	78	265	321	825	1288	1845	1300	474	859	2143	2877	664	1023	480	191	805	105	514	503	782	2029	2170	3287
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	54	79	77	370	382	256	249	602	563	279	812	699	699	303	399	311	486
		Mixed flags (FR+ES)	0	0	0	0	0	0	0	0	0	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 (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	0	0	0	0
		Namibia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Nigeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	274	90	40	219	28	83	26	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
		S. Tomé e Príncipe	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		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	28	31	9	3
		St. Vincent and 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	0
		Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		U.S.S.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	39	56	158	155	89	176	176	202	188	123	231	138	106	161	70	154	40	26
		UK.Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Uruguay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	92	575
		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	0	0	0	0
Discards	ATN	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	0	0	0	0	0	0
		Chinese 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	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	0	0
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0
		U.S.A.	0	0	0	0	0	0	0	0	0	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	0	0	0
	ATS	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Chinese 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	0	0
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		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	0	0	0
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7 (continued).

			1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TOTAL AT			19929	21953	23969	24380	26268	32685	34305	32976	28826	29207	32868	34459	38803	33511	31567	26251	27123	27180	25139	23758	24075	25144	25535	25715	27932	23596	24928	24251	23978	24554	20281	20581	20945
	SWO-N		14527	12791	14383	18486	20238	19513	17250	15672	14934	15394	16738	15501	16872	15222	13025	12223	11622	11453	10011	9654	11442	12068	12373	11470	12302	11050	12081	11553	12523	13868	12069	10670	10668
	SWO-S		5402	9162	9586	5894	6030	13172	17055	17304	13893	13813	16130	18958	21930	18289	18542	14027	15502	15728	15128	14104	12633	13077	13162	14245	15630	12546	12846	12697	11455	10686	8212	9910	10277
Landings	ATN	Longline	14023	12664	14240	18269	20026	18907	15315	14027	14233	14318	15670	14365	15850	13819	12203	10961	10715	9921	8676	8799	10333	11407	11528	10838	11475	10341	11439	10964	11610	12955	11344	10059	10135
		Other surf.	504	127	143	217	212	606	1935	1645	486	693	660	428	496	815	371	778	377	394	433	240	486	341	512	409	546	465	485	437	511	512	526	462	386
	ATS	Longline	5307	8920	9224	4982	5797	12602	16573	16705	13496	13422	15739	17839	21584	17859	18299	13748	14823	15448	14302	13576	11712	12485	12915	13723	14967	11761	12106	11920	10833	10255	7889	9733	10014
		Other surf.	95	242	362	912	233	570	482	599	397	391	391	1119	346	429	222	269	672	278	825	527	920	591	248	522	572	779	741	629	547	291	322	177	263
Discards	ATN	Longline	0	0	0	0	0	0	0	0	215	383	408	708	526	562	439	476	525	1137	896	607	618	313	323	215	273	235	151	148	392	391	199	149	148
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	26	12	9	4	1	6	8	5	7	10	8	8	9	7	5	9	10	0	0	
	ATS	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21	10	6	1	0	0	0	1	0	0	91	6	0	147	74	140	0	0	
		Other surf.	0	0	0	0	0	0	0	0	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	Barbados	0	0	0	0	0	0	0	0	0	0	0	0	0	33	16	16	12	13	19	10	21	25	44	39	27	39	20	13	23	21	16	21	29
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	112	106	184	141	142	76	8
		Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Canada	1088	499	585	1059	954	898	1247	911	1026	1547	2234	1676	1610	739	1089	1115	1119	968	1079	959	1285	1203	1558	1404	1348	1334	1300	1346	1551	1489	1505	1604	1579
		China PR	0	0	0	0	0	0	0	0	0	0	73	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141
		Chinese Taipei	272	164	152	157	52	23	17	270	577	441	127	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	166	115	78	115
		Cuba	410	206	162	636	910	832	87	47	23	27	16	50	86	7	7	7	7	0	0	10	3	3	2	2	0	0	0	0	0	0	0	0	
		Côte 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	25	30	0	0	0	0	
		Dominica	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	1	0	0	0	0	0	
		EU.Denmark	0	0	0	0	0	0	0	0	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.España	7100	6315	7441	9719	11137	9799	6648	6386	6633	6672	6598	6185	6953	5547	5140	4079	3996	4595	3968	3957	4586	5376	5521	5448	5564	4366	4949	4147	4889	5622	4084	3750	4013
		EU.France	0	1	4	4	0	0	0	75	75	75	95	46	84	97	164	110	104	122	0	74	169	102	178	92	46	14	15	35	16	94	44	28	66
		EU.Ireland	0	0	0	0	0	0	0	0	0	0	7	0	0	15	15	132	81	35	17	5	12	1	1	3	2	2	1	1	2	5	2	3	15
		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	1	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	0	0	0	
		EU.Portugal	9	14	22	468	994	617	300	475	773	542	1961	1599	1617	1703	903	773	777	732	735	766	1032	1320	900	949	778	747	898	1054	1203	882	1438	1241	1420
		EU.Rumania	0	0	0	0	0	0	0	0	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.United Kingdom	0	0	0	0	0	0	0	0	0	0	2	3	1	5	11	0	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	3	36	48	0	82	48	17	90	1	0	18	3	
		Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Grenada	0	0	0	0	0	56	5	1	2	3	13	0	1	4	15	15	42	84	0	54	88	73	56	30	26	43	0	0	0	0	0	0	
		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	0	0	0	0	0	0	0	13	0	
		Guyana	0	0	0	0	0	0	0	0	0	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	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	
		Japan	537	665	921	807	413	621	1572	1051	992	1064	1126	933	1043	1494	1218	1391	1089	161	0	0	0	575	705	656	889	935	778	1062	523	639	300	545	436
		Korea Rep.	53	32	160	68	60	30	320	51	3	3	19	16	16	19	15	0	0	0	0	0	0	0	51	65	175	157	3	0	0	0	64	35	
		Liberia	53	0	24	16	30	19	35	3	0	7	14	26	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Maroc	129	81	137	181	197	196	222	91	110	69	39	36	79	462	267	191	119	114	523	223	329	335	334	341	237	430	724	963	782	770	1062	1062	850
		Mexico	0	0	0	0	0	0	0	0	0	0	6	14	0	22	14	28	24	37	27	34	32	44	41	31	35	34	32	35	38	40	33	32	31
		NEI (ETRO)	0	0	0	14	3	207	302	714	43	35	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		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	
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	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	1	4	44	5	0	8	0	22	28	0	17	36	9	14	
		Russian Federation	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	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	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	1	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	28	11	1	44	43	49	78
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sierra Leone	0	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	0	
		St. Vincent and Grenadines	0	0	0	0	0	0	0	3	0	3	23	0	4	3	1	0	1	0	22	22	7	7	7	0	51	7	34	13	11	8	4	40	102
		Sta. Lucia	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	0	0	0	0	0	0
		Trinidad and Tobago	21	26	6	45	151	42	79	66	71	562	11	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17
		U.S.A.	4820	4749	4705	5210	5247	6171	6411	5519	4310	3852	3783	3366	4026	3559	2987	3058	2908	2863	2217	2384	2513	2380	2160	1873	2463	2387	2730	2274	2551	3393	2824	1809	1581
		U.S.S.R.	0	16	13	18	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	0	0	0	
		UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	1	1	5	5	3	3	2	0	0	1	1	0	3	4	3	3	3	1	1	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	4	4	7	0	3	0	0	4	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	0	13	17	
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	29	14	0	0	0	10	23	15	2	4	7
		Venezuela	35	23	51	84	86	2	4	9	75	103	73	69	54	85	20	37	30	44	21	34	45	53	55	22	30	11	13	24	18	25	24	24	29
	ATS	Angola	0	26	228	815	84	84	84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	18	
		Argentina	0	0	361	31	351	198	175	230	88	88	14	24	0	0	0	0	38	0	5	10	8	0	0	0	0	0	0	1	0	0	0	0	
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	17	8	0	0	0	0	0	0	120	32	111	121	207	197	136	45	104
		Benin	0	86	90	39	13	19	26	28	28	26	28	25	24	24	10	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Brazil	781	468	562	753	947	1162	1168	1696	1312	2609	2013	1571	1975	1892	4100	3847	4721	4579	4082	2910	2920	2998	3785	4430	4153	3407	3386	2926	3033	2833	1427	2892	2588
		Cambodia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328
		Chinese Taipei	261	199	280	216	338	798	610	900	1453	1686	846	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	424	379	582	406	511
		Cuba	818	1161	1301	95	173	159	830	448	209	246	192	452	778	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Côte d'Ivoire	0	10	10	10	10	12	7	8	18	13	14	20	19	26	18	25	26	20	19	19	43	29	31	39	17	159	267	156	145	88	110	55	42
		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	0	0	0	
		EU.España	0	0	0	66	0	4393	7725	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059
		EU.Lithuania	0	0	0	0	0	0	0	0	0	0	0	0	794	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	1	0	380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	49	0	0	3	0	0	0	0	0	
		Gabon	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	0	0	0	0	0	
		Ghana	5	15	25	13	123	235	156	146	73	69	121	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56
		Guinea Ecuatorial	0	0	0	0	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	
		Honduras	0	0	0	0	0	0	0	0	0	0	3	0	6	4	5	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	1908	4395	4613	2913	2620	4453	4019	6708	4459	2870	5256	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	975	660
		Korea Rep.	409	625	917	369	666	1012	776	50	147	147	198	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	0	0	42	47	53	5
		Mixed flags (FR+ES)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (ETRO)	0	0	0	0	0	0	856	439	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Namibia	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	730	469	751	504	191	549	832	1118	1038	518	25	417	414	85	129	395	225
		Nigeria	83	69	0	0	0	0	0	0	0	0	3	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	105	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	6	1	8	1	1	4	58	41	49	14	35	15	35	58	
		S. Tomé e Príncipe	0	0	0	0	0	216	207	181	179	177	202	190	178	166	148	135	129	120	120	120	120	126	147	138	138	183	188	193	60	84	60	94	145
		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	77	138	195	180	264	162	178	143	97
		Seychelles	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	0	0	0	0	0	
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	
		South Africa	7	23	8	5	5	4	0	0	5	9	4	1	4	1	1	240	143	328	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218
		St. Vincent and 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	10	7	16	4	3	2	2	19	0
		Togo	0	0	6	32	1	0	2	3	5	5	8	14	14	64	0	0	0	0	0	0	0	9	10	2	0	0	0	0	0	0	0	0	
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	171	396	160	179	142	43	200	21	15	0	0	0	0	0	0	0	0	0	0	
		U.S.S.R.	46	158	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	0	0	0	0	
		UK.Sta Helena	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	4	0	0	0	0	0	0	0	0	0	0	5	6	2
		Uruguay	1084	1927	1125	537	699	427	414	302	156	210	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103	0	
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	26	6	3	0	3	1	3	0	1	1
Discards	ATN	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	52	35	50	26	33	79	45	106	38	61	39	9	15	8	111	59	12	8
		Chinese 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	27	0	
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	598	567	319	263	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	0	0	0	0	0	0	0	0	0	0	0	170	46	19	0	2
		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	1	0	0	0	
		U.S.A.	0	0	0	0	0	0	0	0	215	383	408	708	526	588	446	433	494	490	308	263	282	275	227	185	220	205	148	138	223	217	120	137	137
		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	0	
	ATS	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	6	0	0	0	0	0	0	
		Chinese 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	4	117	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	70	23	0	0	
		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	0	0	
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	21	10	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	

Table 8. SWO live discards (t) available in Task I (T1NC).

Species	Stock	Flag	GearGrp	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
SWO	SWO-N	Canada	LL																28.6
			TW																0.2
		Japan	LL	331.0	329.0	224.0	133.0	339.0	123.0										
		Mexico	LL							0.7	0.3	0.5	0.3	0.5	0.3	0.5	0.1	0.3	0.1
		UK.Bermuda	LL												0.1		0.0		
	sub total			331.0	329.0	224.0	133.0	339.0	123.0	0.7	0.3	0.5	0.3	0.5	0.4	0.5	0.2	0.3	28.9
	SWO-S	Brazil	LL								54.4	2.5							
		Korea Rep.	LL											10.0					
		South Africa	LL														0.0	0.0	
	sub total										54.4	2.5		10.0			0.0	0.0	
TOTAL				**331.0**	**329.0**	**224.0**	**133.0**	**339.0**	**123.0**	**0.7**	**54.8**	**3.0**	**0.3**	**10.6**	**0.4**	**0.5**	**0.2**	**0.3**	**28.9**

Table 9. SWO-N (Atlantic north stock) standard SCRS catalogues on statistics (Task-I and Task-II) by major fishery (flag/gear combinations ranked by order of importance) and year (1990 to 2015). Only the most important fisheries (representing ±97.5% of Task-I total catch) are shown. For each data series, Task I (DSet= "t1", in tonnes) is visualised against its equivalent Task II availability (DSet= "t2") scheme. The Task-II colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= CAS exists) that represents the Task-II data availability in the ICCAT-DB. See the legend for the colour scheme pattern definitions.

Species	Stock	Status	FlagName	GearGrp	DSet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Rank	%	%cum
				T1 Total		15672	14934	15394	16738	15501	16872	15222	13025	12223	11622	11453	10011	9654	11442	12068	12373	11470	12302	11050	12081	11553	12523	13868	12069	10670	10668			
SWO	ATN	CP	EU.España	LL	t1	5736	6506	6351	6392	6027	6948	5519	5133	4079	3993	4581	3967	3954	4585	5373	5511	5446	5564	4366	4949	4147	4885	5620	4082	3750	4013	1	39.5%	40%
SWO	ATN	CP	EU.España	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
SWO	ATN	CP	U.S.A.	LL	t1	4967	4399	4124	4044	3960	4452	4015	3399	3433	3364	3316	2498	2598	2757	2591	2273	1961	2474	2405	2691	2204	2572	3347	2812	1816	1593	2	24.1%	64%
SWO	ATN	CP	U.S.A.	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	2		
SWO	ATN	CP	Canada	LL	t1	819	953	1487	2206	1654	1421	646	1005	927	1136	923	984	954	1216	1161	1470	1238	1142	1115	1061	1182	1351	1502	1290	1383	1489	3	9.5%	73%
SWO	ATN	CP	Canada	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	3		
SWO	ATN	CP	EU.Portugal	LL	t1	463	757	497	1950	1579	1593	1702	902	772	776	731	731	765	1032	1319	900	949	778	747	898	1054	1202	882	1438	1241	1420	4	8.1%	81%
SWO	ATN	CP	EU.Portugal	LL	t2	ab	abc	ac	ab	ab	ab	ab	ab	ab	ab	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	4		
SWO	ATN	CP	Japan	LL	t1	1051	992	1064	1126	933	1043	1494	1218	1391	1089	759	567	319	263	575	705	656	889	935	778	1062	523	639	300	545	436	5	6.4%	88%
SWO	ATN	CP	Japan	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	bc	bc	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	5		
SWO	ATN	CP	Maroc	LL	t1	24	92	41	27	7	28	35	239		35	38	264	154	223	255	325	333	229	428	720	963	700	700	1000	1000	800	6	2.6%	90%
SWO	ATN	CP	Maroc	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1		-1	-1	-1	-1	bc	abc	abc	abc	abc	abc	abc	abc	a	ab	abc	abc	abc	6		
SWO	ATN	NCC	Chinese Taipei	LL	t1	269	577	441	127	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	193	115	78	115	7	2.0%	92%
SWO	ATN	NCC	Chinese Taipei	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	7		
SWO	ATN	CP	Canada	HP	t1	92	73	60	28	22	189	93	89	240	18	95	121	38	147	87	193	203	267	258	248	176	208	97	275	233	98	8	1.1%	93%
SWO	ATN	CP	Canada	HP	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	8		
SWO	ATN	CP	China PR	LL	t1				73	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141	9	0.8%	94%
SWO	ATN	CP	China PR	LL	t2				-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	ab	a	ab	ab	ab	ab	ab	ab	a	ab	9		
SWO	ATN	CP	Trinidad and Tobago	LL	t1	66	71	562	11	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17	10	0.7%	95%
SWO	ATN	CP	Trinidad and Tobago	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	a	a	a	a	ab	10		
SWO	ATN	CP	EU.España	GN	t1	646	124	316	202	150		20																				11	0.4%	95%
SWO	ATN	CP	EU.España	GN	t2	ac	ab	-1	-1	-1		-1																				11		
SWO	ATN	CP	Maroc	GN	t1	19	9	4	2	13	32	322	13	179	60	51	243	64	98	76	9						80					12	0.4%	96%
SWO	ATN	CP	Maroc	GN	t2	-1	-1	-1	-1	-1	-1	-1	-1	c	ac	ac	ac	-1	b	b	b						-1					12		
SWO	ATN	CP	U.S.A.	HL	t1				38			0	1		5	9	9	12	21	23	35	33	125	94	125	129	121	155	105	88	77	13	0.4%	96%
SWO	ATN	CP	U.S.A.	HL	t2				-1			-1	b	b	c	bc	bc	c	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	13		
SWO	ATN	CP	U.S.A.	GN	t1	535	82	86	92	88	74	78	0	36		0		0		0			0		0			0				14	0.3%	96%
SWO	ATN	CP	U.S.A.	GN	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab		-1		-1		-1			-1		bc			c				14		
SWO	ATN	CP	EU.France	UN	t1	75	75	75	95		38	97	164						32	102	178	0	46	14	3	1	0	1				15	0.3%	97%
SWO	ATN	CP	EU.France	UN	t2	-1	-1	c	c		-1	-1	-1						-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		a		15		
SWO	ATN	CP	Korea Rep.	LL	t1	51	3	3	19	16	16	19	15								51	65	175	157	3		170	46	83	35	2	16	0.3%	97%
SWO	ATN	CP	Korea Rep.	LL	t2	ab	a	ab	a	a	a	a	a				a				a	a	a	a	a		-1	-1	ab	ab	b	16		
SWO	ATN	CP	Venezuela	LL	t1	4	73	101	68	60	45	74	11	7	9	30	12	25	29	46	48	15	19	5	8	16	13	18	20	18	29	17	0.2%	97%
SWO	ATN	CP	Venezuela	LL	t2	b	b	b	b	b	b	b	b	b	ab	ab	b	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	17		
SWO	ATN	CP	Belize	LL	t1																		9	1	112	106	184	141	142	76	8	18	0.2%	97%
SWO	ATN	CP	Belize	LL	t2																		a	a	ab	ab	ab	ab	a	a	ab	18		
SWO	ATN	CP	U.S.A.	RR	t1							6	11	5	21	16	2	22	6	25	61	53	68	76	32	49	54	71	22	35	46	19	0.2%	98%
SWO	ATN	CP	U.S.A.	RR	t2	a	a	a	ab	ab	a	a	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	ab	ab	abc	abc	abc	abc	abc	abc	19		
SWO	ATN	CP	Mexico	LL	t1				6	14		22	14	28	24	37	27	34	32	44	41	31	35	34	32	35	38	41	33	32	31	20	0.2%	98%
SWO	ATN	CP	Mexico	LL	t2				a	a		a	a	a	a	a	c	-1	a	a	a	a	a	a	a	a	a	a	a	a	a	20		
SWO	ATN	CP	EU.France	TW	t1					13	13					60		74	138			91			12	32	15	13	35	25	63	21	0.2%	98%
SWO	ATN	CP	EU.France	TW	t2					a	-1					-1		-1	-1			-1			-1	-1	-1	-1	-1	ab	-1	21		
SWO	ATN	NCO	Grenada	LL	t1	1	2	3	13		1	4	15	15	42	84		54	88	73	56	30	26	43								22	0.2%	98%
SWO	ATN	NCO	Grenada	LL	t2	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1		-1	a	a	a	a	a	a								22		
SWO	ATN	NCO	NEI (ETRO)	LL	t1	529																										23	0.2%	98%
SWO	ATN	NCO	NEI (ETRO)	LL	t2	-1																										23		
SWO	ATN	CP	Barbados	LL	t1							33	16	16	12	13	19	10	19	24	39	34	23	36	17	13	23	15	16	20	29	24	0.1%	98%
SWO	ATN	CP	Barbados	LL	t2							-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	24		

