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PREPARATION OF DATA INPUT FILES FOR THE STOCK ASSESSMENTS OF INDIAN OCEAN SWORDFISH

Miguel Herrera[1] *& Lucia Pierre*[2]

Abstract

This document describes the methods used by the IOTC Secretariat to prepare catch tables, length-frequency samples and catch-at-size and catch-at-age tables for swordfish, for the period 1950-2009, using estimates of total catch and the available catch-and effort, size frequency data and other biological data in the IOTC database.

The IOTC Secretariat estimated total catches of swordfish, in number and weight, per year, quarter, and assessment area and fishery, for the period1950-2009, using information from the IOTC database, in particular estimates of total catches by fishery and year, and catch-and-effort and size frequency data by time-area strata. In addition, the Secretariat prepared length-frequency samples from the size frequency data available in the IOTC databases. These datasets were prepared to be used in assessments using estimates of total catches by fishery, area, year and quarter and the samples existing for those strata or estimates of catch-at-size or catch-at-age derived from the referred samples. The results are affected by the lack of information for some fleets, periods and years, and, in particular, by the lack of catch and size data from most artisanal fleets and some industrial fleets.

Rationale

The IOTC database contains estimates of total catches by country, gear, year and IOTC Area (**Figure 1**, page 2). In addition, the IOTC database contains catch-and-effort data and size frequency data by country, gear, time-area strata and species, which generally represent a sample of the total catches estimated by country, gear, year and species.
The Secretariat used the above data to produce the following information for the swordfish:

- Input files for stock assessment, in particular:
  a. Models using estimates of total catches of swordfish, in number and weight, and non-raised length-frequency data (**samples**) available by year, quarter and fishery, for 1950-2009.
  b. Models using estimates of total catches of swordfish, in number and weight, and estimates of total numbers of swordfish caught by length class interval, year, quarter and fishery, or **Catch-at-Size**, for 1950-2009.
  c. Models using estimates of total catches of swordfish, in number and weight, and estimates of total numbers of swordfish caught by age interval, year, quarter and fishery, or **Catch-at-Age**, for 1950-2009.
- Stock status indicators (e.g. trends in average weight per fishery).
- Tables of total catch by fishery, year, month and five degrees square areas.

The construction of a catch-at-size table for a particular species requires that length frequency distributions are assigned to the total catch. Thus, the sampled weight estimated for each stratum (i.e. the weight resulting from summing up the weights estimated for the specimens within each length class) is raised to the nominal catch recorded for that stratum.

Species involved

Catch-at-Size (CAS) and Catch-at-Age (CAA) tables were estimated for the Swordfish only. The estimation of CAS and CAA for marlins or Indo-Pacific sailfish has not been attempted in this paper due to a paucity of data.

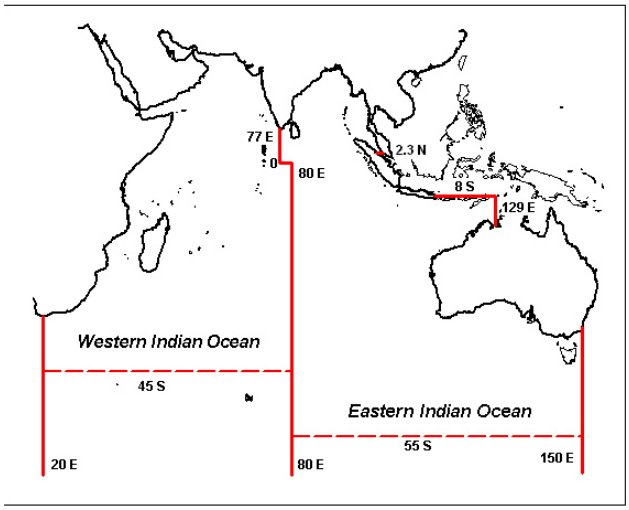
[1] Data Coordinator IOTC (mh@iotc.org; Miguel.Herrera@iotc.org)
[2] Data Assistant IOTC (data.assistant@iotc.org)

Basic Data

Four datasets are used for the preparation of stock assessment tables for swordfish:

- *Nominal catches*: Total catch estimates per Species, Fleet, Year, Gear and IOTC Area (**Figure 1**). The data in this dataset issues from two different sources:
  a. Reports from the flag countries or reports from other countries on the catches of foreign vessels operating within its Economic Exclusive Zone or based in ports within its territory.
  b. Estimates carried out by the IOTC Secretariat: this may involve changes in the catches reported by the above or the estimation of catches for non-reporting fleets (e.g. catches recorded under the NEI[3] category).

Figure 1: IOTC areas used for the Nominal Catches



- *Catches per area* (from catch-and-effort): Catches (in tonnes or/and in number) are recorded per Species, Fleet, Year, Gear, Fishing Mode, Time Interval (month or quarter usually) and area (usually 1^0 square areas for industrial purse seine fisheries, 5^0 square areas for industrial longline fisheries and various regular or irregular areas for artisanal fisheries). Catches per area are not available for all Nominal catches strata. When recorded, the catches in these datasets might represent the total catches of the species in the year for the fleet and gear concerned or represent simply a sample of those.
- *Size data*: Size frequency data (standard or processed length or standard or processed weight) are recorded per Species, Fleet, Year, Gear, Fishing Mode, Time Interval (month or quarter or year usually) and area (usually 5^0 square areas for purse seine fisheries, 10^0 latitude by 20^0 longitude for longline fisheries and various regular or irregular areas for artisanal fisheries). Size data are not available for all Nominal catches strata. When recorded, the size data might represent the total catches of the species in the strata concerned (or Catch-at-Size) or simply a sample of those.
- *Biological data*: includes several types of biological parameters for the swordfish, in particular:
  a. Conversion from non-standard measurements into fork length: Equations (data) used to convert specimens of swordfish measured by using non-standard procedures into the standard length measurement used for the swordfish, representing the distance from the tip of the lower-jaw to the fork of the tail (fork length).
  b. Conversion from fork length into live weight: Equations (data) used to estimate sample weights from the available lengths (length-weight relationships).
  c. Sex-ratio: Data used to estimate numbers of swordfish by sex from the available numbers of swordfish.
  d. Age-Length keys: Data used to estimate numbers of swordfish by age (Catch-at-Age) from the numbers of swordfish by length estimated (Catch-at-Size).

The type of information recorded in each case is summarized in **Table 1** below:

Table 1: Main types of fisheries statistics gathered by the IOTC

Dataset	*Fishery Strata*	*Time Strata*	*Area Strata*	*Represents*
Nominal Catches	Fleet-Gear (or gear aggregate)-Species (or species aggregate)	Year	IOTC Area	Total catches
Catches per area	Fleet-Gear (or gear aggregate)-Fishing Mode (purse seine only)-Species	Month (quarter or year)	1°square area (purse seine) 5°square area (longline) Other regular or irregular areas	Sample
Size data	Species- Fleet-Gear (or gear aggregate)-Fishing Mode (purse seine only)-Type of measurement (length or weight, standard or processed)-Size interval (between size classes)	Quarter (year or month)	5°square area (purse seine) 10°Lat.*20°Lon. area (longline) Other regular or irregular areas	Sample
Biological data	Various, depending on dataset	Various	Various, depending on dataset	Sample

Fisheries and Areas used for the assessments of swordfish

The nominal catches, samples and estimates of Catch-at-Size and Catch-at-Age to be used for the assessments of swordfish were ultimately aggregated by year, quarter, assessment fishery and assessment area.

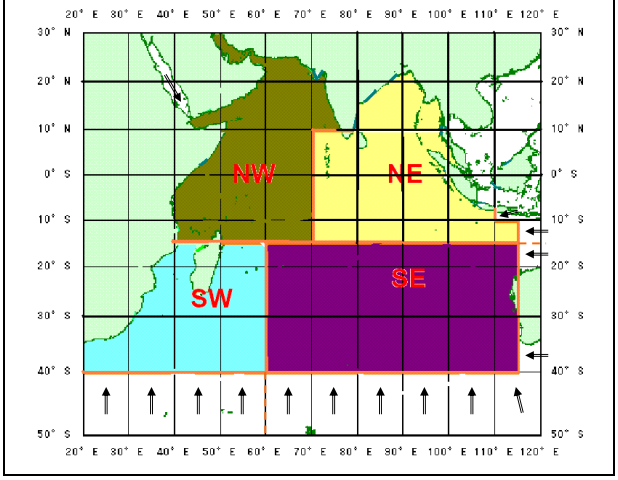
[3] Not elsewhere identified

Assessment Areas: Four areas are used for the assessments of swordfish. These areas are shown in **Table 2** and **Figure 2**. The catches of swordfish from areas outside the four assessment areas were assigned to the closest area, as indicated through the arrows on **Figure 2**. **Table 2** shows also total catches by area accumulated for the entire catch data series (1950-2009) and the contribution that the catches from each area made out of the total accumulated catches for 1950-2009, and in recent years (2005-09).