Table 10. SWO-S (Atlantic south stock) standard SCRS catalogues on statistics (Task-I and Task-II) by major fishery (flag/gear combinations ranked by order of importance) and year (1990 to 2015). Only the most important fisheries (representing ±97.5% of Task-I total catch) are shown. For each data series, Task I (DSet= “t1”, in tonnes) is visualised against its equivalent Task II availability (DSet= “t2”) scheme. The Task-II colour scheme, has a concatenation of characters (“a”= T2CE exists; “b”= T2SZ exists; “c”= CAS exists) that represents the Task-II data availability in the ICCAT-DB. See the legend for the colour scheme pattern definitions.

Species	Stock	Status	FlagName	GearGrp	DSet	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Rank	%	%cum
					T1 Total	17304	13893	13813	16130	18958	21930	18289	18542	14027	15502	15728	15128	14104	12633	13077	13162	14245	15630	12546	12846	12697	11455	10686	8212	9910	10277			
SWO	ATS	CP	EU.España	LL	t1	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059	1	41.9%	42%
SWO	ATS	CP	EU.España	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
SWO	ATS	CP	Brazil	LL	t1	1696	1312	2609	2013	1571	1970	1892	4100	3844	4721	4579	4075	2903	2917	2914	3780	4120	3892	3152	3132	2657	2800	2831	1312	2890	2567	2	20.6%	62%
SWO	ATS	CP	Brazil	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	2		
SWO	ATS	CP	Japan	LL	t1	6708	4459	2870	5256	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	975	660	3	13.5%	76%
SWO	ATS	CP	Japan	LL	t2	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	3		
SWO	ATS	NCC	Chinese Taipei	LL	t1	896	1453	1686	846	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	428	496	582	406	511	4	8.1%	84%
SWO	ATS	NCC	Chinese Taipei	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	4		
SWO	ATS	CP	Uruguay	LL	t1	302	156	210	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103			5	3.3%	87%
SWO	ATS	CP	Uruguay	LL	t2	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab			5		
SWO	ATS	CP	Namibia	LL	t1					22					374	452	607	504	187	549	832	1118	1038	518	25	408	366	22	129	395	225	6	2.1%	89%
SWO	ATS	CP	Namibia	LL	t2					a					a	-1	ab	a	-1	a	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	6		
SWO	ATS	CP	EU.Portugal	LL	t1						380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236	7	1.9%	91%
SWO	ATS	CP	EU.Portugal	LL	t2						a	a	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	7		
SWO	ATS	CP	China PR	LL	t1									29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328	8	1.4%	93%
SWO	ATS	CP	China PR	LL	t2									a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	8		
SWO	ATS	CP	South Africa	LL	t1						1			240	143	327	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218	9	1.1%	94%
SWO	ATS	CP	South Africa	LL	t2						-1			ab	ab	ab	ac	abc	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	9		
SWO	ATS	CP	Ghana	GN	t1	146	73	69	121	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56	10	1.0%	95%
SWO	ATS	CP	Ghana	GN	t2	-1	-1	-1	-1	-1	-1	ab	b	ab	b	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	a	a	a	10		
SWO	ATS	CP	S. Tomé e Príncipe	TR	t1	181	179	177	202	190	178	166	148	135	129	120	120	120	120	126	147	138	138	172	179	176						11	0.9%	96%
SWO	ATS	CP	S. Tomé e Príncipe	TR	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1						11		
SWO	ATS	NCO	Cuba	LL	t1	448	209	246	192	452	778	60	60																			12	0.7%	96%
SWO	ATS	NCO	Cuba	LL	t2	a	-1	-1	-1	-1	-1	-1	-1																			12		
SWO	ATS	CP	Korea Rep.	LL	t1	50	147	147	198	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	147	70	65	47	53	5	13	0.5%	97%
SWO	ATS	CP	Korea Rep.	LL	t2	ab	ab	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	-1	-1	-1	ab	ab	a	13		
SWO	ATS	CP	Brazil	UN	t1									3			7			70	5	310	351	260	253	269	184	0			12	14	0.5%	97%
SWO	ATS	CP	Brazil	UN	t2									-1			-1			-1	-1	b	-1	-1	-1	-1	-1	-1			-1	14		
SWO	ATS	CP	Senegal	LL	t1																		77	138	195	180	264	162	178	143	97	15	0.4%	98%
SWO	ATS	CP	Senegal	LL	t2																		-1	a	-1	a	a	a	a	a	a	15		
SWO	ATS	CP	U.S.A.	LL	t1							172	417	170	185	144	43	200	21	16						0			0			16	0.4%	98%
SWO	ATS	CP	U.S.A.	LL	t2	a	a	a		a		a	a	ab	abc	abc	abc	abc	abc	abc						bc			abc		abc	16		
SWO	ATS	CP	Côte d'Ivoire	GN	t1	8	18	13	14	20	19	26	18	25	26	20	19	19	43	29	31	39	17	159	167	42	145	66	109	55	42	17	0.3%	99%
SWO	ATS	CP	Côte d'Ivoire	GN	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	-1	a	-1	-1	-1	a	a	a	ab	a	17		

Table 11. Number of swordfish (*Xiphias gladius*) conventional tagging events (released, recovered, years at liberty) available in ICCAT-DB.

Year	Released (total)	Recaptured (total)	Years at liberty < 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10+	15+	Unkn	Recapture ratio (%)
1940	2	0										
1961	2	0										
1962	1	0										
1963	2	0										
1964	56	2		2								3.6%
1965	48	1				1						2.1%
1966	33	1				1						3.0%
1967	24	1								1		4.2%
1968	20	8	1	2	2	1		1	1			40.0%
1969	28	2		1				1				7.1%
1970	80	11	6		1		1	3				13.8%
1971	12	0										
1972	7	0										
1973	1	0										
1974	30	2		1		1						6.7%
1975	23	2			1			1				8.7%
1976	10	0										
1977	53	2		1	1							3.8%
1978	165	13	1	3	3	2	4					7.9%
1979	113	5	2	1			1	1				4.4%
1980	464	26	4	6	7	1		7	1			5.6%
1981	240	27	8	10	5	2		2				11.3%
1982	162	4	2	2								2.5%
1983	156	6	2	2	1			1				3.8%
1984	163	5		2				3				3.1%
1985	194	10	2	2	1	1	3	1				5.2%
1986	387	17	3	3	5	2		4				4.4%
1987	393	18	5	6	4	1		2				4.6%
1988	460	15	5	4	1		2	3				3.3%
1989	214	3		1			1	1				1.4%
1990	520	11	3	2	2	4						2.1%
1991	1551	53	12	8	14	12	2	3	2			3.4%
1992	1641	56	12	24	11	3	3	3				3.4%
1993	1481	61	21	11	7	7	4	8	3			4.1%
1994	1866	53	15	7	10	5	6	9			1	2.8%
1995	1137	37	9	5	9	3	8	2			1	3.3%
1996	655	25	10	3	7	2	2	1				3.8%
1997	741	28	11	6	1	3	3	3	1			3.8%
1998	376	21	6	4	5	1	2	2			1	5.6%
1999	250	8	1	2	1	1	1	2				3.2%
2000	181	12	5	5	1			1				6.6%
2001	157	2		1							1	1.3%
2002	271	11	4	3							4	4.1%
2003	244	9	3	1	2		1				2	3.7%
2004	265	19	5	2	3	1		2			6	7.2%
2005	333	11	2	3	1	1					4	3.3%
2006	759	18	3	3	1			1			10	2.4%
2007	340	12	4	2	4						2	3.5%
2008	90	6	2	1		1					2	6.7%
2009	36	2		1	1							5.6%
2010	11	1			1							9.1%
2011	35	3	1	2								8.6%
2012	55	1			1							1.8%
2013	64	0										
2014	16	0										
2015	6	0										
TOTAL	16624	641	170	145	114	57	44	68	8	1	34	3.9%

Table 12. Criteria and substitution rules used in the overall CAS estimations of SWO-N (North Atlantic stock).

General rules for CAS estimations of SWO-N ("short" pseudo code):

```
FOR a given year/fleet/gear/catch-type in T1NC (>= 0.5 t)
FIND IF T2SZ/T2CS is available (having minimum quality*)
IF (YES) THEN
-- no substitutions
  USE it WITH priorities:
    (1)T2CS: re-raise IF (T2CS/T1-1)*100 <> ±2% OTHERWISE (OK)
    (2)T2SZ: raise it using weight factor T1/T2CS) ALWAYS
ELSE (NO)
-- USE substitutions (table below as a reference)
FIND/USE with priorities:
 (1) Closest early year (max 2 yrs old) OF same fleet/gear/catch-type combination OR
 (2) Same year OF a similar fishery (fleet/gear combination) in the same region OR
 (3) Closest early year (max 1 yr old) OF a similar fishery (fleet/gear combination) in the same area OR
 (4) Closest early year (max 1 yr old) OF a similar gear (longline/surface) in the same area OR
 (5) Choose "manually" the best option (usually <= 10% of the cases)
     [Out of scope of the possibilities in the substitution table below]

* Minimum time/area/size-bins/total-fish detail adopted: quarter, sampling area, 5 cm, 20
```

SWO-N		use T2SZ/T2CS as substitute of:									
for T1NC without T2S/CS		HL	HP	LL							
Gear	Flag	U.S.A.	U.S.A.	Belize	Canada	Chinese Taip.	EU.España	EU.Portugal	Japan	Maroc	U.S.A.
GN	Senegal									■	
	Venezuela						■	■			
HL	Barbados	■									
LL	Barbados					■					
	Belize					■	■				
	Côte D'Ivoire						■	■			
	EU.France						■	■			
	EU.United Kingdom						■				
	FR.St Pierre et Miquelon				■						■
	Grenada					■					
	Korea Rep.					■					
	Mexico										■
	Philippines					■					
	St. Vincent and Grenadines					■					
	Trinidad and Tobago					■					
	UK.Bermuda					■					
	UK.British Virgin Islands										■
	Vanuatu					■					
	Venezuela						■	■			
PS	EU.France						■				
TP	EU.España						■				
TR	Sta. Lucia					■					
TW	EU.France						■				
	EU.Ireland						■				
	EU.Netherlands						■				

Table 13. Criteria and substitution rules used in the overall CAS estimations of SWO-S (South Atlantic stock).

General rules for CAS estimations of SWO-S ("short" pseudo code):

```
FOR a given year/fleet/gear/catch-type in T1NC (>= 0.5 t)
FIND IF T2SZ/T2CS is available (having minimum quality*)
IF (YES) THEN
-- no substitutions
  USE it WITH priorities:
    (1)T2CS: re-raise IF (T2CS/T1-1)*100 <> ±2% OTHERWISE (OK)
    (2)T2SZ: raise it using weight factor T1/T2CS) ALWAYS
ELSE (NO)
-- USE substitutions (table below as a reference)
FIND/USE with priorities:
 (1) Closest early year (max 2 yrs old) OF same fleet/gear/catch-type combination OR
 (2) Same year OF a similar fishery (fleet/gear combination) in the same region OR
 (3) Closest early year (max 1 yr old) OF a similar fishery (fleet/gear combination) in the same area OR
 (4) Closest early year (max 1 yr old) OF a similar gear (longline/surface) in the same area OR
 (5) Choose "manually" the best option (usually <= 10% of the cases)
     [Out of scope of the possibilities in the substitution table below]

* Minimum time/area/size-bins/total-fish detail adopted: quarter, sampling area, 5 cm, 20
```

SWO-S		use T2SZ/T2CS as substitute of							
for T1NC without T2S/CS		GN	LL						
Gear	Flag	Ghana	Brasil	Chinese Taip.	EU.España	Japan	Namibia	South Africa	Uruguay
GN	Brasil								■
	Côte D'Ivoire	■							
	Ghana	■							
HL	Brasil								■
	S. Tomé e Príncipe	■					■		
LL	Belize				■				
	Brasil								■
	Côte D'Ivoire			■	■		■		
	EU.Portugal				■				
	EU.United Kingdom						■		
	Japan					■			
	Korea Rep.			■		■			
	Philippines			■		■			
	Senegal						■		
	South Africa						■		
	St. Vincent and Grenadines			■					
	Uruguay		■						
	Vanuatu			■					
TR	S. Tomé e Príncipe						■		
TW	Argentina								■

Table 14. Available abundance indices for North Atlantic in 2017.

series	Canada LL old		Canada LL smooth		Canda LL factor		EU-Portugal		EU-Spain		JPN LL historic		JPN LL 2		JPN LL 3		USA LL		USA Larval		Maroc LL	
Use in 2017 stock assessment	no		no		contingent		yes		contingent		yes		yes		yes		yes		no		Yes	
age																						
units of index	count		count		count		weight				weight		weight		weight		count		count		weight	
area	NW ATL		NW ATL		NW ATL		NE Atl				Northwest Atlantic		Northwest Atlantic		Northwest Atlantic		Northwest Atlantic		Gulf of Mexico		SE Atl off Maroc	
method	GLMM		GAM-NB		GAM-NB		GLMM lognormal				GLM – lognormal		GLM – lognormal		GLM – lognormal		GLM-NB		GLM-ZIB		GLM-lognormal	
time of the year	Mar to Dec		Mar to Dec		Mar to Dec		All months				All quarters		All quarters		All quarters		All months		April-May		All months	
source	SCRS/2013/059		SCRS/2017/064		SCRS/2017/064		SCRS/2017/053				SCRS/2017/075		SCRS/2017/075		SCRS/2017/075		SCRS/2017/070		SCRS/2017/074		SCRS/2017/063	
Year	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**
1959																						
1960																						
1961																						
1962			112.83	0.075	69.456	0.179																
1963	2.0218	12.721	85.863	0.065	137.93	0.079																
1964	0.9471	9.2871	66.555	0.058	60.035	0.066																
1965	0.7095	8.6203	53.705	0.054	40.808	0.066																
1966	0.7234	8.2421	45.959	0.052	42.042	0.062																
1967	0.8536	8.3164	42.087	0.053	59.648	0.062																
1968	0.6161	8.7741	41.11	0.054	39.972	0.061																
1969	0.5881	8.5733	42.264	0.055	38.873	0.062																
1970	0.7205	8.3425	44.895	0.058	48.981	0.067																
1971			48.503	0.06																		
1972			52.852	0.064																		
1973			57.71	0.067																		
1974			62.734	0.07							27.53	0.086										
1975			67.451	0.073							18.757	0.055										
1976			71.266	0.075							20.588	0.072										
1977			73.511	0.075							5.1727	0.077										
1978			73.548	0.073							5.1105	0.063										
1979	0.8511	13.404	70.91	0.07	75.355	0.101					6.2764	0.054										
1980	0.8339	10.619	65.686	0.065	65.405	0.08					7.043	0.042										
1981	0.7218	12.957	59.241	0.061	62.764	0.104					9.9073	0.067										
1982	0.622	14.85	53.329	0.059	52.371	0.107					8.489	0.069							0.15	0.28		
1983	0.4536	13.244	49.193	0.06	43.97	0.114					11.32	0.074							0.04	0.52		
1984	0.36	12.82	47.371	0.062	45.117	0.107					11.409	0.066							0.04	0.71		
1985	0.5544	14.462	47.856	0.063	50.394	0.107					11.92	0.059										
1986	0.6779	15.515	50.207	0.063	72.761	0.111			300.78	0.028	7.2491	0.062							0.03	0.72		
1987	0.3954	14.698	53.513	0.062	53.962	0.105			302.8	0.028	9.1233	0.065							0.00			
1988	0.4603	13.749	56.399	0.061	53.789	0.104			257.4	0.029	10.197	0.060							0.00			
1989	0.4033	12.657	57.393	0.059	45.811	0.096			260.43	0.029	8.5092	0.059							0.08	0.36		
1990	0.7028	13.361	55.642	0.057	67.334	0.095			260.62	0.029	5.2557	0.061							0.04	0.43		
1991	0.3989	11.146	51.455	0.053	46.838	0.071			265.13	0.029	3.8598	0.069							0.11	0.30		
1992	0.4376	10.96	46.105	0.049	55.5	0.07			260.59	0.029	3.9965	0.076					0.99	0.09	0.03	0.51		
1993	0.4446	9.6796	41.08	0.046	45.571	0.059			230.72	0.029	4.3247	0.087					0.94	0.08	0.02	0.52		
1994	0.3609	9.1662	37.461	0.044	34.908	0.048			221.32	0.029	1.9829	0.162					0.97	0.08	0.04	0.40		
1995	0.3473	9.5532	35.8	0.043	40.872	0.049			244.57	0.029	1.2971	0.149					0.96	0.08	0.05	0.34		
1996	0.234	10.191	36.291	0.043	25.748	0.052			206.45	0.030	1.6313	0.121					0.80	0.09	0.05	0.40		
1997	0.4146	9.3266	38.914	0.044	38.344	0.053			204.03	0.030	2.7716	0.102					0.95	0.09	0.08	0.33		
1998	0.5658	9.8046	43.413	0.044	49.602	0.056			219.82	0.029	2.7845	0.081					1.38	0.09	0.05	0.40		
1999	0.7295	9.3695	49.124	0.045	61.627	0.057	217.6	0.13	245.91	0.029							1.29	0.09	0.10	0.26		
2000	0.4257	9.5099	54.881	0.046	45.656	0.06	308.5	0.16	309.08	0.028							0.99	0.09	0.08	0.30		
2001	0.5255	9.8325	59.271	0.046	50.651	0.056	323.3	0.16	269.71	0.029							0.88	0.09	0.08	0.34		
2002	0.5426	10.593	61.288	0.046	74.163	0.062	281.9	0.14	231.85	0.029							1.08	0.09	0.02	0.60		
2003	0.8892	10.832	60.908	0.046	60.762	0.059	328.9	0.14	265.35	0.028							0.94	0.08	0.06	0.39		
2004	0.8833	9.6144	59.067	0.046	52.003	0.057	395.9	0.14	241.23	0.029							0.81	0.08	0.04	0.52		
2005	0.9354	9.4047	57.094	0.047	64.585	0.056	305.2	0.12	237.95	0.029							1.16	0.08	0.05	0.35	558.30	0.06
2006	0.9722	9.991	56.125	0.047	55.261	0.056	301.2	0.12	221.21	0.030			4.74	0.31			1.08	0.08	0.06	0.33	277.40	0.05
2007	1.0194	10.313	56.811	0.048	54.933	0.06	329.4	0.12	254.16	0.029			5.823	0.376323			1.347	0.081	0.0828	0.3321	227.1	0.07
2008	1.3572	10.589	59.251	0.048	65.866	0.063	305.1	0.12	293.32	0.028			9.318	0.295566			1.249	0.08	0.06061	0.34339	294.3	0.06
2009	1.1842	10.616	62.936	0.048	60.141	0.063	365.6	0.12	269.45	0.029			18.956	0.274965			1.035	0.079	0.01017	1.01938	294.7	0.06
2010	1.4031	11.577	66.703	0.049	83.001	0.062	416.4	0.12	262.05	0.029			18.937	0.259022			0.736	0.08	0.02037	1.00408	450.5	0.05
2011	1.1327	10.59	68.923	0.05	62.361	0.061	357.0	0.11	269.61	0.029					26.051	0.273855	1.011	0.081	0.02703	0.59757	314.4	0.05
2012	1.155	10.79	68.131	0.05	67.267	0.061	487.2	0.12							21.305	0.313714	1.025	0.08	0.091	0.40138	331.4	0.05
2013			63.861	0.049	62.732	0.061	457.2	0.13							7.574	0.382619	0.92	0.079	0.04512	0.46813	362.9	0.05
2014			56.961	0.048	53.044	0.059	426.2	0.11							11.709	0.319003	0.719	0.08	0.04562	0.59587	273.4	0.05
2015			49.038	0.05	55.083	0.059	583.3	0.12							20.417	0.305843	0.733	0.08	0.04217	0.39044	304.9	0.05
2016			41.519	0.054	41.803	0.058	551.6	0.14													357.7	0.06

Table 15. Criteria table for available abundance indices in North Atlantic SWO for the 2017 stock assessment.

Use in 2017 stock assessment	**contingent on changes to model**	**Yes**	**contingent on changes to model**	**Yes**	**No as index but will be compared to assessment results for use as a stock status indicator.**	**Yes**
SCRS Doc N	**SCRS/2017/064**	**SCRS/2017/053**	**SCRS/2017/063**	**SCRS/2017/075**	**SCRS/2107/074**	**SCRS/2017/070**
Index Name	**CAN LL**	**EU.Portugal - North**	**Maroc LL**	**JPN LL**	**USGOM-Larval**	**USA_LL_Observer**
Diagnostics	Residual diagnostic checks. Analysis of Deviance check of nested models, Check for overdispersion, Outlier detection and collinearity check	Provided in the paper: Variable selection with likelihood ratio tests; GOF with AIC and pseudo R2; model validation with residual analysis	Some trend in the residuals and evidence of heteroscedasticity. Residual by year should be provided.	Provided in the paper.	Provided in paper; residual analysis indicated positive skew in resdiual distribution.	good. Distribution goodness-of-fit, Model selection criteria, 95% Confidence Interval
Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	Excluded sets with incomplete information or which were outliers. Remove months with occaisional fishing over time series	Excluded data from earlier years (1995-1998) due to low coverage. For the other years 1999-2016 all data was used (SWO-targeting fishery).	All Data was used	unknown	NA-Fishery_independent data	good. Scientific observer based, species is a primary target, target variables in the dataset and used in the model. Closed areas removed in time and space back in time
Geographical Coverage (East or west Atlantic? Or Med)	NW	E	SE in Moroccan waters	NW	GOM	W
Catch Fraction to the total catch weight (North)	15% of total	EU.PRT catches 8.5% SWO in the North Atl stock. Sample used in the study covers 41% of PRT catch or 3.5% of total	3.3% on average of total	6.4% of total	NA-Fishery_independent data	23% of total
Length of Time Series relative to the history of exploitation.	1962 to 2016	Exploitation in the North Atl started in 1990's; Time series starst in 1999	from 2005 to 2016	time series 2006-2015 and 1975 to 1998	1982-2015	1992-2016
Are other indices available for the same time period?	the only index prior to 1971	yes	yes	yes	yes	yes
Does the index standardization account for Known factors that influence catchability/selectivity?	model includes bait and species composition of catch	Targeting ratios are used and may be problematic. Models with and without this are run as a sensitivity	the index accounts the factor gear wich influences selectivity	Partially	Fishery_independent data	Index was standardized by target species (based on gear and captain reports), year, area, month, sea surface temperature, day/night of set and gear characteristics (bait, and hook type). Effect of fleet change in hook was estimated by the hook type effect
Is interannual CV high, and is there potential evidence of unaccounted process error (trends in deviations from production model dynamics, high peaks, multiple stanzas, increasing or decreasing catchability)	medium	medium	medium	medium	Interannual CVs are high, due to the low sample sizes and the low proportion positive occurrence	medium
Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	GAM or GAMM with area, year, month, targeting vars and number of hooks as fixed effects and vesssel as re. Best fit using NB dist. Based on logbook data.	Model used is a GLMM with simple effects + interactions (year intractions are used as randon effects); Distribution used is a lognormal (with constant) which seems reasonable for the low % of zeros (1.9%). Based on observer, self sampling and port sampling data.	Model used is a GLM ; Distribution used is a lognormal. No factors are available to capture changes in catchability but this is assumed to have remained constant. Based on landing market data.	GLM with year, quarter and hooks per basket. Based on aggregated logbook data.	A main concerns was how the area sampled in the Gulf of Mexico relates to the main spawning area of the northern stock of SWO. Another concern was the low proportion positive catch and number of larvae in the survey.	Set by set spatial information, gear configuration. Based on scientific observer data.
Is this CPUE time series continuous?	No. There was no data available during the mercury ban.	Yes	Yes	No. There is a gap between 1999 to 2006	year 1985 is missing	Yes
Other Comment						

Table 16. Available abundance indices for South Atlantic in 2017.

series	**BRA-LL1**		**BRA-LL2**		**JPN-LL**		**URU-LL**	
Use in 2017 stock assessment	Yes		Yes		Tentativelly yes. However, considerations must be given to alternative models to deal with the high % of zeros		Yes	
age								
units of index	**count**		**count**		**count**		**count**	
area	**west of South Atlantic**		**west of South Atlantic**		**vest and east of South Atlanti**		**southwest of South Atlantic**	
method	**GLM – NB**		**GLM – NB**		**GLM-Lognormal**		**GLM-delta-lognormal**	
time of the year	**all months**		**all months**		**all months**		**all months**	
source	**SCRS/2017/068**		**SCRS/2017/068**		**SCRS/2017/075**		**SCRS/2017/078**	
Year	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**	**Std. CPUE**	**CV**
1978	2.9494	0.2254						
1979	2.4268	0.2224						
1980	4.0450	0.2231						
1981	5.7217	0.2294						
1982	6.2309	0.2402						
1983	3.6204	0.2268						
1984	2.3361	0.1625						
1985	2.9703	0.2216						
1986	3.7012	0.2183						
1987	6.4285	0.3042						
1988	3.1920	0.1912						
1989	1.9056	0.2042						
1990	4.1683	0.2660			2.6770	0.0135		
1991	3.8570	0.2274			1.6100	0.0155		
1992	3.8068	0.2751			1.3280	0.0173		
1993	1.6782	0.3006			1.2990	0.0169		
1994	3.1031	0.2626			1.4840	0.0151		
1995	5.2806	0.3696			1.0740	0.0162		
1996	6.3446	0.2609			1.0900	0.0169		
1997	4.1544	0.2040			0.9610	0.0202		
1998	2.6688	0.1886			0.9420	0.0217		
1999	3.5965	0.1895			0.8010	0.0223		
2000	4.9840	0.1915			0.5760	0.0239		
2001	2.1907	0.2023			0.4760	0.0289	6.4700	
2002	4.0703	0.2090			0.6010	0.0306	4.1300	0.7600
2003	7.2621	0.2877			0.5150	0.0238	6.1700	0.4300
2004	6.9652	0.2492			0.5510	0.0231	5.2200	0.4200
2005			0.8605	0.0954	0.4440	0.0333	5.2100	0.4300
2006			1.2962	0.1179	0.7830	0.0267	5.5000	0.3400
2007			1.9030	0.1442	1.0410	0.0353	4.9600	0.3900
2008			1.2108	0.1133	0.9290	0.0308	3.2300	0.4400
2009			1.2607	0.1054	1.0380	0.0290	3.5100	0.4100
2010			1.4001	0.1156	0.9550	0.0294	3.2900	0.4500
2011			1.1468	0.1248	0.7970	0.0288	2.0000	0.4300
2012			1.1365	0.1099	1.0380	0.0364	5.0800	0.4700
2013					0.9760	0.0288		
2014					1.0060	0.0482		
2015					1.0070	0.0365		

Table 17. Criteria table for available abundance indices in South Atlantic SWO for the 2017 stock assessment.

Paper	**SCRS/2017/068**	**SCRS/2017/075**	**SCRS/2017/078**
Index	BRA	JPN	URU
Diagnostics	Partial residuals with respect to explanatory variables need to be calculated	Some biases as indicated by partial residuals concering "year" explanatory factor	residual diagnostics indicate the model is not biased
Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	Nonsensical and non-sampling errors were discarded. However the identification of targets is still an issue	unknown	Sets with missing information were discarded. Also years with convergence problems with the model.
Geographical Coverage (East or west Atlantic? Or Med)	west	east and west	southwest
Catch Fraction to the total catch weight (East or West)	Overall the years 18% but the fractions were higher than 23% in recent years	Overall the years 20% but the fraction were lower than 15% in recent years	3.8% (1995-2013) of the total captures in South.
Length of Time Series relative to the history of exploitation.	(1978-2012)/(1956-2016)	series: 1990-2015	Fishery 1981 - 2012. Time series 2001 - 2012. 38%
Are other indices available for the same time period?	There are other indices for part of the period (Spain, Japan and Uruguay), but not exactly for the same area	yes	yes
Does the index standardization account for Known factors that influence catchability/selectivity ?	Partial. Other variables concernig characteristics of the longlines and enviroment are	Partially	Gear configuration and environmental factors were used.
Are there conflicts between the catch history and the CPUE response?	In some periods of the time series	In some periods of the time series	no
Is interannual CV high, and is there potential evidence of unaccounted process error (trends in deviations from production model dynamics, high peaks, multiple stanzas, increasing or decreasing catchability)	Time series was split: a) 1978-2004; b) 2005-2012. The interannual CVs were 0.39 0.23 respectively. Cvs of estimations by year were close to 0.2 (1978-2004) and 0.11 (2005-2012)	CV is 0.45	CV is 0.45 (0.34 - 0.76)
Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	Partially	Partially	Partially
Is this CPUE time series continuous?	Yes, but the WG has decided to split it into parts	Yes	Yes
Other Comment			

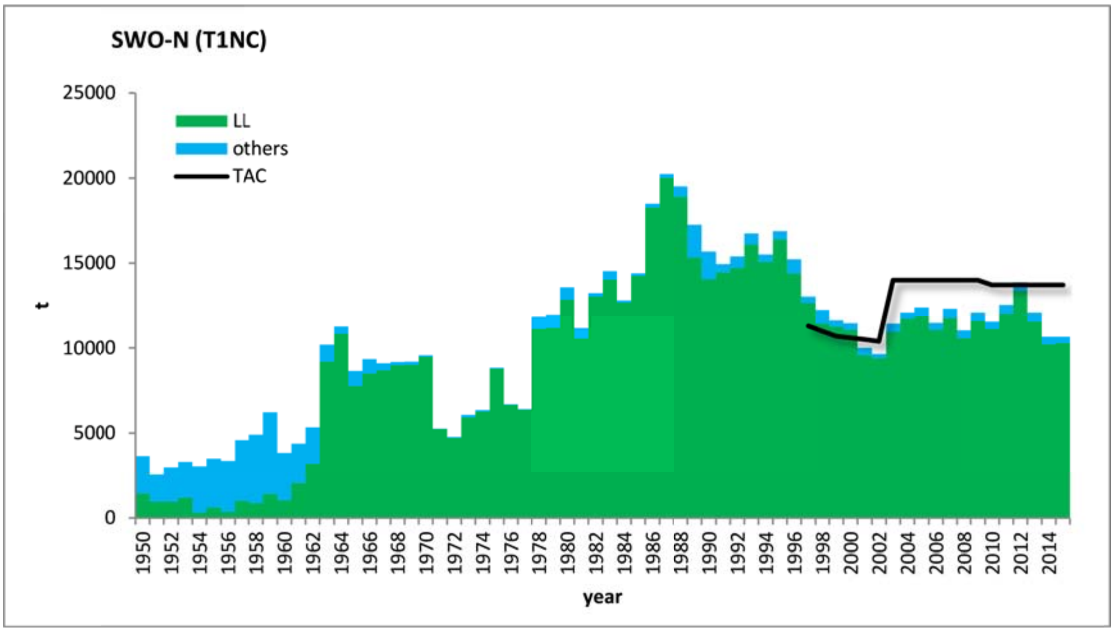


Figure 1. SWO-N Task I cumulative catches (t) by major gear and year (with yearly stock TACs).