Table 2: Areas used for the assessments of Indian Ocean swordfish; the total catches (metric tons) accumulated for the period 1950-2009 (Total Catch 50-09), the relative importance of the catches in each area over both the entire catch series (%50-09) and in current years (%05-09), and the catches by assessment fishery (see Table 3) in each of the areas concerned are also shown

Area	*Description*	*Catch (t) 50-09*	*% 50-09*	*% 05-09*	*Catches by Fishery (t)*						
					ALGI	*AUEL*	*EUEL*	*ISEL*	*JPLL*	*TWFL*	*TWLL*
NW	Northwest Indian Ocean	198,244	31	32	4,566		7,823	3,578	28,251	2,281	151,731
SW	Southwest Indian Ocean	178,514	28	30	209		42,973	21,697	23,573	236	89,850
NE	Northeast Indian Ocean	163,231	26	21	30,589		844		13,635	41,695	76,467
SE	Southeast Indian Ocean	92,183	15	18	648	11,763	32,139	2,120	11,288	3,442	30,793

Figure 2: Areas used for the assessments of Indian Ocean swordfish



Assessment Fisheries: Seven fisheries are used for the assessments of swordfish, as indicated in **Table 3**. Details on the fisheries that were assigned to each fleet-gear-catch/length frequency stratum can be found in **Appendix III**. **Table 3**, below, shows the fisheries that are used for the assessment of swordfish. It shows also total catches by fishery accumulated for the entire catch data series (1950-2009) and the contribution that the catches from each fishery made out of the total accumulated catches for 1950-2008, and in recent years (2005-09).

Table 3: Fisheries used for the assessments of Indian Ocean swordfish; the total catches accumulated for the period 1950-20089(Total Catch 50-09 in metric tons) and the relative importance of each fishery over both the entire catch series (%50-09) and in current years (%05-09) is also shown

Fishery	*Description*	*Total Catch 50-09*	*% 50-09*	*% 05-09*
ALGI	Contains data for all gillnet, trolling and other minor artisanal fisheries	36,012	6	6
AUEL	Contains data for the longline fishery of Australia (target is SWO)	11,763	2	1
EUEL	Contains data for EU longliners (from Spain, Portugal and the UK) plus other longliners assimilated to EU longliners (generally owned by Spanish nationals), all targeting SWO	83,779	13	37
ISEL	Contains data for the semi-industrial longline fleets operating in Reunion(France), Mayotte(France), Madagascar, Mauritius and the Seychelles, which also target SWO	27,395	4	6
JPLL	Contains data for the longline fishery of Japan plus other fleets assimilated to the Japanese fleet (e.g. South Korea, Thailand, Oman)	76,747	12	7
TWFL	Contains data for the fresh-tuna longline fleets of Taiwan and Indonesia, plus other fresh-tuna longline fleets assimilated to those and all sport fisheries and fleets operating hand lines	47,653	8	10
TWLL	Contains data for the large scale tuna longline fleet of Taiwan,China, plus other longline fleets assimilated to the Taiwanese fleet (a component of those fleets may target SWO)	348,842	55	33

Input Tables

The Secretariat has prepared the following input tables for the WPB:

- Stock assessments of swordfish: Three sets of tables were prepared, depending on the type of assessment models to be used:
  Assessment models using non-raised length frequency data (samples)

a. Estimates of total catches of swordfish, in number of specimens and weight, by year, quarter, fishery and area.
b. Number of swordfish specimens sampled by length interval, by fishery, area, year, and quarter.

Assessment models using Catch-at-Size data

a. Estimates of total catches of swordfish, in number of specimens and weight, by year, quarter, fishery and area.
b. Estimates of total number of specimens of swordfish caught by length class (Catch-at-Size) by fishery, area, year, and quarter.

Assessment models using Catch-at-Age data

a. Estimates of total catches of swordfish, in number of specimens and weight, by year, quarter, fishery and area.
b. Estimates of total number of specimens of swordfish caught by age class (Catch-at-Age) by fishery, area, year, and quarter.

- Stock status indicators for billfish species: The Secretariat used total catches, catch-and-effort, length frequency samples and Catch-at-Size data in the preparation of sets of stock status indicators for swordfish, marlins and Indo-Pacific sailfish.
- Total catches by time-area strata: The Secretariat prepared a table containing estimates of total catches of swordfish, in number and weight, by fleet, gear, year, quarter, and 5^0 square areas.

An example of the above tables can be found in **Appendix I**.

Data Processing

Estimation procedures used for the preparation of data for the assessments of swordfish

The way in which the Secretariat prepared the information to be used for the assessments of swordfish is summarized below. Details about these procedures are provided in the following sections.

1. Standardizing catch and size frequency tables
    a. Nominal catches (NC): Assigning the catches not reported by species/gear by species/gear (NC➔NCst)
    b. Catch-and-effort (CE): Assigning catches not recorded by 5^0 grid/quarter by 5^0 grid/quarter (CE➔CEst)
    c. Size frequency (SF➔LFst):
        i. Converting non-standard measurements into standard measurements
        ii. Breaking the existing lengths into the standard length class intervals used for the species (e.g. 15-18cm, 18-21cm, etc.)
        iii. Assigning samples not recorded by area (purse seine and other gears)/quarter by area/quarter
2. **Swordfish length frequency samples input file** (LFst ➔**LF_{INPUT}**) Aggregating the length frequency samples in LFst by fishery-area-year-quarter-number of specimens sampled by length class, for 1950-2009.
3. Breaking the NCst by quarter and 5^0 grid using the CEst (NCst➔NCds)
4. Assigning length frequency samples to all NCds strata (Fleet-Gear-Year-Quarter-PS/Other Area) (NCds➔LFcv)
5. Deriving Catch-at-Size (CAS) by scaling up length frequency distributions in LFcv from sample weight to total weight for each stratum (LFcv➔CAS)
6. Adjusting/estimating NCds weights/numbers by using average weights derived from the CAS (NCds➔NCad)
7. **Swordfish total catch input file** (NCad➔**NC_{INPUT}**) Aggregating the catches in NCad by fishery-area-year-quarter-total catch of swordfish (in number and weight), for 1950-2009.
8. **Swordfish Catch-at-Size input file** (CAS➔**CAS_{INPUT}**): Aggregating the length frequency data in CAS by fishery-area-year-quarter-total number of specimens by length class interval, for 1950-2009.
9. **Swordfish Catch-at-Age input file** (CAS➔**CAA_{INPUT}**): Deriving Catch-at-Age for swordfish using CAS_{INPUT} and the existing Length-Age key to obtain estimates of total n umber of specimens caught by age class, fishery, area, year and quarter, for 1950-2009.

Breaking the catches not recorded by gear and/or species by species and gear

The catches in the IOTC nominal catches database are not recorded by species and/or by gear in all cases. The Secretariat conducted a review aiming at estimating catches when data were not available by species or gear in the IOTC database. This process was documented in a paper presented to the WPTT in 2004 (IOTC-2004-WPTT-06).

Standardization of catch-and-effort data

The catches in the catch-and-effort table are recorded under different levels of aggregation.
All the catches from this record were assigned by Species-Fleet-Gear-Fishing Mode-Year-Month-5^o square grid-Catch in number of fish-(and/or)-Catch in metric tons.

i. Grid allocation: All the catches not recorded by 5^o square grid were assigned to 5^o square grids as follows:
    a. Allocation of catches recorded under irregular areas by 5^o square grid: The catches recorded under irregular areas (e.g. port of unloading, fishing district, etc.) were assigned to the neighbouring 5^o square grid(s).
    b. Allocation of catches recorded under areas that fell within a single 5^o square area: all catches recorded under areas that fell within a 5^o square area were assigned to the corresponding 5^o square areas.
    c. Allocation of catches recorded under areas overlapping two or more 5^o square areas: all catches recorded under areas that overlapped two or more 5^o square areas were assigned proportionally by 5^o square area (i.e. by using the proportions

obtained by dividing the amount of 1 degree square grids that fell within each 5 ^{o} square area over the total amount of squares from the overlapping area).

ii. Time period allocation: The catches available in the catch-and-effort file were assigned by month as follows:
   a. Allocation of catches recorded under time period strata that fall within a single month: all catches recorded under time periods that fell within a month were assigned to the corresponding months.
   b. Allocation of catches recorded under time period strata overlapping two or more months: all catches recorded under time periods that overlapped two or more months were assigned proportionally by month (e.g. 1/3 of the catches recorded under the first quarter of a year were assigned to each of the months making up that quarter).

Standardization of size frequency data

The following process was used to convert the samples of swordfish available into standard form:

i. Converting non-standard lengths into standard length (**Table 4**): The regression equations presented in **Table 4** were used to estimate the distance from the tip of the lower jaw to the fork of the tail (fork length) for specimens of swordfish that were recorded under non-standard lengths or weights in the IOTC database (deterministic conversion). The equations used for other billfish species are presented in **Appendix IX**.

Table 4: Swordfish: Regression equations used to convert from non-standard measurements into standard lengths

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size range*	*Source*
Cleithrum to caudal fork length	$\frac{(L+b)}{a}$	a= 0.8087 b= 8.6712	n/a	n/a	***Reference not available***
Cleithrum to keel length	$aL+b$	a= 1.55108 b= 13.5025	179	Min:88 Max:252	***Two step conversion as CKL = (0.690253*EFL) -3.541823 in formula LJFL = 8.00884+(1.07064*EFL); NOAA Data (Pacific Ocean)***
Eye orbit to Fork Length	$aL+b$	a= 1.066 b= 10.449	123	Min:48 Max:255	***Data from Reunion Island, Indian Ocean Poisson 2001 (in IOTC-2005-WPTT-05)***
Pectoral fin to anal fin length	$aL+b$	a= 2.5407 b= 25.698	1,806	Min:18 Max:105	***Data from Reunion Island, Indian Ocean Poisson 2001 (in IOTC-2005-WPTT-05)***
Pectoral fin to caudal fork length	$aL+b$	a= 1.2398 b= 11.204	55	Min:60 Max:157	***Data from Reunion Island, Indian Ocean Poisson 2001 (in IOTC-2005-WPTT-05)***
Weight gilled and gutted	$(w/a)^{(1/b)}$	a= 0.0000043491 b= 3.188	3,608	Min:89 Max:266	***Inverted length-weight equation(ICCAT Mejuto et al 1998 South-East Atlantic Ocean)***
Weight headed and gutted	$(w/a)^{(1/b)}$	a= 0.000004592 b= 3.137	n/a	n/a	***Inverted length-weight equation. Reference not available***
Weight round	$(w/a)^{(1/b)}$	a= 0.000003815 b= 3.188	3,608	Min:89 Max:266	***Converted to GGT (GGT=RND/1.14 (Mejuto et al. 1998)) and inverted length-weight equation (ICCAT Mejuto et al. 1998 South-East Atlantic Ocean)***

ii. Breaking the samples according to the standard length frequency intervals used for the swordfish: The length-frequency intervals that are used for billfish species are shown in **Table 5**.

Table 5: Standard length, first length, interval and total number of size classes used for billfish species

Species	*Standard Length*	*First length (cm)*	*Interval between length classes (cm)*	*Total number of size classes*	*Maximum interval allowed (cm)*
Swordfish	Tip lower jaw - Fork of tail length*	15	3	150	5
Blue marlin	Eye orbit - Fork of tail length+	15	3	150	5
Black marlin	Eye orbit - Fork of tail length	15	3	150	5
Striped marlin	Eye orbit - Fork of tail length	15	3	150	5
Indo-Pacific sailfish	Eye orbit - Fork of tail length	15	3	150	5

NOTE: All samples in the IOTC database were assigned according to the specifications above; the samples recorded under length intervals greater than the maximum interval specified above were not used
***Refers to the straight distance measured, to the closest lower centimetre, between the tip of the lower-jaw and the fork of the tail**
+ Refers to the straight distance measured, to the closest lower centimetre, between the front orbit of the eye and the fork of the tail

   a. Allocation of specimens recorded under length classes that fall within a single standard length class:
      - Billfish specimens recorded under one centimetre length classes were aggregated under the corresponding three centimetre length classes (e.g. specimens recorded under the classes 15-16cm, 16-17cm and 17-18cm were accumulated under fork length class 15).
      - Billfish specimens recorded under two or three centimetre length classes that fell within standard length classes were assigned to the corresponding standard length classes (e.g. specimens recorded under length classes 15-17cm or 15-18cm -for length frequency data reported by 2cm or 3cm length intervals, respectively-, were assigned to standard length class 15-18cm)

b. Allocation of specimens recorded under length classes overlapping two or more standard length classes: all the specimens recorded under length classes that overlap the standard classes used for the species (**Table 3**) were assigned proportionally to the corresponding standard length classes (e.g. 1/2 of the swordfish specimens recorded under the length class 17-19cm were assigned to length class 15-18cm and 1/2 to length class 18-20cm; 1/5 of the specimens recorded under length class 17-21cm were assigned to length class 15-18cm, 3/5 to length class 18-20cm and 1/5 to length class 20-22cm). The specimens of swordfish from samples using length class intervals 6cm or higher were discarded.

Breaking the nominal catches by month and 5^{O} degree square grid

The aim of this process is to break the catches recorded in the nominal catches table by month and 5^{o} square grid. This information is used:

- For the estimation of total catches by fishery, year, quarter and assessment area: The catches recorded in the nominal catches table (by fleet, gear and year) need to be further broken by fishery, year quarter and assessment area (**Figure 2**).
- For the estimation of catch-at-size tables: The length distributions of tuna species may change depending on the area and/or time fished and therefore the estimation of catches-at-size is likely to be improved if this information is used.
- For the estimation of total catches by time-period and 5^{o} square area for the Tuna Atlas.

The steps given to assign the catches available for each NC stratum per month and 5^{o} square areas are indicated below:

i. Nominal catches strata for which time-area catches exist:
   a. Deleting time-area catches that are not representative of the fishery: Time-area catches for NEI-(deep)-freezing longliners and NEI-fresh tuna longliners were not used because they refer to very limited areas and time-periods and are not considered to be representative of the activities of these fleets.
   b. Breaking the nominal catches by time-period and area: The nominal catches were broken by time and area in years for which spatio-temporal catches are available for the fleet concerned.

ii. Nominal catches strata for which time-area catches do not exist:
   a. Time-area catches exist for the fleet concerned for a period up to 15 years before or after the year concerned:
      i. Time-area catches of the species concerned are available within the period specified: The catches recorded in the five years closest to the year of reference were accumulated and the average values obtained used to break the catches per area in the year concerned. Data extending to up to 15 years above or below the year concerned are used.
      ii. Time-area catches of the species concerned are not available within the period specified: The catches of other species are used, where available:
         a. The catches recorded in the year of reference were accumulated and the average values obtained used to break the catches by time and area in the year concerned.
         b. The catches recorded in the five years closest to the year of reference were accumulated and the average values obtained used to break the catches per area in the year concerned. Data extending to up to 15 years above or below the year concerned are used.
   b. Time-area catches do not exist for the fleet concerned for up to 15 years before or after the year concerned:
      i. Fleets that are presumed to operate as other fleets for which time-area catches exist: This refers mainly to industrial fleets. The catches per area available for other fleets (and years) are used to break the nominal catches per month and 5^{o} square area/s.
         a. Time-area catches exist for the alternative fleet during the year concerned: This information is used to break the nominal catches by time and area.
         b. Time-area catches do not exist for the alternative fleet during the year concerned: The same substitution scheme as the one defined in ii.a. above is used.

      The fisheries for which the above substitution scheme was used and the alternate fleets and gears selected for substitution in each case can be found in **Appendix IV**.
      ii. Fleets that are presumed to operate in specific areas: This refers mainly to artisanal and semi-industrial fleets. One or more 5^{o} square areas were assigned to each fleet.
         a. Time-area catches exist for other fleets in the areas concerned: The nominal catches are broken per month and area according to the proportion that the catches available from other fleets make in the area/s concerned.
         b. Time-area catches do not exist for other fleets in the areas concerned: The catches for the fleet concerned are broken proportionally per month and area.