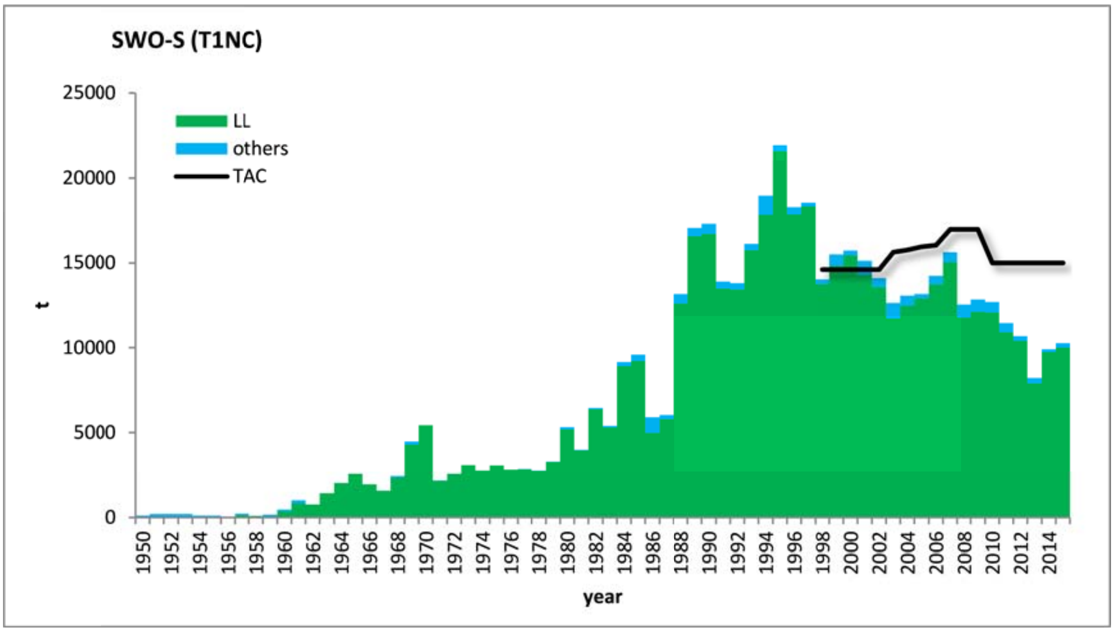
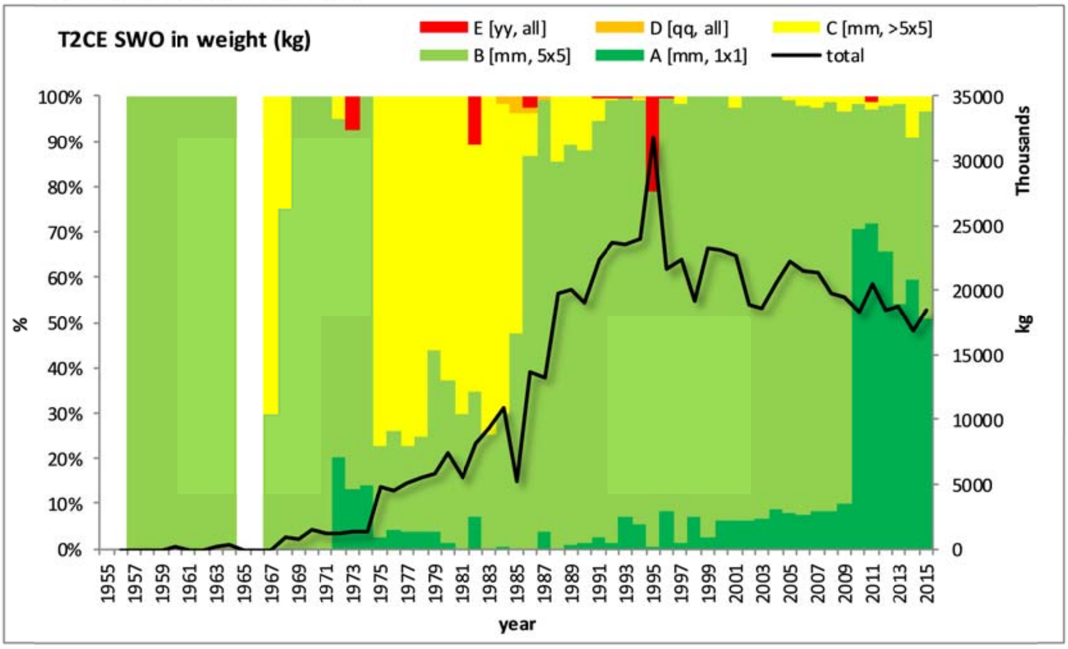


Figure 2. SWO-S Task I cumulative catches (t) by major gear and year (with yearly stock TACs).

a) T2CE with SWO in weight (kg)



b) T2CE with SWO in number

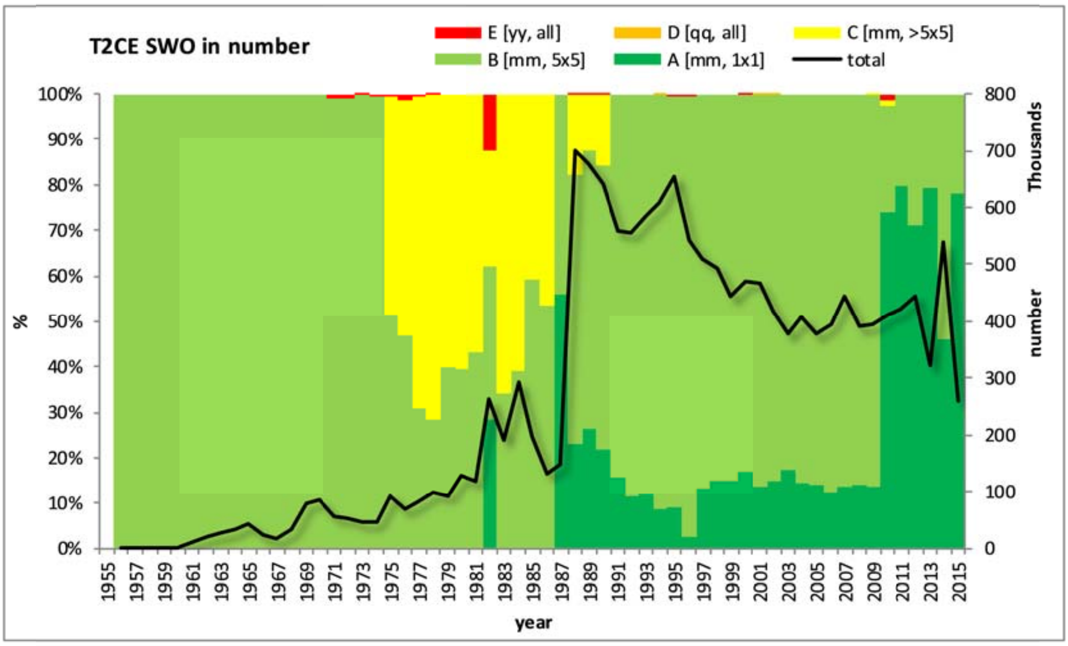
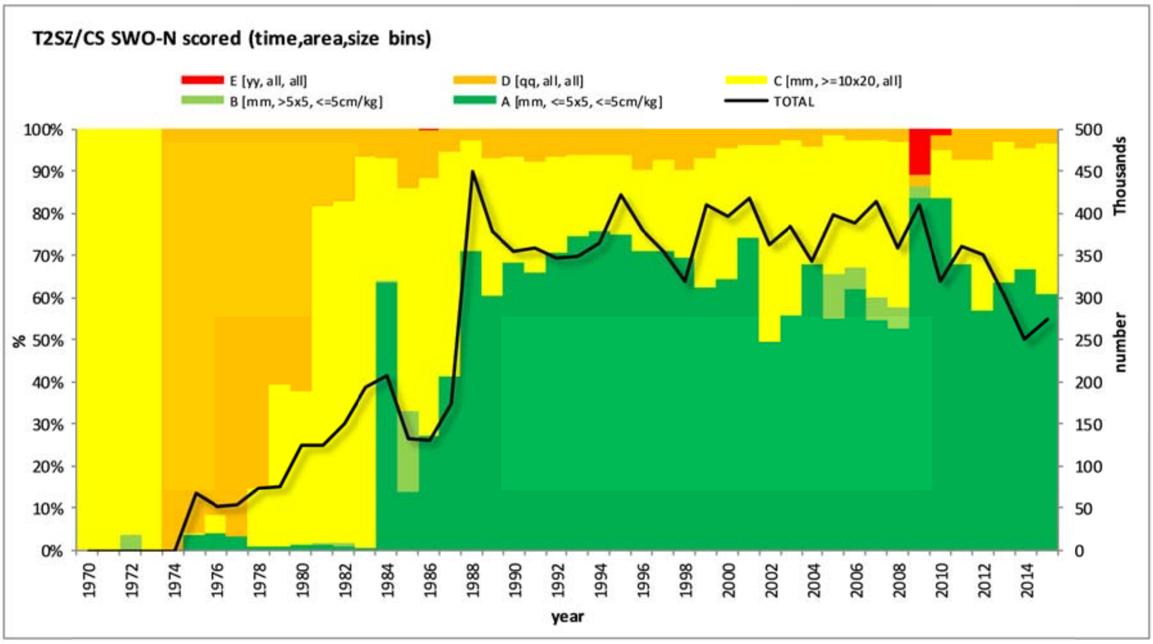


Figure 3. A basic scale (A best, …, E worst) using the time-area level of stratification of T2CE series associated with SWO (includes ATL and MEDI), showing the improvement tendency (the black line shows the absolute values – right scale) in T2CE over time. The upper figure (a) shows the cumulative ratios (%) of SWO using the series reported in weight (kg). The lower figure (b) shows the cumulative ratios (%) of SWO using the series reported in number.

a) SWO-N: T2SZ/CS scores (detail level: time-area-size bins) over time



b) SWO-S: T2SZ/CS scores (detail level: time-area-size bins) over time

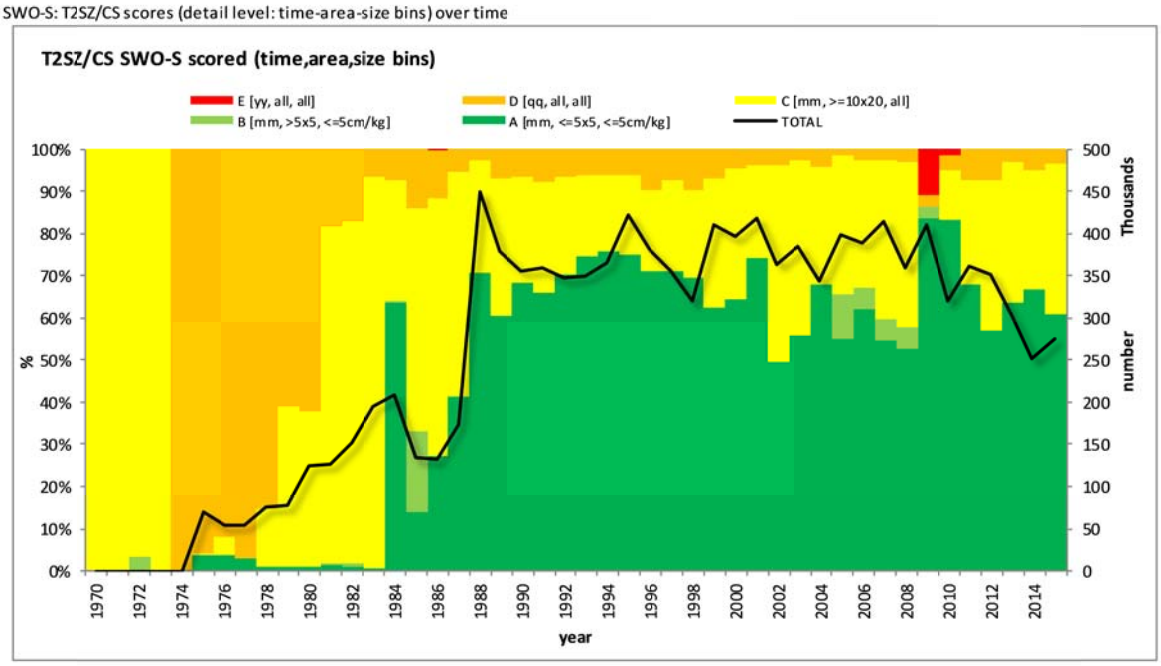


Figure 4. A basic scale (A best, …, E worst) using the T2SZ/T2CS stratification level (3 dimensions: time/area/size-bins) of all the series associated with SWO, showing the improvement tendency (the black line shows the absolute values in number – right scale) in T2SZ/CS over time. The upper figure (a) shows the cumulative ratios (%) of the number of fish available in SWO-N. The lower figure (b) shows the cumulative ratios (%) of the number of fish available in SWO-S.

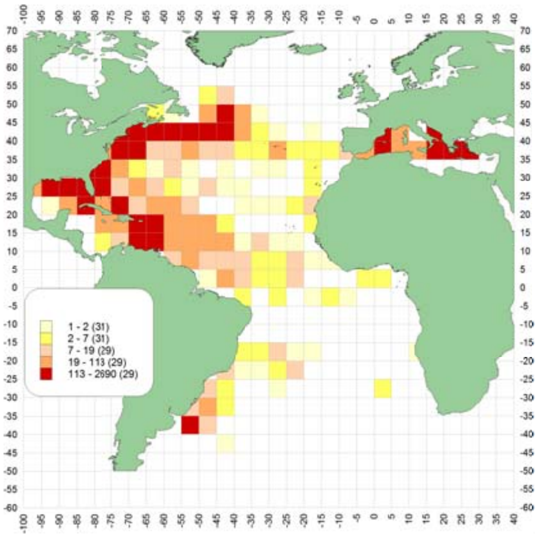


Figure 5. SWO release density plot.

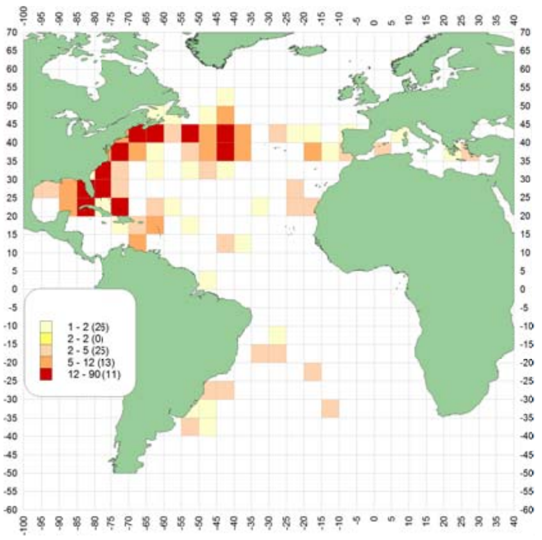


Figure 6. SWO recovery density plot.

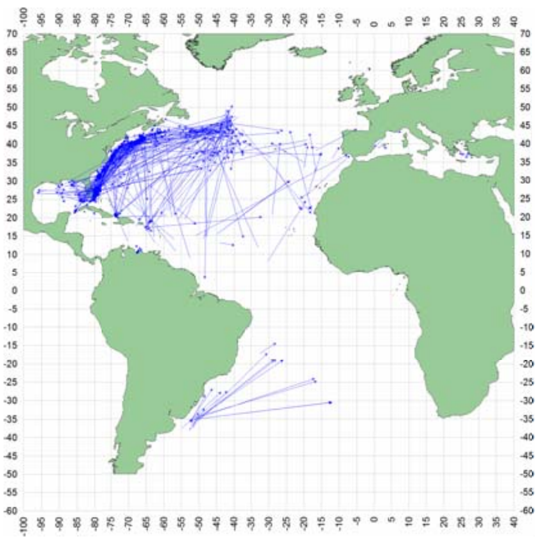


Figure 7. SWO apparent movement (tagging to recovery position).

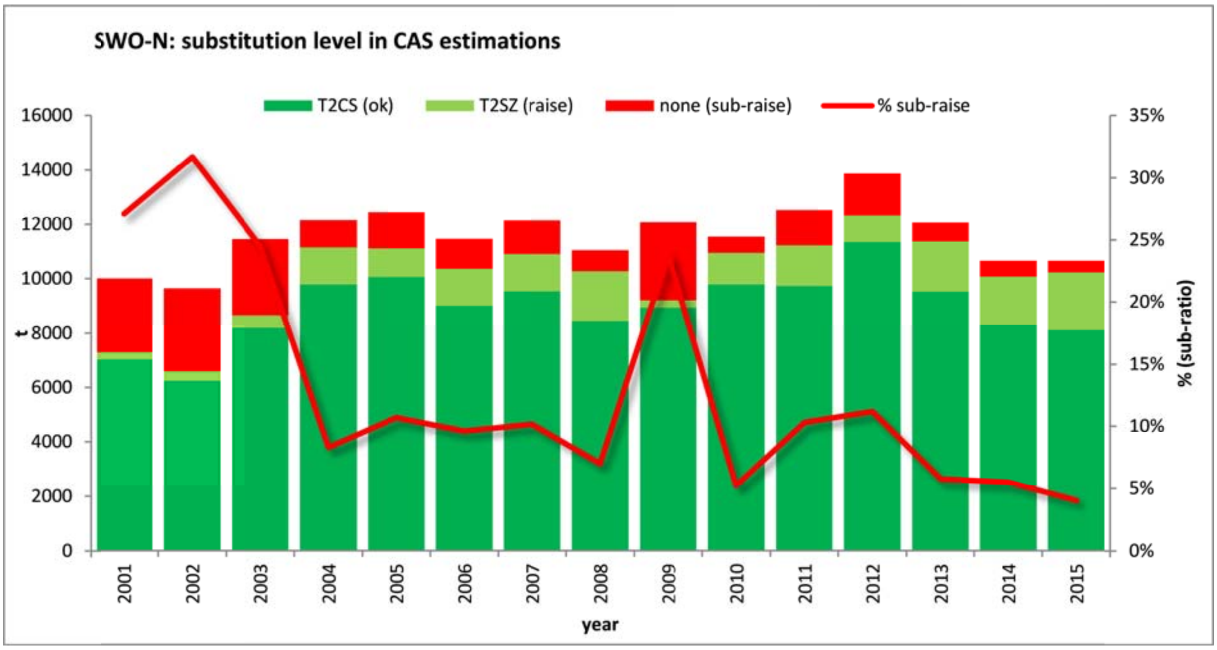


Figure 8. SWO-N: substitution levels used in the CAS estimations (2001 to 2015). Cumulative ratio (%) obtained from Task I (t) coverage by both types of chosen (for CAS/CAA estimations) size information (T2SZ: weight of observed size frequencies; CAS: weight of size frequencies extrapolated to total catches by CPC scientists) by year.

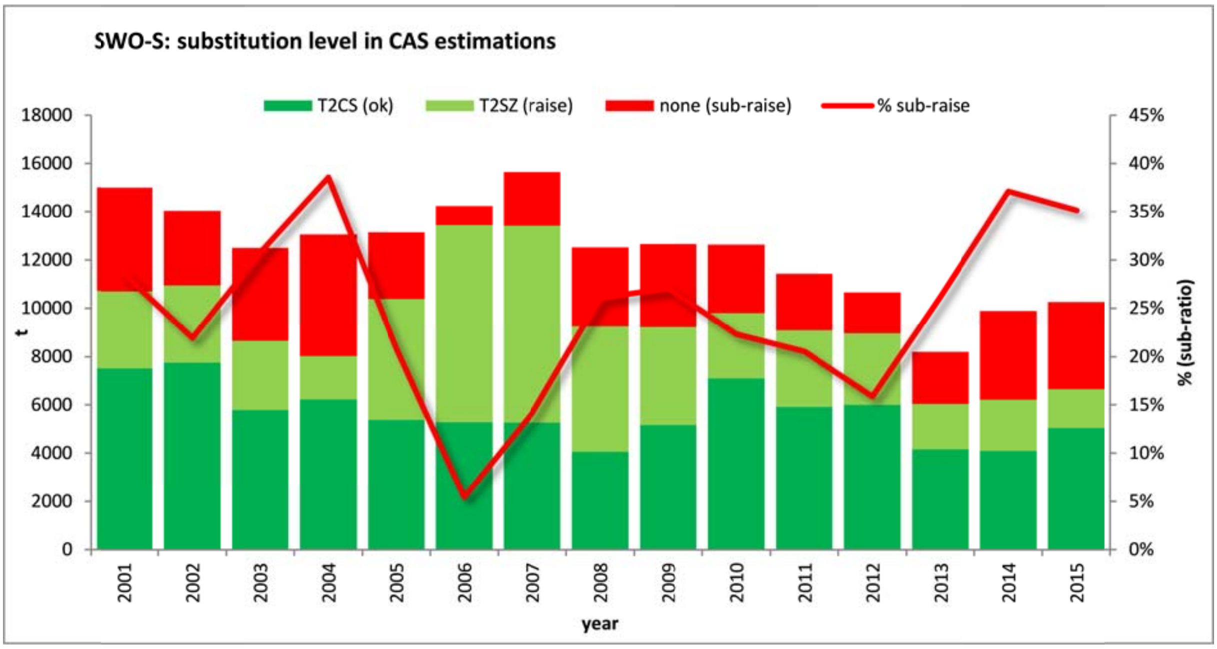


Figure 9. SWO-S: substitution levels used in the CAS estimations (2001 to 2015). Cumulative ratio (%) obtained from Task I (t) coverage by both types of chosen (for CAS/CAA estimations) size information (T2SZ: weight of observed size frequencies; CAS: weight of size frequencies extrapolated to total catches by CPC scientists) by year.

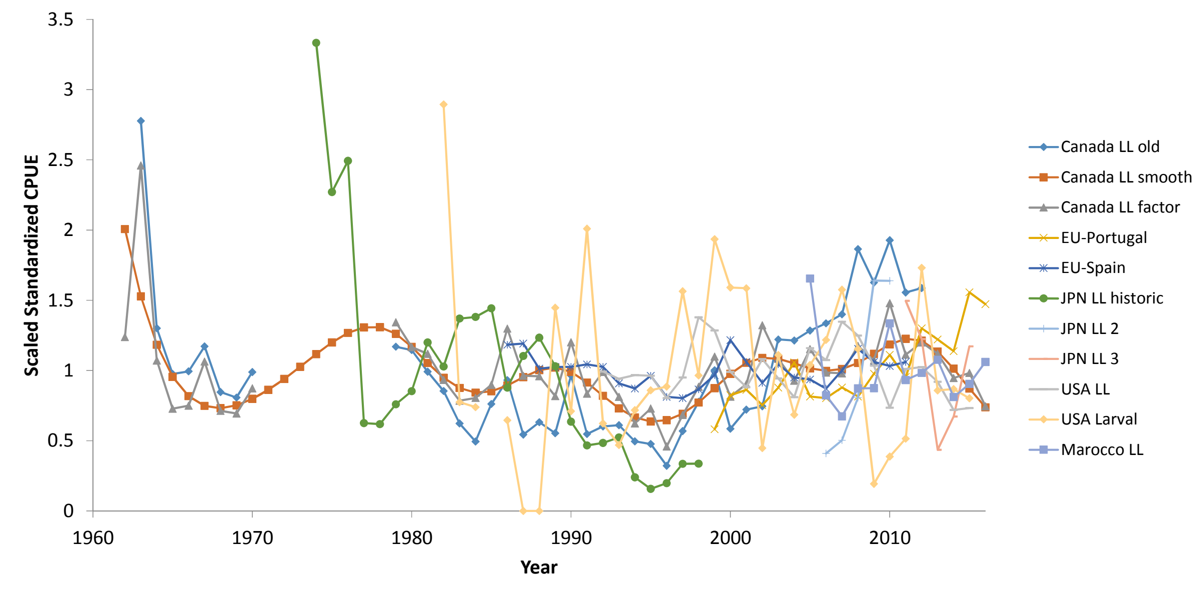


Figure 10. Standardized CPUE indices of abundance available for the North Atlantic swordfish.

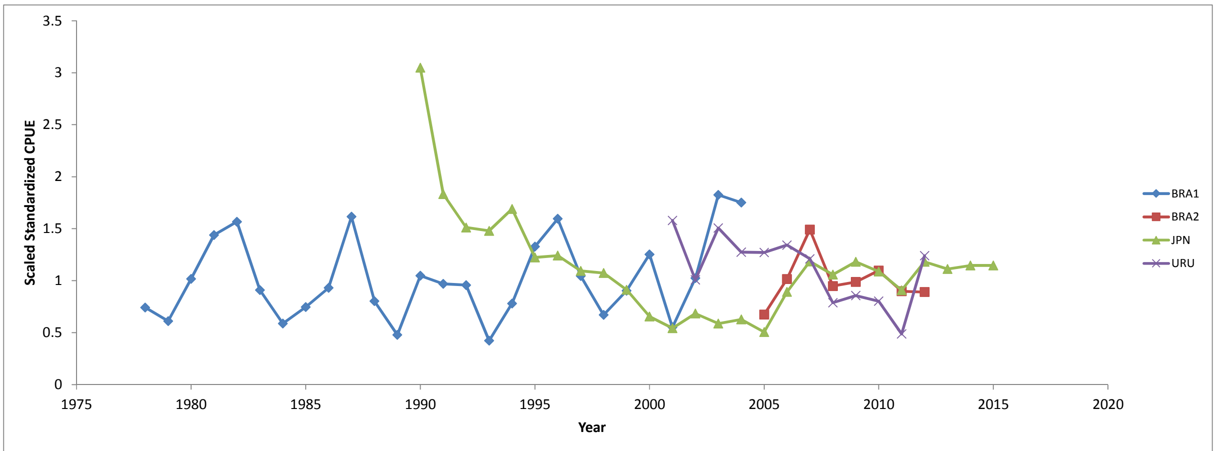


Figure 11. Standardized CPUE indices of abundance available for the South Atlantic swordfish.

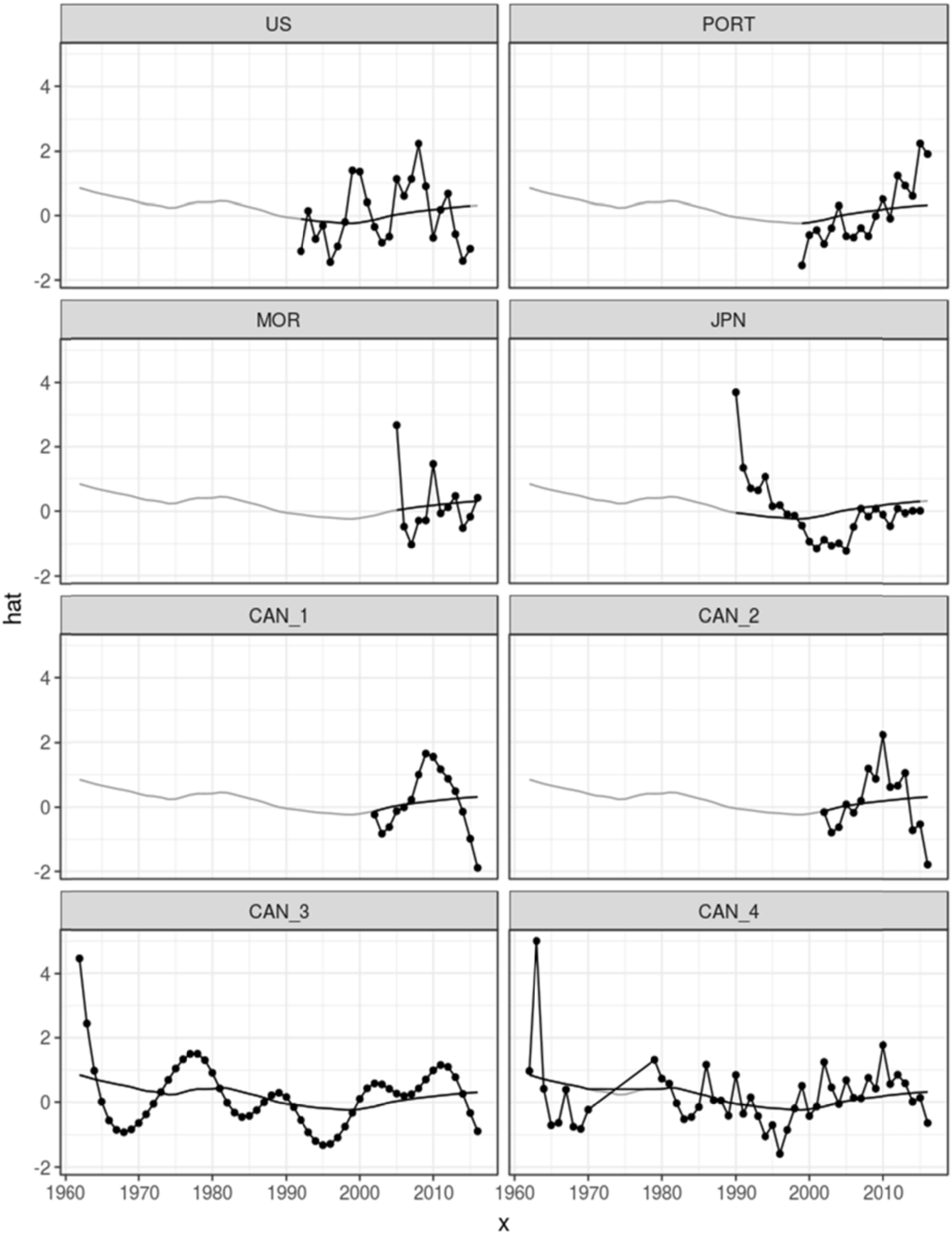


Figure 12. Time series of CPUE indices, Northern indices. Continuous black line is a lowess smother showing the average trend by area (i.e. fitted to year for each area with series as a factor).

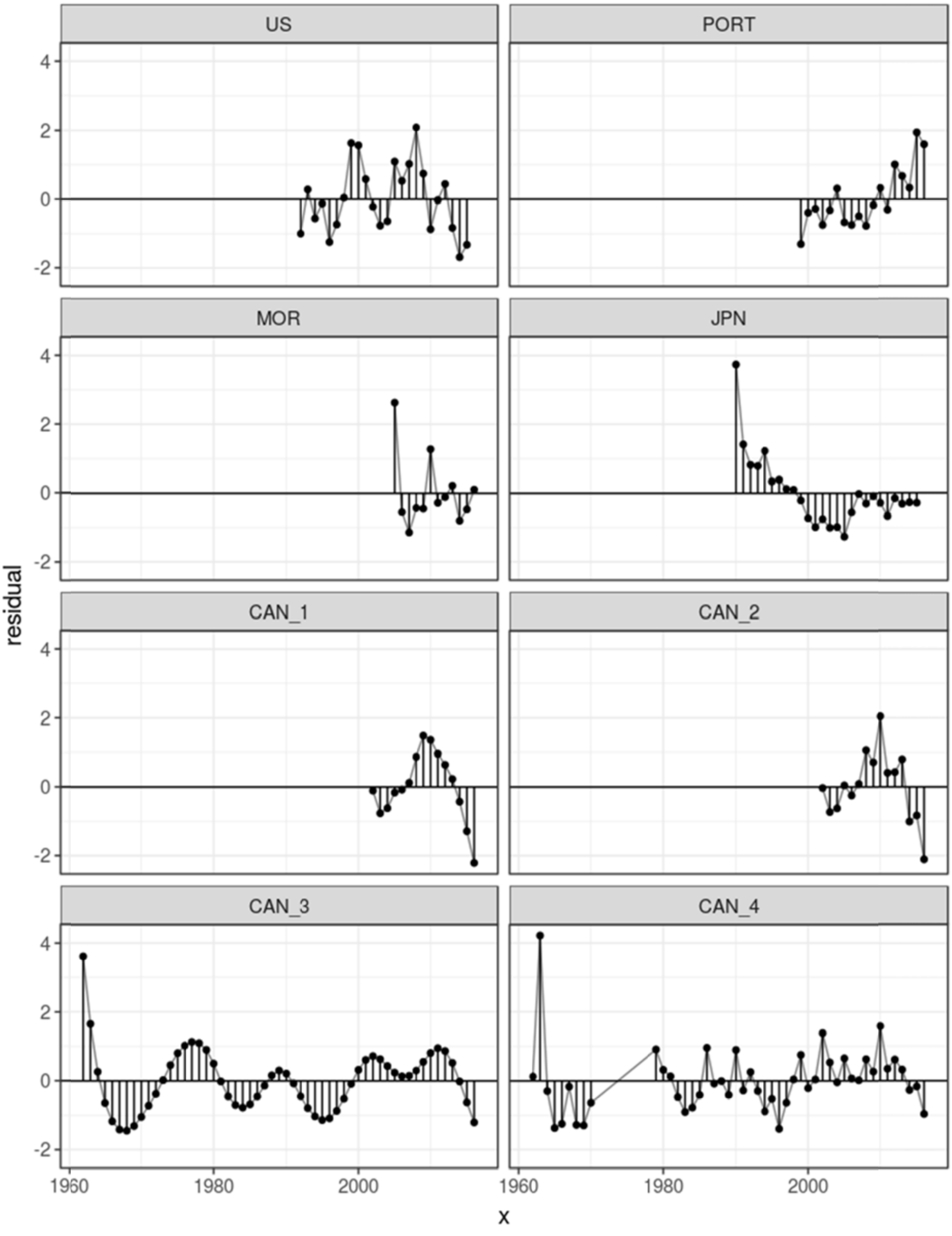


Figure 13. Time series of residuals from the lowess fit, Northern indices.

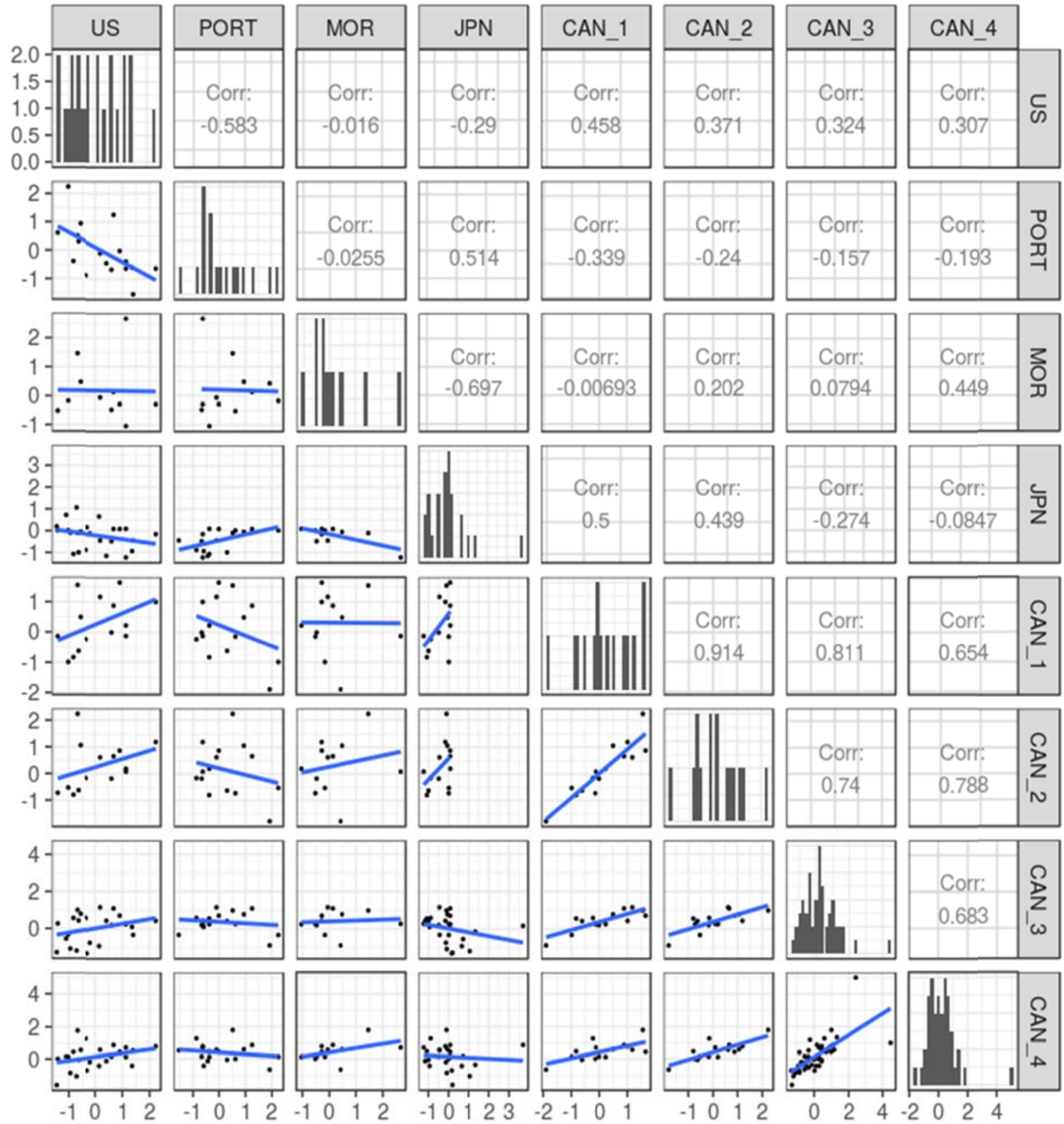


Figure 14. Pairwise scatter plots to look at correlations between Northern indices.