Estimation of Catch-at-Size (CAS)

The aim of this process is to estimate length frequency distributions for each species, year and gear type. Thus, the accumulated weight estimated from the specimens making up the length frequency shall be the same than the total weight recorded in the stratum concerned and the weight issuing from all the strata shall be equal to the total catches recorded for the species in the year concerned. These data are used to estimate catches-at-age and other information used for stock assessment.

Reformatting of length frequency data

The time-area resolution used for the estimation of catches-at-size depends on the gear type.

i. Allocation of estimation areas: Two different types of estimation areas are used:

- Industrial purse seine fisheries: The statistical areas used for the sampling of EU purse seiners are used; these are shown on **Figure 3**.
- Other fisheries (industrial longline plus all artisanal fisheries): 10° latitude by 20° longitude areas are used, as shown on **Figure 4**[4].

Figure 3: Areas used for industrial purse seiners

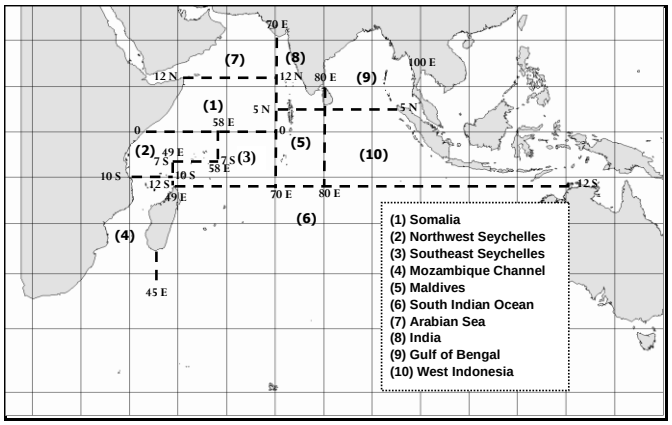
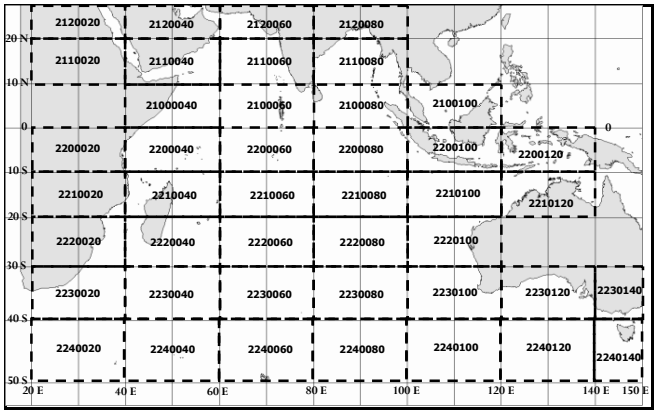


Figure 4: Areas used for other fisheries



The samples in the size frequency table are recorded under different types of geographic areas. The following process was followed to allocate the existing samples by estimation area:

a. Allocation of samples recorded under irregular areas: The samples recorded under irregular areas (e.g. port of unloading, fishing district, etc.) were assigned to regular areas.
b. Allocation of specimens recorded under areas that fall within a single standard area: all specimens recorded under areas that fell within the standard areas were assigned to the corresponding areas (as shown on **Figures 3-4**).
c. Allocation of specimens recorded under areas overlapping two or more standard areas: the specimens recorded under areas overlapping two or more standard areas (**Figures 3-4**) were assigned proportionally by estimation area (i.e. by using the proportions obtained by dividing the amount of 1 degree square grids that fell within each estimation area over the total amount of squares from the overlapping area).

ii. Time period allocation: The available length frequency samples were assigned by quarter as follows:

a. Allocation of specimens recorded under time-periods that fall within a single quarter: all specimens from samples recorded under time periods that fell within a quarter were assigned to the corresponding quarter.
b. Allocation of specimens recorded under time-periods overlapping two or more quarters: all specimens from samples recorded under time-periods that overlapped two or more quarters were assigned proportionally by quarter (e.g. 2/3 of the specimens recorded under the time period February-April of any year were assigned to the first quarter (Jan-Mar) of that year while the remaining 1/3 specimens were assigned to the second quarter (Apr-Jun)).

iii. Estimation of sample weight: The weight for each sample was calculated by adding the weights estimated for all the specimens making it. The equations used to estimate weights from the available lengths are shown in **Table 6** (note that deterministic methods were used for the conversion).

Estimation of catch-at-size tables

The amount of length frequency data available is scarce for some fisheries and/or periods with samples not available for all strata in which catches are recorded or sample numbers too low to be considered. Thus, substitution is required where samples are not available for a fleet-gear(fishing mode)-year-quarter-estimation area (figures 3-4) or where sample numbers are very low.

For this purpose the minimum sample size was set to 30 specimens, i.e. strata with no samples available or with samples made up of less than 30 fish are combined with other strata in order to attain the minimum number of specimens required prior to the estimation of catch-at-size for the strata concerned.

[4] Note that Japan and Taiwan,China have always reported size data for their longline fisheries as per the areas shown on Figure 4

Table 6: Equation used to convert billfish measurements in standard length to round weight

Species	*Gear Type/s*	*From type length – To round weight*	*Equation*	*Parameters*	*Sample size*	*Length*
Swordfish	All gears	Tip of lower-jaw to fork of caudal fin length(cm) – Round Weight(kg)[A]	$w^{live} = aFL^{b}$	a= 0.0000042030 b= 3.21340	2569	Min:80 Max:253
Black marlin	All gears	Front of eye orbit to fork of caudal fin length(cm) – Round Weight(kg) [B]	$w^{live} = aEFL^{b}$	a= 0.0000144217 b= 2.98851	24	Min:95 Max:279
Blue marlin	All gears	Front of eye orbit to fork of caudal fin length(cm) – Round Weight(kg) [B]	$w^{live} = aEFL^{b}$	a= 0.00000272228 b= 3.30967	154	Min:109 Max:269
Striped marlin	All gears	Front of eye orbit to fork of caudal fin length(cm) – Round Weight(kg) [B]	$w^{live} = aEFL^{b}$	a= 0.00000133263 b= 3.41344	17	Min:101 Max:178
Indo-Pac. sailfish	All gears	Front of eye orbit to fork of caudal fin length(cm) – Round Weight(kg) [B]	$w^{live} = aEFL^{b}$	a= 0.0000690103 b= 2.52429	35	Min:86 Max:187

A: Data from the Atlantic Ocean, Spanish longline fishery (Mejuto et al., 1988, ICCAT)

B: PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands)

The substitution scheme used to assign length frequency data to all strata having catches is explained below:

i. Length frequency data are available for the stratum concerned:
   a. Deleting samples from the length frequency table: The samples recorded for South Korea were not used because they are presumed to be very incomplete.
   b. Assigning the available length frequency distributions by strata: The remaining length frequency distributions were assigned by strata.

ii. Length frequency data are not available for the stratum concerned:
   a. Length frequency data are available within the year before or after the quarter concerned:
      i. Length frequency data are available for the same fleet and gear. Two substitution schemes are used depending on the gear type:
         a. Industrial purse seiners: The estimation areas defined in **Figure 3** are used. The following latitude and longitude are assigned to each area[5]:

Table 7: Coordinates assigned to PS areas (used for strata substitution)

PS Area	*Q-Lat-Lon*	*PS Area*	*Q-Lat-Lon*
(1) Somalia	1 00 040	(6) S Indian Ocean	2 20 060
(2) NW Seychelles	2 00 020	(7) Arabian Sea	1 20 040
(3) SE Seychelles	2 00 060	(8) India	1 00 080
(4) Moz. Channel	2 10 020	(9) Gulf of Bengal	1 00 100
(5) Maldives	2 00 080	(10) W Indonesia	2 00 100

         b. Other gears: The estimation areas defined in **Figure 4** are used. Two regions are identified:
            i. Areas below 10°S
            ii. Areas above 10°S

Table 8: Time-area substitution scheme used to assign samples to nominal catches strata with less than 30 swordfish lengths measured (note that only the first five steps and the last are shown)