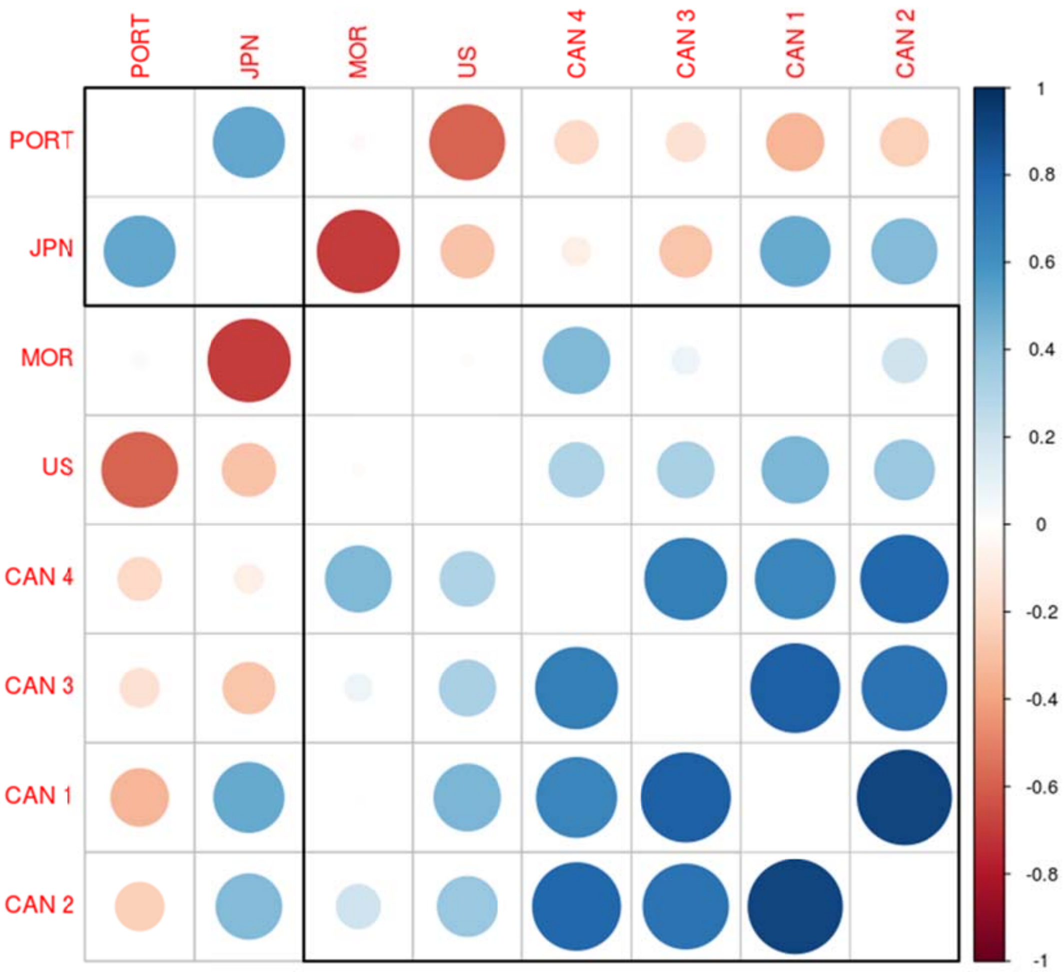


Figure 15. Plot of the correlation matrix for the Southern CPUE indices, blue indicate a positive correlation and red negative. The order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities for the indices being clustered.

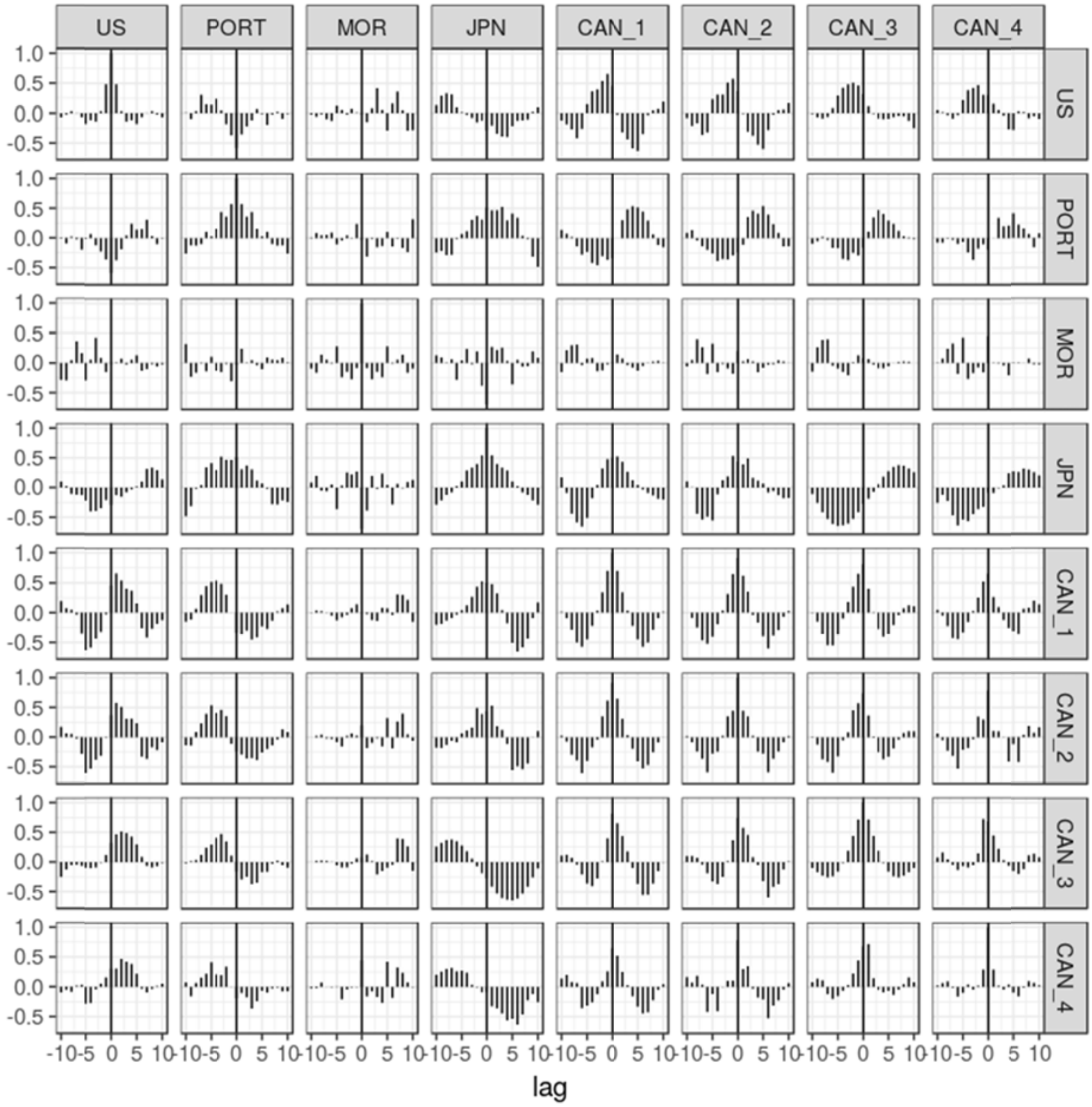


Figure 16. Cross correlations between Northern indices, to identify potential lags due to year-class effects.

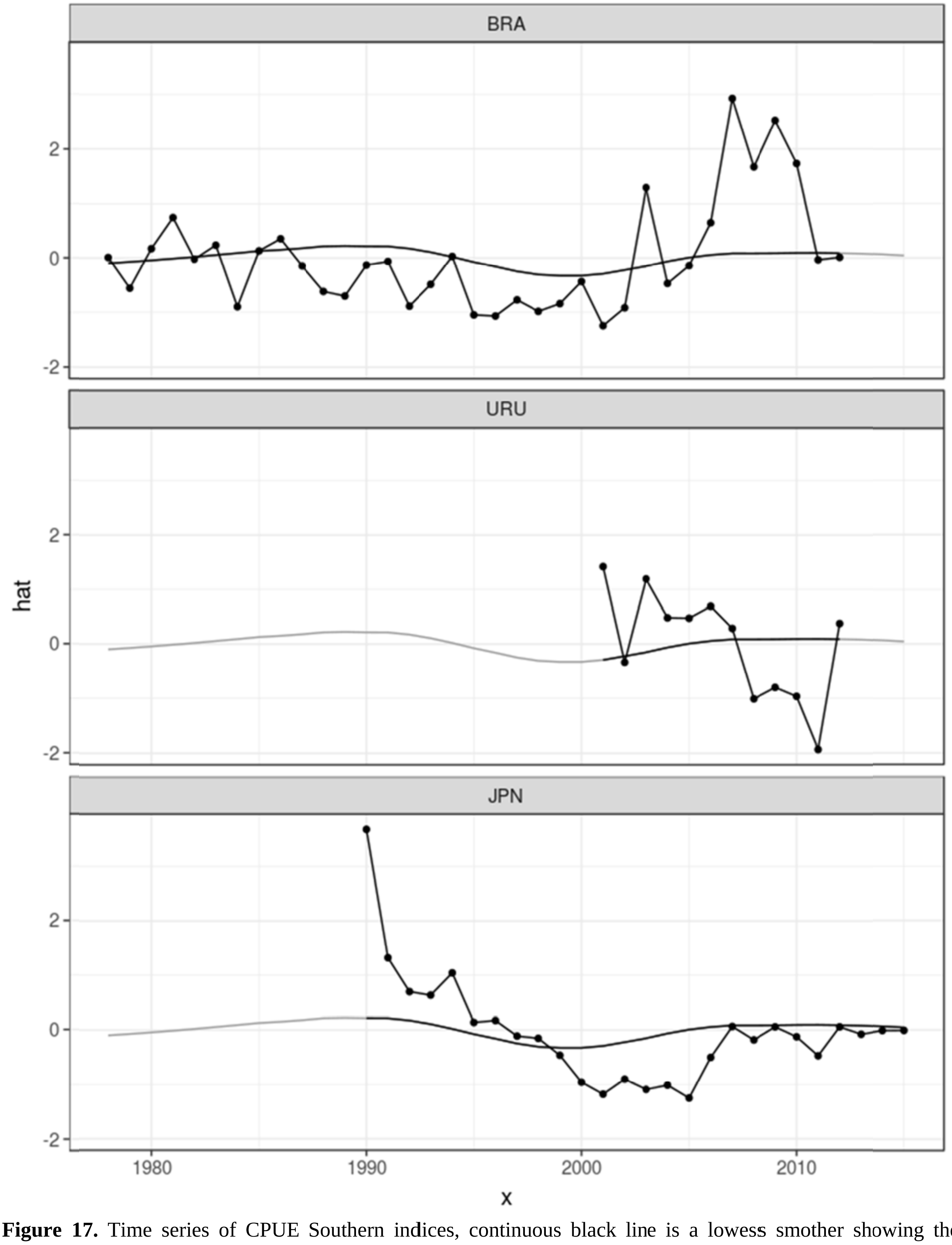


Figure 17. Time series of CPUE Southern indices, continuous black line is a lowess smother showing the average trend by area (i.e. fitted to year for each area with series as a factor).

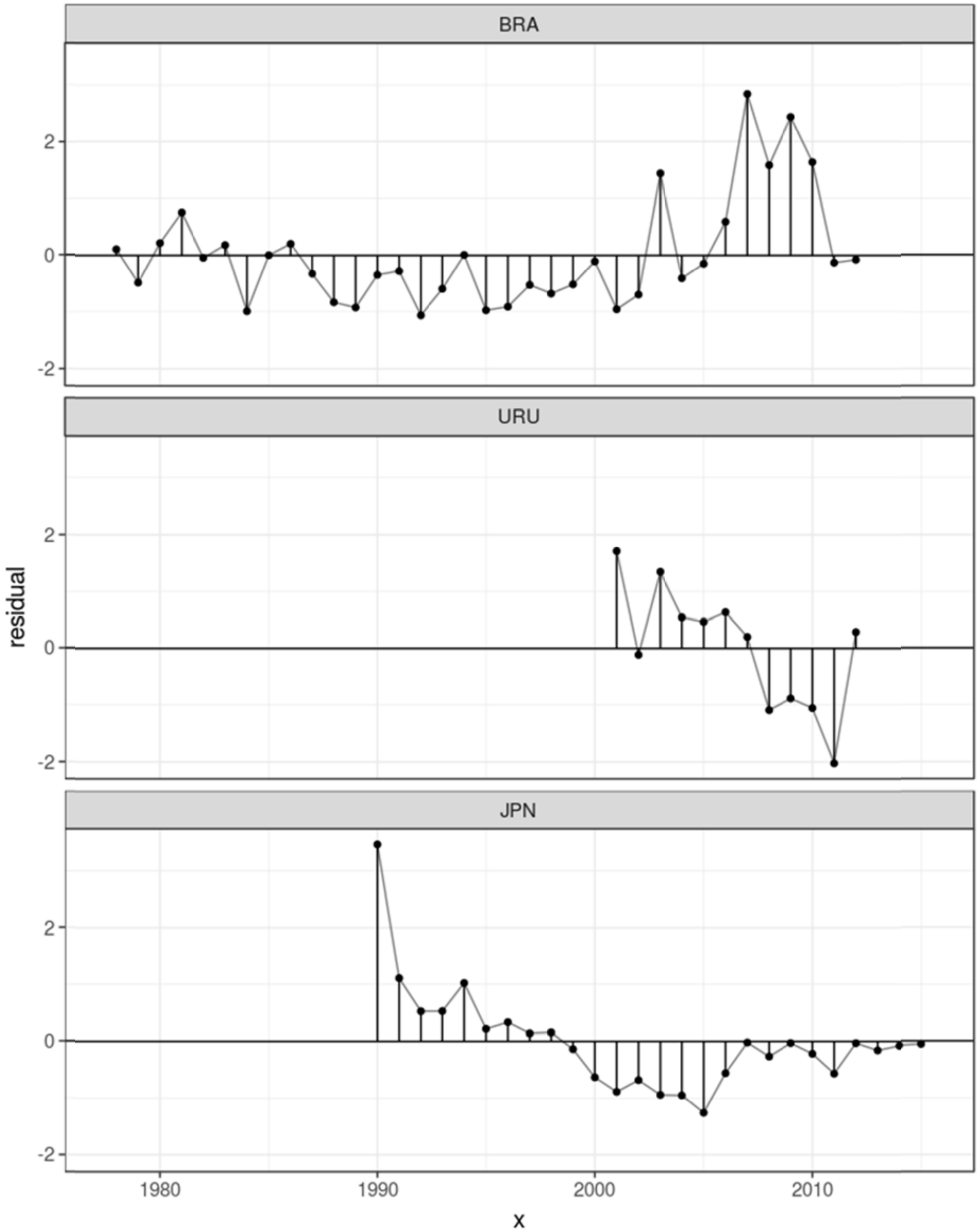


Figure 18. Time series of residuals from the lowess fit, Southern indices.

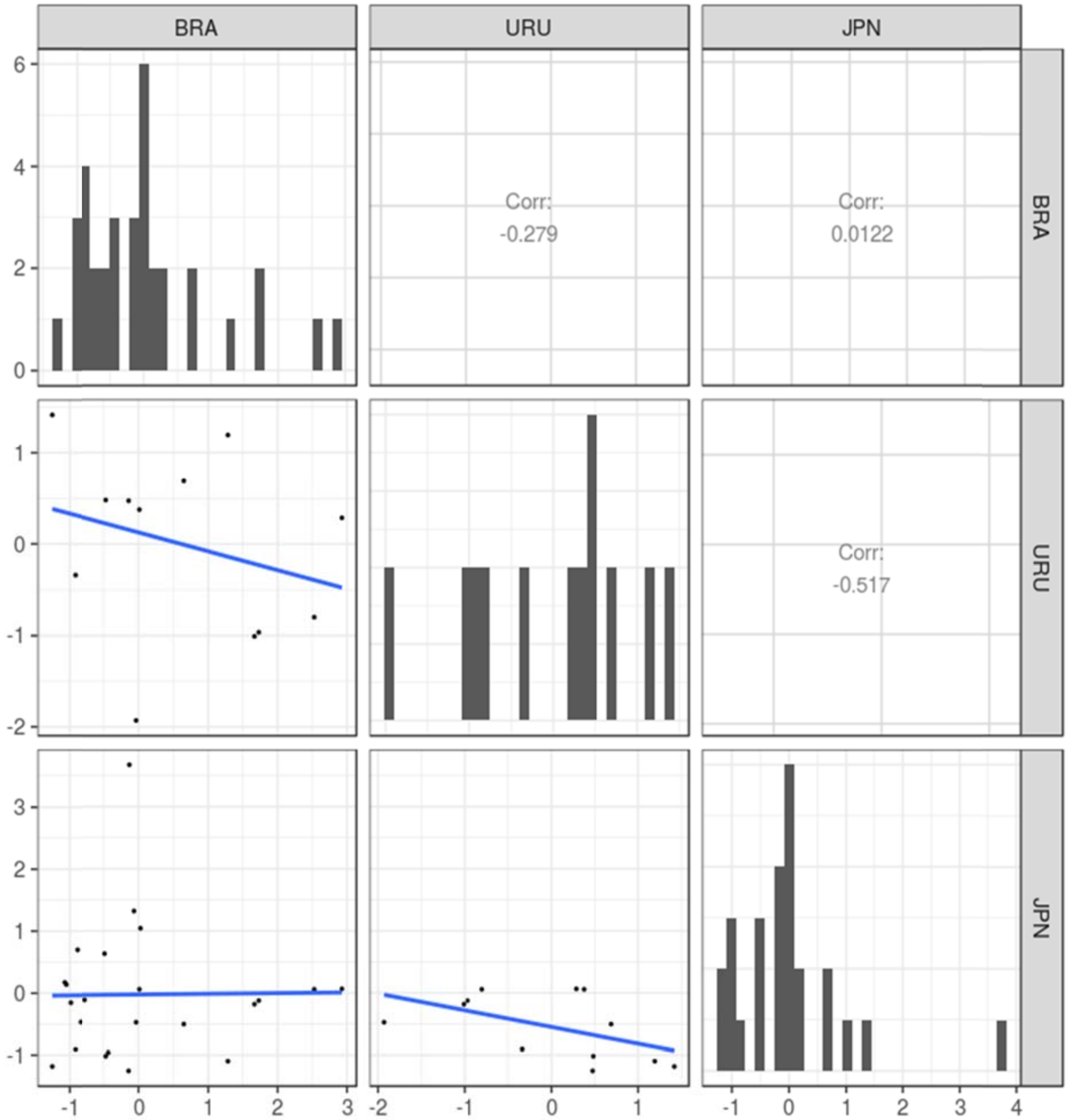


Figure 19. Pairwise scatter plots to look at correlations between Southern indices.

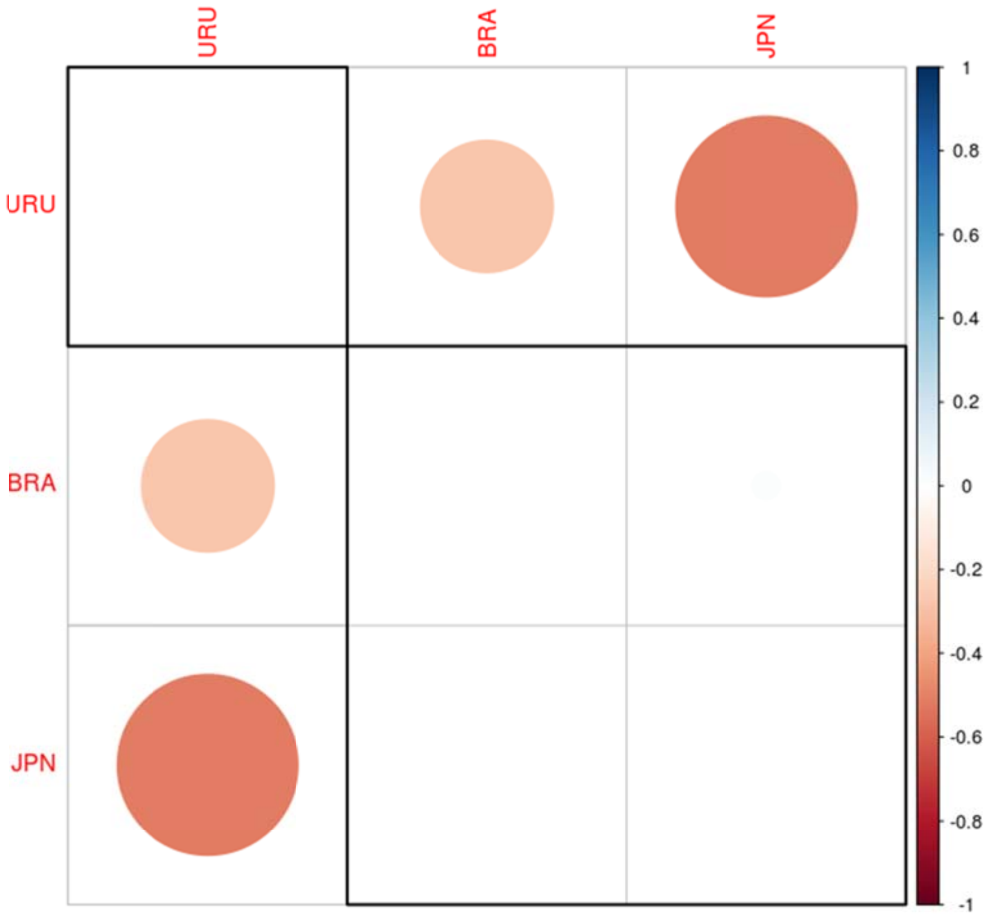


Figure 20. Plot of the correlation matrix for the Southern CPUE indices, blue indicate a positive correlation and red negative. The order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities for the indices being clustered.

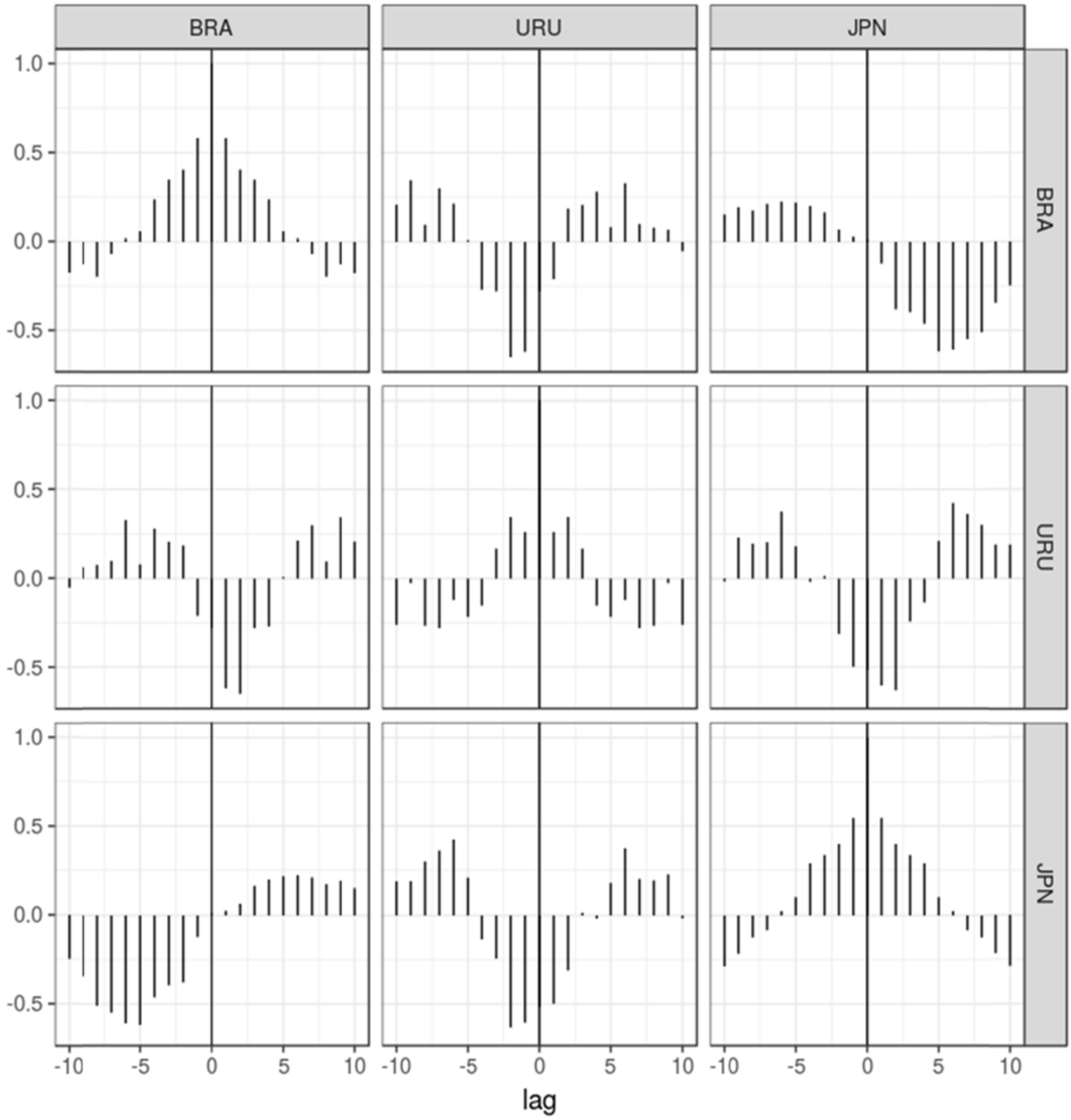


Figure 21. Cross correlations between Southern indices, to identify potential lags due to year-class effects.

Appendix 1

Agenda

1. Opening, adoption of the Agenda and meeting arrangements

2. Review of historical and new information on biology

3. Review of data held by the Secretariat
   3.1 Review of Task I data
   3.2 Review of Task II catch/effort
   3.3 Review of Task II size data
   3.4 Review of tagging data.

4. Review of CAS, CAA and WAA

5. Indices of abundance
   5.1. North
   5.2. South
   5.3. Trends and correlations in the CPUE indices
   5.4. Alternative indices

6. Discussion on models to be used during the assessment and their assumptions

7. Other matters

8. Recommendations

9. Adoption of the report and closure

Appendix 2

List of participants

CONTRACTING PARTIES

BRAZIL
Andrade, Agrelli Humber
UFRPE/DEPAq, Laboratório de Modelagem Estatística Aplicada (MOE), Rua Dom Manuel de Medeiros, s/n, Dois Irmaos, 52171.900 Recife-PE
Tel: + 55 81 3320 6530, Fax: + 55 81 3320 6501, E-Mail: humber.andrade@gmail.com

CANADA
Hanke, Alexander
Scientific, St. Andrews Biological Station/ Biological Station, Fisheries and Oceans Canada, 531 Brandy Cove Road, St. Andrews New Brunswick E5B 2L9
Tel: +1 506 529 5912, Fax: +1 506 529 5862, E-Mail: alex.hanke@dfo-mpo.gc.ca

Melvin, Gary
Biological Station - Fisheries and Oceans Canada, Department of Fisheries and Oceans, 531 Brandy Cove Road, St. Andrews, New Brunswick E5B 2L9
Tel: +1 506 529 5874, Fax: +1 506 529 5862, E-Mail: gary.melvin@dfo-mpo.gc.ca

CÔTE D'IVOIRE
Bahou, Laurent
Chercher Hydrobiologiste, Centre de Recherches Océanologiques de Côte d'Ivoire, 29 Rue des pêcheurs, Treinchville, BP V 18 Abidjan 01
Tel: +225 084 02024, Fax: +225 213 51155, E-Mail: lbahoucrothon@yahoo.fr

EUROPEAN UNION
Coelho, Rui
Portuguese Institute for the Ocean and Atmosphere, I.P. (IPMA), Avenida 5 de Outubro, s/n, 8700-305 Olhão, Portugal
Tel: +351 289 700 504, Fax: +351 289 700 535, E-Mail: rpcoelho@ipma.pt

Fernández Costa, Jose Ramón
Ministerio de Economía y Competitividad, Instituto Español de Oceanografía - C. Costero de A Coruña, Paseo Marítimo Alcalde Francisco Vázquez, 10 - P.O. Box 130, 15001 A Coruña, Spain
Tel: +34 981 218 151, Fax: +34 981 229 077, E-Mail: jose.costa@co.ieo.es

MOROCCO
Abdellah, Ikkiss
Centre Régional de l'Institut National de Recherche Halieutique, Dakhda
Tel: +212 662 276 541, E-Mail: ikkiss.abdel@gmail.com

Zahraoui, Mohamed
Ingénieur en Chef à la Division de la Protection des Ressources Halieutiques, Ministère de l'Agriculture et de la Pêche Maritime, Service de l'Application de la Réglementation et de la Police Administrative, Nouveau Quartier Administratif, BP 476, Haut Agdal, Rabat
Tel: +212 666 155999, Fax: +212 537 688 134, E-Mail: zahraoui@mpm.gov.ma; zahraouiay@gmail.com

UNITED STATES
Brown, Craig A.
Chief, Highly Migratory Species Branch, Sustainable Fisheries Division, NOAA Fisheries Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami Florida 33149
Tel: +1 305 586 6589, Fax: +1 305 361 4562, E-Mail: craig.brown@noaa.gov

Ingram, Walter
NOAA Fisheries, 3209 Frederic Street, Pascagonla MS 39567
Tel: +1 228 549 1686; 329 4465, Fax: +1 228 769 9600, E-Mail: walter.Ingram@noaa.gov

Schirripa, Michael
NOAA Fisheries, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami Florida 33149
Tel: +1 305 361 4568, Fax: +1 305 361 4562, E-Mail: michael.schirripa@noaa.gov

URUGUAY
Forselledo Cladera, Rodrigo
Dirección Nacional de Recursos Acuáticos - DINARA, Sección de Recursos Pelágicos de Altura, Constituyente 1497, 11200 Montevideo
Tel: +598 2400 46 89, Fax: +598 241 32 16, E-Mail: rforselledo@gmail.com

SCRS CHAIRMAN
Die, David
SCRS Chairman, Cooperative Institute of Marine and Atmospheric Studies, University of Miami, 4600 Rickenbacker Causeway, Miami Florida 33149, United States
Tel: +1 673 985 817, Fax: +1 305 421 4221, E-Mail: ddie@rsmas.miami.edu

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ICCAT Secretariat
C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain
Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

Neves dos Santos, Miguel
Kell, Laurence
Palma, Carlos
Ortiz, Mauricio
De Bruyn, Paul

Appendix 3

List of Papers and Presentations

Reference	Title	Authors
SCRS/2017/052	Hooking mortality of swordfish in pelagic longlines: comments on the efficiency of the minimum retention size currently in place in ICCAT	Coelho R. and Lechuga R.
SCRS/2017/053	Standardized CPUE of swordfish in the Portuguese pelagic longline fishery in the Atlantic	Coelho R., Rosa D. and Lino P.G.
SCRS/2017/063	Updated standardized catch rate of swordfish (*Xiphias gladius*) from the Moroccan longline fishery operating in the north Atlantic	Sid'Ahmed B., Abid N., Malouli M.I. and Benmhamed A.
SCRS/2017/064	A relative index of Atlantic swordfish abundance based on Canadian pelagic longline data (2002 to 2016)	Hanke A.R.
SCRS/2017/067	Estimations of standardized catch rates of swordfish (*Xiphias gladius*) caught by Brazilian fleet as calculated using fixed and random effects	Oliveira E.S.C., Carneiro V.G.O., Rodrigues S.L. and Andrade H.A.
SCRS/2017/068	Update standardized catch rate of swordfish (*Xiphias gladius*) caught in the South Atlantic by the Brazilian fleet	Carneiro V.G.O., Rodrigues S.L., Oliveira .S.C. and Andrade H.A.
SCRS/2017/070	Standardized catch indices of Atlantic swordfish, *Xiphias gladius*, from the United States pelagic longline observer program	Lauretta M. and Walter J.
SCRS/2017/072	Length based indicators of Atlantic swordfish and bluefin tuna stock status	Hanke A.
SCRS/2017/073	A first approximation to relative habitat size for swordfish stocks	Arrizabalaga H, Kell L. and Coelho R.
SCRS/2017/074	Annual indices of swordfish (*Xiphius gladius*) spawning biomass in the Gulf of Mexico (1982-2015)	Ingram W.G.
SCRS/2017/075	Update CPUE standardization of the Atlantic swordfish caught by Japanese longliners	Ijima H. and Yokawa K.
SCRS/2017/077	Preliminary results on the comparison of CPUE and size of swordfish, *Xiphias gladius*, caught with different longline gears in the Southwestern Atlantic Ocean	Forselledo R., Mas F. and Domingo A.
SCRS/2017/078	Standardized CPUE of swordfish, X*iphias gladius*, based on data gathered by National Observer Program on board the Uruguayan longline fleet (2001-2012)	Forselledo R., Mas F., Pons M. and Domingo A.
SCRS/2017/079	Length-length and length-weight relationships of swordfish, *Xiphias gladius*, caught by longliners in the Southwestern Atlantic Ocean	Forselledo R., Mas F., Ortiz M. and Domingo A.
SCRS/2017/080	Production et Effort de pêche sur l'espadon *Xiphias gladius* (Linnaeus, 1758) débarqué par des pêcheurs artisans en Côte d'Ivoire	Bahou L., Konan J.K. and N'Guessan C.D.
SCRS/P/2017/005	Resiliency for Swordfish North using life history parameters	Sharma R. and Arocha F.
SCRS/P/2017/006	Simulation of Harvest Control Rules for North Atlantic swordfish utilizing a historic perspective	Schirripa M.
SCRS/P/2017/007	North Atlantic Swordfish Stock Synthesis configuration v1.0	Schirripa M.
SCRS/P/2017/008	BSP model runs	Babcock E.A.

Appendix 4

SCRS Document Abstracts

SCRS/2017/052 – This working document revises data on hooking (at-haulback) mortality of swordfish captured and discarded by the Portuguese pelagic longline fishery in the Atlantic Ocean. The overall at-haulback mortality for swordfish was 85.2% (87.8% for specimens smaller than 125cm LJFL and 88.1% for specimens smaller than 119cm LJFL). The specimen size was significant for calculating the odds of at-haulback mortality, with mortality decreasing as specimen size increases. This study focuses only on one fishery and fleet, even though the data are widespread along a wide Atlantic area. Additionally, this study focuses only on the short term immediate mortality, while the overall mortality might be higher due to the potential post-release mortality. This work presents new and important information on the potential efficiently of the minimum landing sizes for swordfish currently in place in ICCAT fisheries in the Atlantic Ocean.

SCRS/2017/053 – This working document provides fishery indicators for the swordfish captured by the Portuguese pelagic longline fishery in the Atlantic, in terms of standardized CPUEs and size distribution. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self-sampling), collected between 1995 and 2016. The mean sizes were compared between years, seasons (quarters), stocks (north and south) and sampling areas. The CPUEs were analyzed for the North Atlantic and compared between years, and were modeled with GLM tweedie, GLM Delta lognormal, GLM and GLMM lognormal (adding a constant) approaches for the CPUE standardization procedure. In general the nominal CPUE trends increased during the period, with some annual variability. The standardized also showed similar trends with an overall increase during the period, with some oscillations. For the size distribution there were some increasing trends in the North Atlantic and no major trends in the South. The data presented in this working document can be considered for use in the upcoming 2017 Atlantic swordfish assessment specifically the standardized CPUE for the North Atlantic and the size distribution for both hemispheres.

SCRS/2017/063 – The General Linear Modelling approach (GLM), assuming a lognormal distribution error, was used to update the standardized index of abundance for the swordfish caught by the Moroccan longline fleet targeting this species south of the Moroccan Atlantic coast during the period 2005-2016. The analysis covered 1311 trips carried out by this fleet during the same period. The index has shown an improvement since 2015, after the decline observed in 2014.

SCRS/2017/064 – A relative index of North Atlantic swordfish abundance was developed for the period 2002 to 2016 using set level data and from 1962 to 2016 using trip level data. The standardizations were based on the number of swordfish caught and involved fitting general additive mixed effects models that controlled for the effect of hooks, bait, Julian day, month, shark and tuna caught, area and vessel. The area specific index indicates a decline in relative abundance to levels comparable with the years prior to the institution of a rebuilding plan in 1999.