Step	*Lat*	*Long*	*Qtr*	*Description*
1	0	0	-0.25	Length frequency data from the same area and previous quarter are used for substitution, if any
2	0	0	0.25	Length frequency data from the same area and following quarter are used for substitution, if any
3	0	-20	0	Length frequency data from the first area to the West and same quarter are used for substitution, if any
4	0	20	0	Length frequency data from the first area to the East and same quarter are used for substitution, if any
5	0	-20	-0.25	Length frequency data from the first area to the West and previous quarter are used for substitution, if any
764	0	120	1.00	Length frequency data from the area 120 degrees to the East and following year are used for substitution, if any

Note that the latitude and longitude defined above for industrial PS and those from the 10*20 grids for other fisheries are used

The sizes of the specimens of yellowfin tuna and bigeye tuna seem to vary markedly depending on the latitude. The substitution scheme is therefore applied independently to each area (i.e. Length frequency data from areas

[5] Note that the substitution scheme is based on changes in time and/or space (latitude and/or longitude). The areas assigned are used for the substitution.

below 10°S are not used for strata in the North and *vice versa*). **These regions are used for all species, including swordfish. The size data available for the swordfish need to be analyzed in order to assess if the sizes of swordfish vary significantly depending on the area or time fished.**

The substitution process is based on changes in time (quarter) and/or space (latitude and/or longitude). An example of the first substitution steps is shown in **Table 8** (previous page).

ii. No length frequency data are available for the same fleet and gear: Information from other fleet/s is used. The length frequency data available from other fleets that are presumed to operate the same areas and/or use the same fishing techniques are used for substitution. The same substitution scheme in time and area is applied in each case. Three levels of aggregation are established. The complete substitution tables for each species are shown in **Appendix V**. **Table 9** below shows an example of the substitution scheme:

Table 9: Nominal catches strata and alternative fleets from which length frequency samples are used in the case that less than 30 lengths of swordfish are available for the NC strata concerned (example)

Catch Strata			*Level Aggregation 1*		*Level Aggregation 2*		*Level Aggregation 3*	
Species	*Gear*	*Fleet*	*Gear Ag1*	*Fleet Ag1*	*Gear Ag2*	*Fleet Ag2*	*Gear Ag3*	*Fleet Ag3*
SWO	LL	IND	LL	AG3	LL	AG2	LL	AG1
SWO	LL	IRN	LL	AG2	LL	AG2	LL	AG1
SWO	LL	JPN	LL	AG1	LL	AG1	LL	AG1
SWO	LL	KOR	LL	AG1	LL	AG1	LL	AG1
SWO	LL	NEI-DFRZ	LL	AG3	LL	AG2	LL	AG1
SWO	LL	PHL	LL	AG3	LL	AG2	LL	AG1
SWO	LL	SUN	LL	AG2	LL	AG2	LL	AG1
SWO	LL	SYC	LL	AG3	LL	AG2	LL	AG1
SWO	LL	THA	LL	AG1	LL	AG1	LL	AG1
SWO	LL	TWN	LL	AG3	LL	AG2	LL	AG1

For example, if no samples of swordfish are recorded for the longline fishery of South Korea in the NC stratum concerned (or the sample is made up of less than 30 specimens) the samples available for South Korea and/or Japan and/or Thailand are combined. The time-area substitution scheme referred to in the previous section applies also in this case.
If no samples are available for the above fleets the second level of aggregation is used and the third level is used in the case that no samples are found.

b. No length frequency data are available within the year before or after the quarter concerned:

i. Length frequency data are available for the same fleet in other years: The samples for the three years that are closest to the year concerned are used. Only the samples from the 15 years before or after the year concerned are used.

ii. No length frequency data are available for the same fleet in other years or they are very far in time (more than 15 years ahead or behind the year concerned). The available length data for other fleets are used. The information from the fleets and gears specified in **Appendix V** and the above substitution scheme (b.i.) apply in this case.

c. No Length frequency data are available for the gear concerned in the 15 years before or after the year concerned:

i. Length frequency data are available for the same fleet and gear anytime at all: all available samples are used (i.e. the accumulated length frequency for the whole period is used).

ii. No length frequency data are available for the same fleet and gear anytime at all: The available length data for other fleets are used. The information from the fleets and gears specified in **Appendix V** and the above substitution scheme (c.i.) apply in this case.

The average weights estimated from the samples (by using the equation in **Table 6**) are used to estimate the number of specimens or the weight for each stratum in the CAS table:

- Longline fisheries: The catches are usually recorded in numbers. The average weights estimated from the sample are multiplied by the numbers of fish recorded (from the NC table) to obtain the weights per stratum. This method is also used for fisheries other than longline for which only numbers of fish are recorded.
- Other fisheries: The catches are usually recorded in weight. The average weights estimated from the sample are divided by the weight recorded (from the NC table) to obtain the numbers per stratum. This method is also used for longline fisheries for which only the weights are recorded.

The resulting weights are accumulated per fleet, gear, year, species and IOTC Area. The factor resulting from dividing the total catches estimated for the species (nominal catches) and those issuing from the CAS table is used to estimate total weight, total number of fish and number of fish per length class for each stratum in the CAS table (i.e. the numbers of swordfish by length class for each stratum are scaled up/down so as the total number of fish for the stratum matches the number of fish estimated in the NC)

Estimating total catches by year, quarter, assessment fishery and assessment area (NC_{INPUT})

The catches and numbers of fish in the NC table were weighted by using the method covered in the previous section. The catches in the resulting NC table are then aggregated as follows:

i. Allocation of assessment fishery: Each Fleet-gear stratum in the NC table was assigned to the corresponding assessment fishery. Details on the fisheries that were assigned to each fleet-gear length frequency stratum can be found in **Appendix III**. The fisheries that are used for the assessment of swordfish are presented in **Table 3** (page3).

ii. Allocation of assessment area: The catches in the NC table were aggregated by assessment area. The areas used for the assessment are shown on **Figure 2** (page 3). The catches of swordfish from areas outside the four assessment areas were assigned to the closest area, as indicated through the arrows on **Figure 2.**

The following process was used to allocate the existing samples by area:

a. Allocation of catches for selected fisheries to specific assessment areas: The catches of swordfish estimated for some selected fisheries were fully assigned to specific assessment areas on the assumption that the majority of the catches from those fisheries came from the area assigned. This is thought to be the case with the majority of the artisanal fisheries having catches of swordfish and with a limited number of industrial fisheries. Details on the areas that were assigned to each fleet-gear catch stratum can be found in **Appendix II**.

b. Allocation of catches for other fisheries: All other catches in the NC table were assigned to the corresponding assessment areas, i.e. the catches recorded under each 5 square area were assigned to the assessment area containing that 5^0 square area. The catches estimated for 5^o squares outside the assessment areas were assigned to the closest assessment area, as indicated through the arrows on **Figure 2**.

iii. Aggregation of catches by year, quarter, assessment area, and assessment fishery: The above catches were aggregated by year, quarter, assessment area, and assessment fishery. An example of the Input Table containing the Total Catches can be found in **Appendix I**.

Assigning samples by year, quarter, assessment fishery and assessment area (FL_{INPUT})

The length frequency data in standard format (page 5) were used to derive the samples to be used for the assessments of swordfish. The following process was followed to create the table FL_{INPUT}:

i. Scaling raised length frequency data down to sample numbers: The length frequency data in the IOTC database do not represent sample numbers in all cases as some countries report length frequency data that has been raised in various ways (e.g. to the catches in the stratum covered through sampling, to the total catches estimated for the country, etc.). The sample numbers were used in these cases to scale down the reported length frequency data, i.e. the number of specimens recorded under each length class was multiplied by the number obtained by dividing the total number of specimens sampled (all lengths combined) by the total number of specimens in the raised length frequency (all lengths combined).

ii. Allocation of assessment area: The existing samples were aggregated by assessment area. The following process was used to allocate the existing samples by area:

a. Allocation of the samples available for selected fisheries to specific assessment areas: The samples available for some selected fisheries were fully assigned to specific assessment areas on the assumption that the majority of the specimens sampled on those fisheries came from the area assigned. This is thought to be the case with the majority of artisanal fisheries for which there is size data available and with a limited number of industrial fisheries. Details on the areas that were assigned to each fleet-gear size frequency stratum can be found in **Appendix II.**

b. Allocation of the samples available for other fisheries:

   a. Allocation of specimens recorded under areas that fall within a single assessment area: all specimens from samples recorded under areas that fell within one of the areas used for the assessment (**Figure 2**) were assigned to the corresponding assessment area.

   b. Allocation of specimens recorded under areas overlapping two or more assessment areas: all specimens from samples recorded under areas that overlapped two or more assessment areas were assigned proportionally by assessment area using the proportion that the catches in each area made out of the total catches in all overlapping areas.

iii. Time period allocation: The available length frequency samples were assigned by quarter in the same way as indicated in iii.a. and iii.b. (page 6)

iv. Allocation of assessment fishery: Each Fleet-gear stratum in the length frequency data table was assigned to the corresponding assessment fishery (**Appendix III**).