SCRS/2017/067 – Estimations of standardized CPUE were calculated following three approaches: A) year was included in the models as main fixed effect only; B) year was included in the models as main fixed effect and also in fixed effect interactions; and C) year was included in the models as main fixed effect and in random effect interactions. We have used Generalized Linear Models (GLM) and Generalized Linear Mixed Models (GLMM) with Poisson distribution and logarithm link function. The response variable was the catch (number of fish), explanatory variables were year, area, flag and quarter, and logarithm of effort was included as offset. Convergence of GLMM was difficult to achieve probably due to the lack of balance of the Brazilian dataset. Time trend of the three standardized CPUE time series were not different. However, it is important to highlight that in this preliminary study we have analyzed only part of Brazilian dataset using simple model with few explanatory variables.

SCRS/2017/068 – The longline Brazilian fleet is composed of national and leased vessels from different countries. In addition the target species has changed across the years, which make difficult to estimate relative abundance indices based on commercial catch per unit effort. In this paper standardized CPUE was calculated based on four different approaches concerning the variables flag and number of hooks per basket. Ancillary information about the historical development of the fishery was also considered. Overall the four standardized CPUE series showed similar time trends from 1978 to 2012. However the estimations presented in this paper and the previous one calculated in 2013 were conflictive, probably due to the different explanatory variables included in the analyses. While cluster analysis was used in the previous calculation to account for the "target" effect, in this paper we relied on a physical characteristic of the longline as a proxy of the target.

SCRS/2017/070 – United States pelagic longline observer data were analyzed to estimate annual indices of swordfish abundance in the western Atlantic Ocean for the periods, 1992 to 2015. Observer recorded data were filtered for sets that targeted swordfish, exclusively. A negative binomial generalized linear model was used to evaluate multiple factors which may affect catch rates, including year, month, and fishing area, as well as gear characteristics and environmental conditions. Significant factors included year, month, area, day/night, target species, light stick use, sea surface temperature, bait type, and hook type. Standardized abundance indices are presented along with estimates of mean uncertainty for both periods. In the 2013 assessment this index was split into two time periods to account for a change due to a switch to circle hooks. Subsequent analyses of the datasets indicated that hook type could be included as a model factor in the observer dataset to account for regulatory changes from predominately J hooks to circle hook and, in some regions, weak circle hooks.

SCRS/2017/072 – Rebuilding and maintaining healthy spawning stocks can be facilitated by being conscious of how fishery removals affect a stock's age composition. Length based indicators for the fraction of the catch that are mega spawners, mature and of optimal size for harvest are shown to be a useful diagnostic tool that provides an additional perspective on stock status and that can identify fishing in regions and/or with gears that put the population at risk.

SCRS/2017/073 – In this paper we propose proxies for relative habitat size of swordfish stocks worldwide. The simple calculations are based on historical CPUE records of the Japanese longline fleet for the period 1950-2012. The habitat size proxy is simply proportional to the number of 5º5º boxes with positive CPUE for swordfish. The habitat of Atlantic stocks was estimated to be approximately ten times larger than for the Mediterranean stock. On the other hand, the habitat size of Pacific stocks was estimated to be approximately twice as large as those of the Atlantic, and slightly larger than the Indian Ocean habitat. Additional proxies for habitat size calculations are also discussed. Having relative habitat size estimates for stocks of the same specie could help establish priors for K, e.g. under the assumption of proportionality between K and habitat size.

SCRS/2017/074 – Fishery independent indices of spawning biomass of swordfish in the Gulf of Mexico are presented utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2015 in the Gulf of Mexico. Indices were developed using the occurrence of larvae sampled with neuston gear using a zero-inflated binomial model, including the following covariates: time of day, month, area sampled, year, gear and habitat score. The habitat score was based on the presence/absence of other ichthyoplankton taxa and temperature and salinity at the sampling station.

SCRS/2017/075 – We updated the standardized CPUE of the Atlantic swordfish caught by Japanese longliners in the Northern and Southern Atlantic Ocean for the use of stock assessments of these stocks. The boundary of Northern and Sothern stocks was sets at 5N based on the agreement of the SCRS. The North Atlantic CPUE was standardized according to the final model of previous stock assessment and that period is between 2006 and 2015, and both were reasonably converged. Updated CPUE of Northern stock showed increased trend in the period between 2006 and 2011, and suddenly dropped between 2012 and 2013. It showed some recovery in most recent years. The CPUE for the Southern stock was updated using the same GLM methodology as used in the previous assessment. The result of updated CPUE showed a similar trend as the previous analysis result, and the recent CPUE showed a stable trend. The overall trends of updated CPUE of southern stocks were similar to the one estimated by the previous study. The updated results of this study indicated the level of the Southern stock had not changed since the mid-2000s.

SCRS/2017/077 – Understanding differences between fisheries is important for better stock assessment. Differences in CPUE and size at capture may be based on different fishing gears and/or configurations. Two pelagic longline fisheries were considered in this study based on data gathered by the Uruguayan national on board observer program. The Uruguayan pelagic longline fishery and the Japanese pelagic longline fishery. The Uruguayan fleet can be divided in two categories based on the branch line material. Many ships in this fleet used branch lines entirely made of simple monofilament, whereas a few other ships had the terminal section of the branch line reinforced with stainless steel. The Japanese fleet operated at deeper depths than the Uruguayan and used only monofilament in their branch lines. The objective of this study is to compare swordfish size and CPUE in three different gears operating in the Southwestern Atlantic Ocean and mainly in the Uruguayan EEZ.

SCRS/2017/078 – This study presents the standardized catch rate of swordfish, *Xiphias gladius*, caught by the Uruguayan longline fleet in the Southwestern Atlantic using information from the national on board observed program between 2001 and 2012. Because 8.3% of sets had zero swordfish catches the CPUE (catch per unit of effort in weight) was standardized by Generalized Linear Mixed Models (GLMMs) using a Delta Lognormal approach. The independent variables included in the models as main factors and first-order interactions in some cases were: Year, Quarter, Area, Sea Surface Temperature and Gear. A total of 1,706 sets were analyzed. Standardized CPUE showed a decreasing trend during the study period.

SCRS/2017/079 – This study reports size and weight relationships for swordfish (*Xiphias gladius*) in the Southwestern Atlantic Ocean. Relationships presented are length-length between Lower Jaw Fork length (LJFL) and Dorsal Caudal Length (DCL), and length-weight between LJFL and Dressed weight (DWT). Data used in this document were gathered by Uruguay National Observer Program on board the Uruguayan pelagic longline fleet between 1998 and 2012, on board the Japanese tuna longline fleet operating in Uruguayan jurisdictional waters in the period 2009–2011 and 2013, and on board DINARA´s R/V. The relationships provided in this contribution cover at least an extended portion of the reported full size spectrum of swordfish.

SCRS/2017/080 – Swordfish (*Xiphias gladius*) is among the billfishes caught by a small-scale fishery operating in continental shelf waters of Côte d'Ivoire. Data collected from this fishery are of great importance for carrying out studies which can enable accurate knowledge to be gathered on swordfish in Ivorian waters. Specimen swordfish were counted and measured in two landing-places ("Zimbabwé" and Abobo-Doumé) by members of two raw-data collection teams. This task was carried out daily from January 2013 to December 2015 as often as landings occurred. The results indicated that much more specimens were landed in the "Zimbabwé" landing-place throughout the year, as the landings in 2013 were 752 fish, those in 2014 were 499 fish and still those in 2015 were 242 fish. Yet, in the Abobo-Doumé landing-place, specimens that were landed numbered 376 in 2013, 240 in 2014 and 193 in 2015. In addition, within each year and regardless of landing-place convenience, much more landings occurred from July to September than they did occur in any other month. Size frequency distribution showed that the specimens landed in the "Zimbabwé" landing-place were larger than the ones landed in the other place. Specimens ranging in size (lower-jaw fork length, LJFL) from 90 cm to 220 cm were commonest. However, some individual fish not reaching up to 90 cm and other ones larger than 220 cm were often among the specimens caught. Higher catches were recorded from July to September each year for both landing-places. "Zimbabwé" proved to be the landing-place with higher catch each year, as amount of reported catches in that place reached 89.198 t in 2013, 43.733 t in 2014 and 28.27 t in 2015, compared to the 42.195 t, 24.432 t and 20.082 t reported respectively for the Abobo-Doumé landing-place. No relationships were found between the fishing effort (expressed as the number of canoes that unloaded their catches) and number of swordfish landed. However, landings seemed to be up considerably during the cooler season.

Appendix 5

Revision of SWO Atlantic Task I nominal catches (T1NC, 1950 to 2015)

The Group revised entirely T1NC for the two Atlantic stocks (SWO-N and SWO-S). This revision, made during the five days meeting, involved the participants, the Secretariat, and CPC scientists involved in the fishery (Secretariat contact through email). The details are here described (includes all the revisions discussed and adopted by the Group) and the ones received until 2017-04-10. All the changes (updates, corrections, gaps recovered) adopted by the Group were included in the T1NC database with a reference to this meeting.

The revision, was split into two periods (1950 to 1989 and 1990 to 2015), and was made by stock (SWO-N, SWO-S) and involved Flag by Flag analyses (with consultation to SCRS scientific papers whenever necessary).

Main goals: eliminate as much as possible catches from unclassified gears (UNCL, SURF, SPOR, SPHL), improve the internal consistency of each one of the series in T1NC, eliminate duplicates, complete as much as possible data gaps identified in the past. Overall, this exercise affected approximately 5% (~300 records) of the total T1NC information. The overall results were recognized by the Group as a great improvement to T1NC noting however that, this revision/validation work must continue in the future.

CAVEAT: part of unclassified gear series (UNCL, SURF) in the tropical zone (Liberia, Nigeria, Togo, Guinea Equatorial, etc.) could be gillnets (GILL). Those series, and GILL in general, are still incomplete.

1) Early period (1950 to 1989)

a) SWO-N

Canada:	UNCL gear catches (1980-1981) allocated to HARPE (gap); HARPE and LL-surf between 1971 and 1974 completed with zero (mercury fishing restrictions did not allow fishing); all longline gears catches unified as gear LL-surf.
EU-España:	complete 1987 by-catches gaps for the gear GILL (1 t) and TRAP (1 t).
Grenada:	UNCL catches (1988-1989) reclassified as LL (unique series).
Maroc:	unclassified SURF catches (1983-1984) allocated to TRAP (gaps).
Mexico:	UNCL gear catches (1972-1978) allocated to LL (unique series).
USA:	UNCL catches (1970-1977) reclassified as LL (preliminary). This full LL catch allocation has pending the ongoing scientific USA revision on both LL and HARP catches on this period, and also, the identification of the UNCL gear (could be GILL) catch series between 1978 and 1985.
USSR:	UNCL gear catches (1987) reclassified as LLMB (gap).
Others:	minor corrections in gear codes (mostly under groups LL and TW) of some flags to simplify and harmonise the catch series.

b) SWO-S

Argentina:	UNCL catches (1982-1989) to LL (unique series) acknowledging that a small portion could belong to TRAW by-catch.
Brazil:	unclassified SURF catches (1977-1984) allocated to GILL (gaps).
Côte d'Ivoire:	UNCL gear catches (1984-1987) renamed as GILL (Abidjan based artisanal fishery).
Ghana:	unclassified SURF gear catches (1968-1969) reclassified as GILL (gaps).
St. Tomé e Principe:	UNCL catches (1988-1989) allocated to artisanal TROL. Some doubts about this series (most probably GILL).
Others:	minor corrections in gear codes (mostly under groups LL and TW) of some flags to simplify and harmonise the catch series.

2) Recent period (1990 to 2015)

a) SWO-N

Canada:	longline catches (LLHB, LL-surf) merged into a unique LL-surf series (1990-2015); two harpoon series (HARP, HARPE) merged into a unique HARPE series (1990-2015).
Côte d'Ivoire:	PS catches in SWO-N (2012) added to the southern stock PS series (error).
Cuba:	UNCL gear catches (1991-1999) reclassified as LL (gap completion).

EU-España:	UNCL gear catches (1992-1996) allocated to GILL (gaps).
EU-Portugal:	unclassified (UNCL, SURF) mainland fleet catches (2012-2015) merged with LL-surf.
FR.SPM:	unification of longline gears (LL, LLSWO, LL-surf) reclassified as LL-surf (2007-2011).
Grenada:	UNCL catches (1990-1999) reclassified as LL (gaps) as the unique existent fleet.
Libya:	unique value (2 t) 2006 LL catch in SWO-N moved to the Mediterranean stock (gap).
Senegal:	UNCL gear catches (108 t) in 2004 and 2005 (carry over) deleted (error); UNCL gear catches (2015) reclassified as TROL (gap); simplification of longline catch series (LL, LLSWO) into a unique LL series (2007-2015).
UK-Bermuda:	UNCL gear catches (2002-2005) reclassified as LLSWO (gap).
Others:	minor corrections in gear codes (mostly under groups LL and TW) of some flags to simplify and harmonise the catch series.

b) SWO-S

Brazil:	Simplification of longline catch series (a total of 63 reduced to 27) by dropping the port associations (in fleet codes) and keeping only the nationality of the fleet (National/Foreign separation). Reclassification already adopted by Brazil, and in the line of the work done in other species (only 2003-2013).
Côte d'Ivoire:	GILL gaps recovered for 2009 (167 t) and 2010 (42 t).
Cuba:	UNCL gear catches (1991-1997) reclassified as LL (gap completion).
EU-Portugal:	unclassified (UNCL, SURF) gear catches (Mainland fleet) merged with Mainland LL-surf (2012).
Senegal:	longline catches (LL, LLSWO) allocated to a unique LL series (2012-2015).
St. Tomé e Principe:	UNCL catches (1990-2004) allocated to TROL (artisanal fleet). Some doubts about this series (most probably is GILL). PSS catches (2011-2014) reclassified as TROL; 2015 catches (145 t) split into three gears (HAND: 22 t, PSS: 18 t; TROL: 105 t).
South Africa:	Unclassified SPORT fisheries (1992-1994) reallocated to fleet ZAF-Rec (recreational/sport) under gear RR (may change/split to/in HAND in the future).
Others:	minor corrections in gear codes (mostly under groups LL and TW) of some flags to simplify and harmonise the catch series.

Results and discussion

Overall, the integral revision of bluefin T1NC (Task I catches) has only affected slightly the total catches (t) in any of the two Atlantic stocks (**Figure 1**).

The major improvement was observed in terms T1NC internal consistency in any of the two stocks (SWO-N SWO-S). The improvements were important at the fisheries time series discrimination and completeness. Unclassified gears (UNCL, SURF, SPOR, and, SPHL) were reasonably reduced in the seventies (SWO-N) and the eighties (SWO-S) as shown in **Figure 1.** However, this revision in the Task I nominal catches of SWO Atlantic stocks is not complete (GILL still missing/incomplete, UNCL gear catches still exist) and should continue in the future.

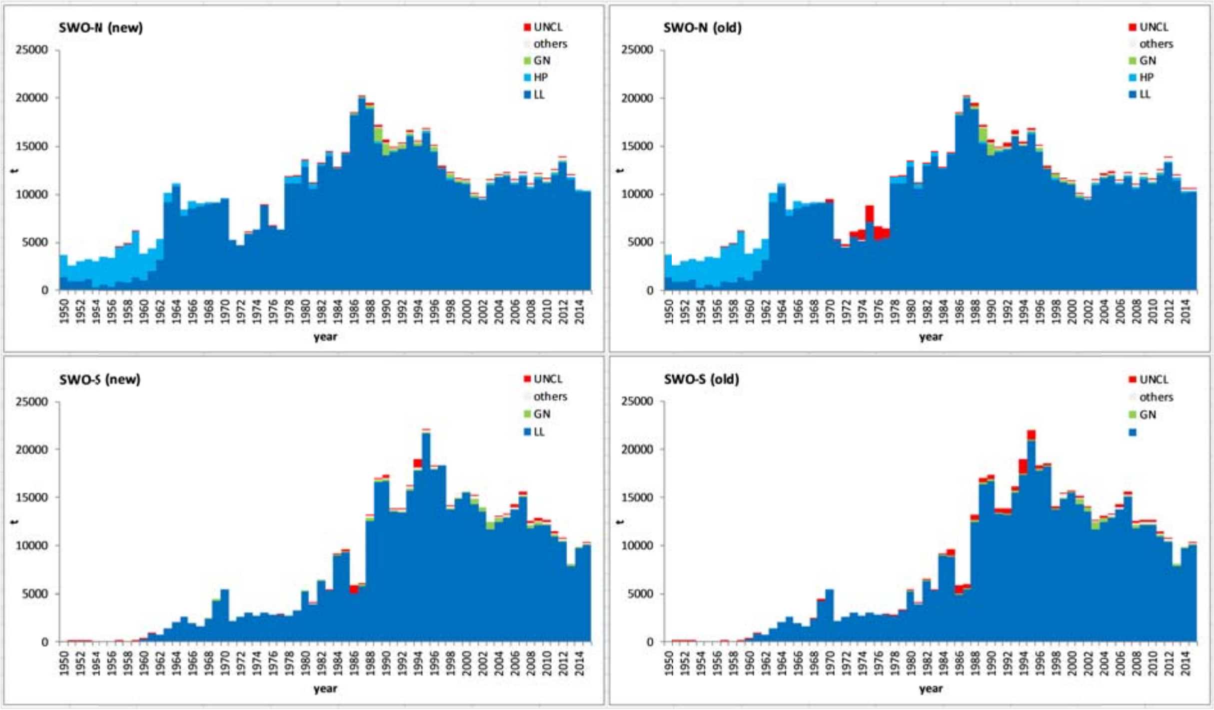

Figure 1. Comparison of T1NC catches by major gear (cumulative) in both SWO Atlantic stocks (top: SWO-N; bottom SWO-S) after (left panel: "new"; right panel: "old") the full revision made. The series in "red" (UNCL) in all the four figures denotes the unclassified gears group (UNCL, SURF, SPOR, SPHL), which a reasonable reduction in the "new" T1NC.