The resulting data were aggregated to obtain the number of swordfish specimens sampled by standard length interval (3cm), year, quarter, assessment fishery, and assessment area. An example of the Input Table containing the samples of swordfish can be found in **Appendix I**.

Assigning Catch-at-Size by year, quarter, assessment fishery and assessment area (**CAS_{INPUT}**)

Catch-at-Size data are estimated for each fleet-gear(fishing mode)-year-quarter strata. The following process was followed to create the table **CAS_{INPUT}**:

i. Allocation of assessment area: CAS were aggregated by assessment area. The following process was used to allocate CAS by area:
   a. Allocation of the CAS for selected fisheries to specific assessment areas: The CAS for some selected fisheries were fully assigned to specific assessment areas on the assumption that the majority of the specimens sampled on those fisheries came from the area assigned. This is thought to be the case with the majority of artisanal fisheries for which there is size data available and with a limited number of industrial fisheries. Details on the areas that were assigned to each fleet-gear size frequency stratum can be found in **Appendix II.**
   b. Allocation of the CAS for other fisheries:
      a. Allocation of specimens recorded under estimation areas that fall within a single assessment area: CAS recorded under estimation areas that fell within one of the areas used for the assessment (**Figure 2**) were assigned to the corresponding assessment area.
      b. Allocation of specimens recorded under estimation areas overlapping two or more assessment areas: CAS recorded under estimation areas that overlapped two or more assessment areas were assigned proportionally by assessment area using the proportion that the catches in each area made out of the total catches in all overlapping areas.

ii. Allocation of assessment fishery: Each Fleet-gear stratum in the length frequency data table was assigned to the corresponding assessment fishery (**Appendix III**).

The resulting data were aggregated to obtain the total number of swordfish specimens caught by standard length interval (3cm), year, quarter, assessment fishery, and assessment area. An example of the Input Table containing CAS of swordfish can be found in **Appendix I**.

Estimating Catch-at-Age (**CAA_{INPUT}**)

The catches-at-age (CAA) for the swordfish were estimated from the available catches-at-size (CAS_{INPUT}).
CAA was estimated using a VB model and swordfish data from the Indian Ocean (Young, J., and A. Drake. 2004[6]):

$$L(t) = L_{\infty}\left(1 - e^{-K[t-t_0]}\right)$$

Where:

Species	Sex	L_{∞}	t_0	*k*
SWO	Female	323.4	-3.413	0.08148
	Male	260.47	-3.3808	0.1096

An Age-Length key, both sexes combined, was derived from above (Sheng-Ping Wang, *pers.comm.*) and used to convert the numbers of specimens estimated by length (CAS) into age (CAA). The referred Age-Length key is shown in **Appendix VI**.
The resulting Catches-at-Age were aggregated by Age class (0-15+), year, quarter and assessment fishery. An example of the Input Table containing the CAA table to be used in the ASPM stock assessments can be found in **Appendix I**.

[6] Young, J., and A. Drake. 2004. Age and growth of broadbill swordfish (*Xiphias gladius*) from Australian waters. Final report for project 2001/014, Fisheries Research Development Corporation, Canberra, Australia. 121 pp.

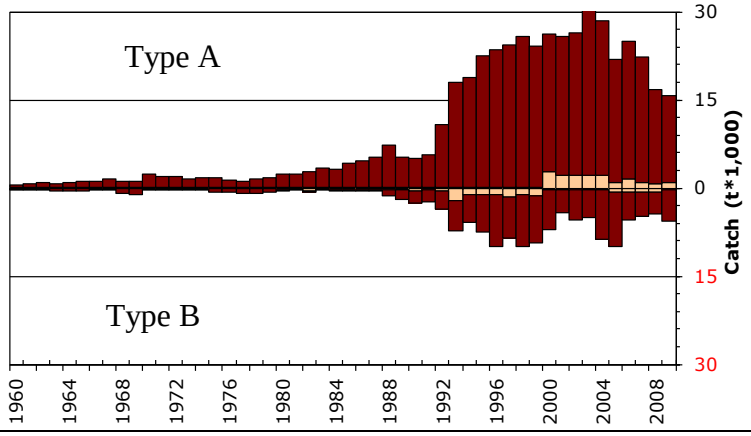
Results

Total catch by year

The total catches by assessment fishery and year estimated from the process for the swordfish are shown in **Appendix VII**. The catches estimates for 2008-09 are likely to change in the future, especially for some longline fleets that have reported preliminary catches to the Secretariat (Taiwan,China, Japan, Indonesia).
Swordfish are caught by industrial longliners, gillnets and, to a lesser extent, other artisanal or recreational fisheries. **Figure 5** shows the status of the catches of swordfish for 1959-2008.

Figure 5: Uncertainty of time-area catches for swordfish (Data as of May 2011)

*Catches below the zero-line (**Type B**) refer to fleets that do not report catch-and-effort data to the IOTC, do not report catch-and-effort data by gear and/or species or any of the other reasons provided in the document. Catches over the zero-line (**Type A**) refer to fleets for which no major inconsistencies have been found to exist. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets.*



The catches of swordfish estimated are thought to be more uncertain since the mid-90's due to:

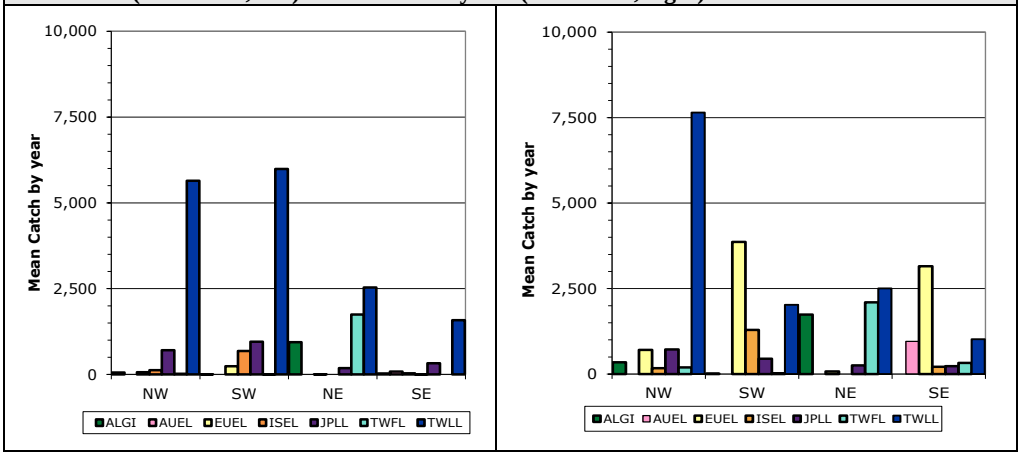
- The catches of swordfish estimated for the fresh tuna longline fishery of Indonesia may have been underestimated in recent years. The majority of the catches of albacore and swordfish are stored and unloaded frozen and are seldom sampled in port. Although no market data for swordfish are available at the moment, the Secretariat believes that the catches of swordfish may be underestimated by as much as 4,000 t in recent years.
- To date, Iran has not reported catches of swordfish for its gillnet fishery. In recent years, many Iranian vessels have moved on to the high seas, using drifting gillnets to catch tunas and other species. The fleet is operating in the northwest Indian Ocean (Figure 2), which is the area that has recorded the highest catches of swordfish in recent years. The Secretariat has little information on the activities of this fleet which has made it impossible to estimate catches of swordfish for the fleet. The catches of swordfish by this fleet may represent as much as 5,000 t in recent years.
- Poor reports from IOTC CPC's: The catches of swordfish recorded for the longline fleet of India were estimated by the IOTC Secretariat as India has never reported catches for its commercial longline fleet (around 100 vessels operating since 2004). Malaysia and Indonesia do not report catches for longliners under their flags that are not based in these countries. The catches for this component were estimated by the IOTC Secretariat.
- Non-reporting industrial longliners (NEI): The amount of non-reporting longliners targeting swordfish was high during the 1990's and early 2000's due to the shift of vessels from the Atlantic Ocean to the Indian Ocean. The catches of these vessels were estimated by the Secretariat by using information from various sources.
- Conflicting catch reports: The catches for South Korean longliners reported as nominal catches and catches and effort are conflicting, with higher catches recorded in the CE table for some years. The Secretariat revised the catches of swordfish for the Korean fleet for the period concerned.

Catches per quarter, fishery and assessment area and Catch-at-Size data (CAS_{INPUT})

The precision of the estimates is likely to vary depending on the quality of the catches (see the above section), the availability of catches in time and space and the amount (coverage) and representativeness of the samples available for swordfish.

Completeness of time-area catches: **Figures 6** and **7** show mean catches (tonnes) of swordfish by year estimated by assessment area and fishery for 1990-99 and 2000-09.

Figures 6-7: Average catches of swordfish by year estimated by Area and Fishery for the entire time series (1990-1999; left) and in current years (2000-2009; right)



The amount of catches that are available in time and space *versus* the total catches of swordfish estimated are shown in the **Figures 8 to 12**. The amount of catches for which time-area information is available has been changing over time. Three different periods can be identified:

- 1954-1966: The total catches of swordfish estimated for this period are low (below 1,500t). Between 20-30% of the total catches estimated come from fisheries for which time-area catches are either not available or poor quality. No time-area catches are available from the Taiwanese longline fleet for this period.
- 1967-1988: The total catches of swordfish estimated for this period range between 1,500t and 3,000t (1967-84) and between 4,000t and 8,000t for subsequent years (1985-88). Time-area information is available from the majority of the fleets with catches of swordfish estimated for this period, representing more than 95% of the total catches of swordfish estimated in most years.
- 1989-2009: The total catches of swordfish estimated for this period range between 6,000t and 35,000t. Between 25-30% of the total catches estimated come from fisheries for which time-area catches are either not available or poor quality. No time-area catches are available for:
    - Fresh-tuna longliners from Taiwan,China (1984-2006) and Indonesia (1973-2009)
    - Longliners from India (2004-09) and various other fleets, in particular longline fleets targeting swordfish (NEI) (2000's)

Figure 8: Total catches of swordfish (SWO) available in time and space *versus* the total catches recorded for the species (all gears combined).

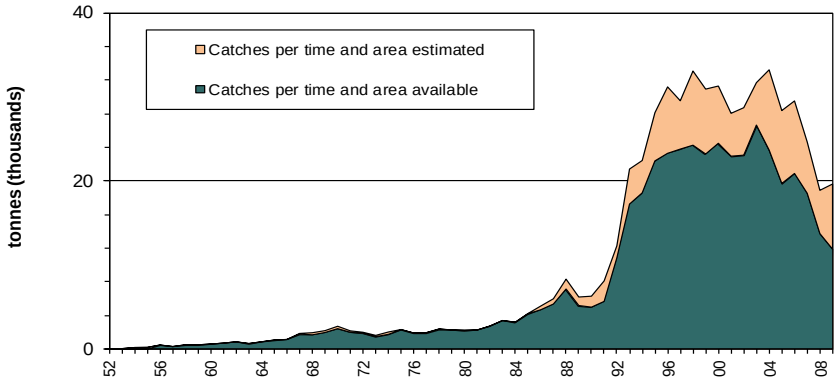


Figure 9: Total catches of swordfish (SWO) available in time and space *versus* the total catches recorded for the species (longline Taiwan,China and assimilated fleets)

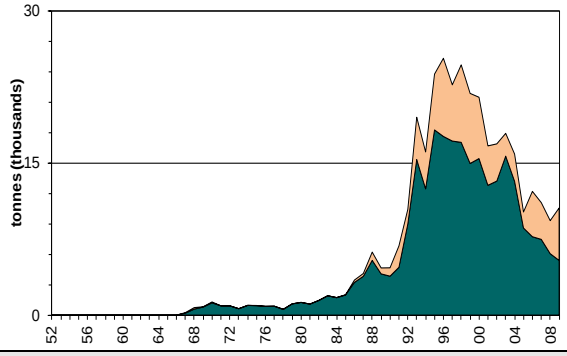


Figure 10: Total catches of swordfish (SWO) available in time and space *versus* the total catches recorded for the species (longline fisheries for swordfish)

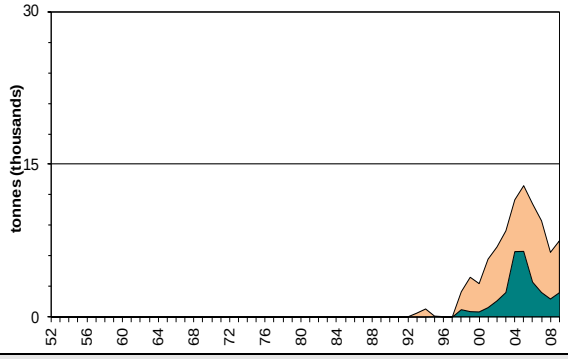


Figure 11: Total catches of swordfish (SWO) available in time and space *versus* the total catches recorded for the species (longline Japan and assimilated fleets)

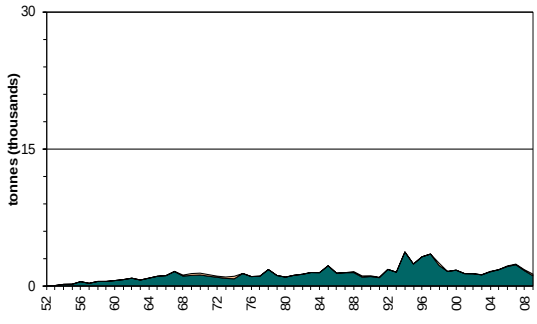
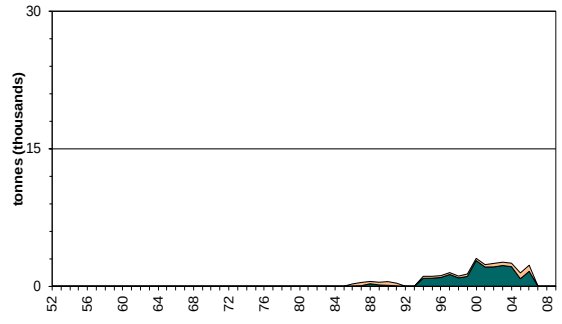


Figure 12: Total catches of swordfish (SWO) available in time and space *versus* the total catches recorded for the species (artisanal fisheries).



The lack of data or poor quality data existing for some periods and/or fisheries may compromises the quality of the catches that are estimated for the assessments of swordfish, as this information is used to break the catches in the nominal catches by quarter and assessment area.

Completeness of length data: The total numbers of swordfish caught and sampling coverage estimated for 1950-2009, by year and fishery, are shown in **Figures 13 to 17**. The coverage was estimated as the amount (expressed as a percentage) that the total amount of swordfish (in number) from strata having at least 30 specimens of swordfish sampled made out of the total amount of swordfish (numbers) estimated for that year, and fishery. The amount of catches for which length frequency samples are available has been changing over time. Four different periods can be identified:

- 1950-1969: The total catches of swordfish estimated for this period are low (below 1,500t in most years). No size frequency data are available for this period. The majority of the catches of swordfish for the period come from the Japanese and Taiwanese longline fleets.

- 1970-1979: The total catches of swordfish estimated for this period range between 2,000t and 3,000t. Size frequency data is only available for the longline fishery of Japan. Between 3-16% of the total catches estimated (in number) are covered through sampling. Samples are not available for the longline fishery of Taiwan,China during this period.
- 1980-1991: The total catches of swordfish estimated for this period range from 2,000t to 8,000t. Samples are available for the majority of the strata having catches of swordfish, representing 55-90% of the total catches of swordfish estimated (in number), depending on the year.
- 1992-2009: The total catches of swordfish estimated for this period range between 14,000t and 35,000t. Between 40-60% of the total catches estimated (in number) come from fisheries for which samples are available. The main problems are:
    - Poor sample sizes and time-are coverage for the longline fishery of Japan
    - Lack of length samples for the longline fisheries of India, Oman and various other flags (NEI)
    - Lack of samples or poor quality samples from gillnet and other artisanal fisheries.

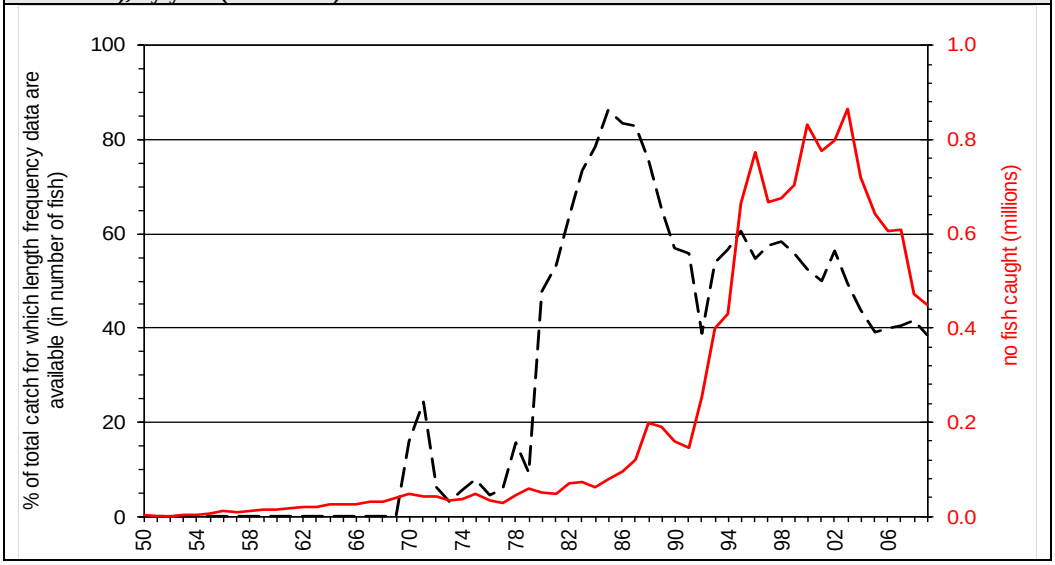
The lack of length samples or low sampling coverage for some periods and/or fisheries may compromise the assessments that use length frequency samples or CAA data derived from estimates of CAS, adding uncertainty to the results.
The numbers of fish measured per strata in relation with the total numbers caught by several longline fisheries, mainly Japan, has been declining in recent years. The representativeness of the samples might be also compromised for this reason.

Figures 18-29 show length frequency distributions for original samples (blue line) and catches at size estimated (orange bars) for the entire catch-series, all fisheries combined, and by decade and type of fishery (only periods from which samples are available are shown).
Figures 30-31 show the catches at size estimated for periods in which no samples were available, for the longline fisheries of Taiwan,China and Japan.

The length frequency distributions for some fisheries and periods differ significantly from the length frequency samples; this is especially the case with:

- Longline fishery of Japan and other assimilated fleets for the period 2000-09
- Longline fishery of Taiwan,China and other assimilated fleets for the period 2000-09
- Artisanal fisheries over the entire period

Figure 13: Total numbers of swordfish (SWO) estimated (continuous line) and proportion (in number of fish) estimated (broken line) for strata having length frequency data (all gears combined), by year (1950-2009).



Figures 14-17: Total numbers of swordfish (SWO) estimated (continuous line) and proportion (in number of fish) estimated (broken line) for strata having length frequency data, by year (1950-2009): longline Taiwan,China and assimilated fleets (top left), longline fisheries for swordfish (top right), longline Japan and assimilated fleets (bottom left), and artisanal fisheries (bottom right)

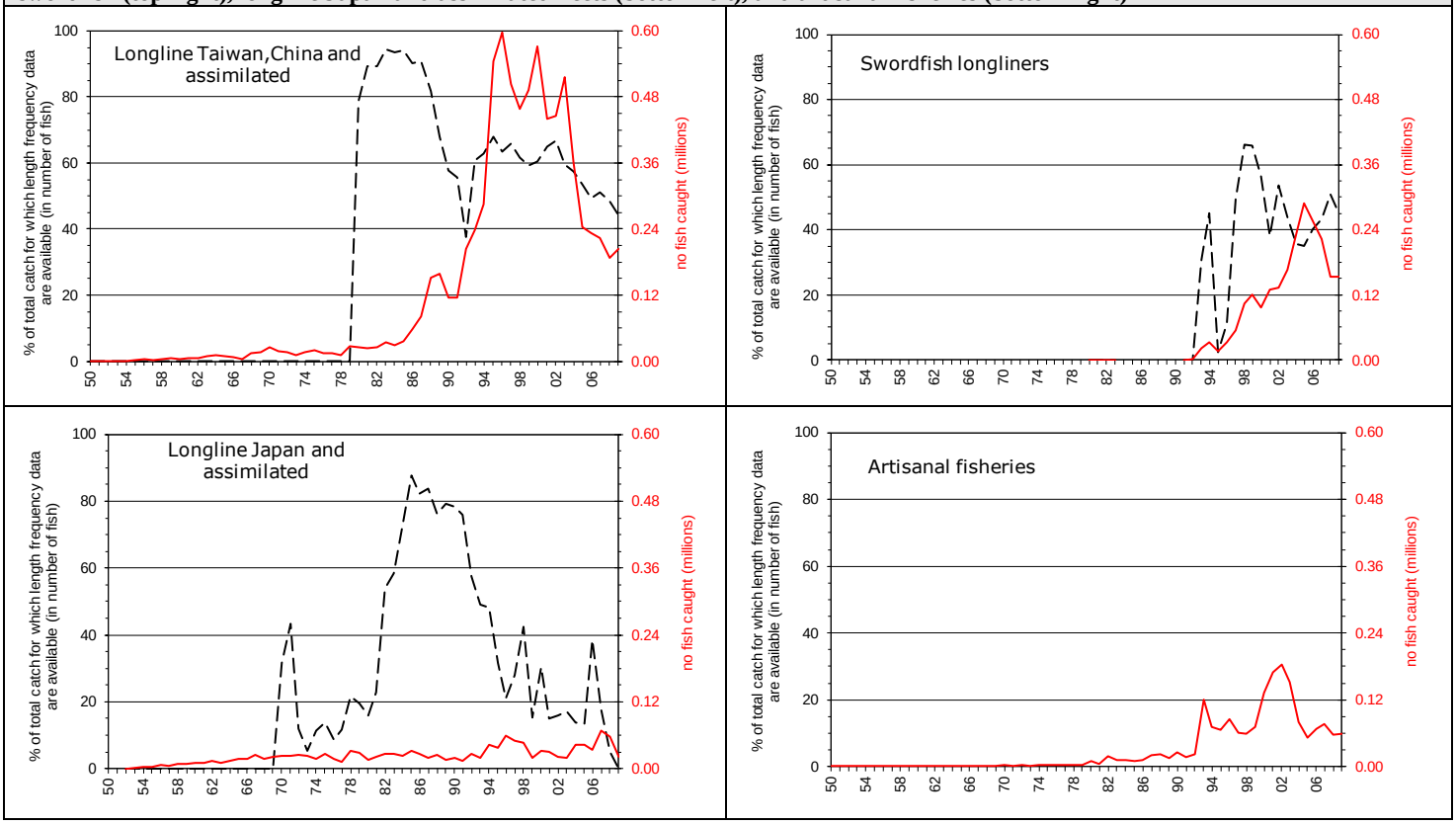
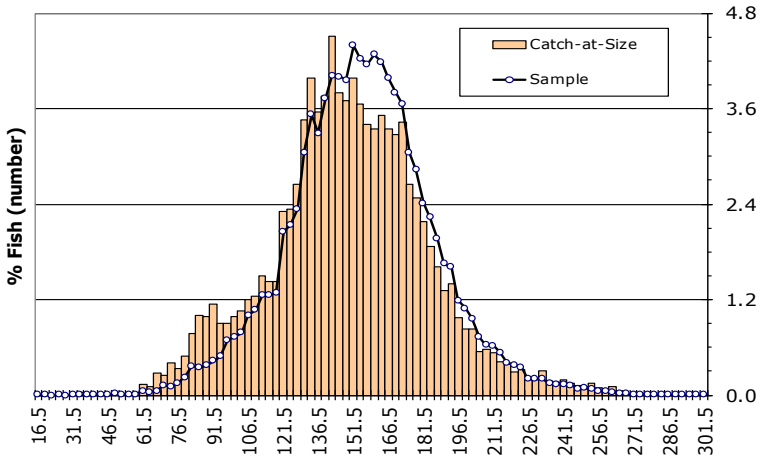
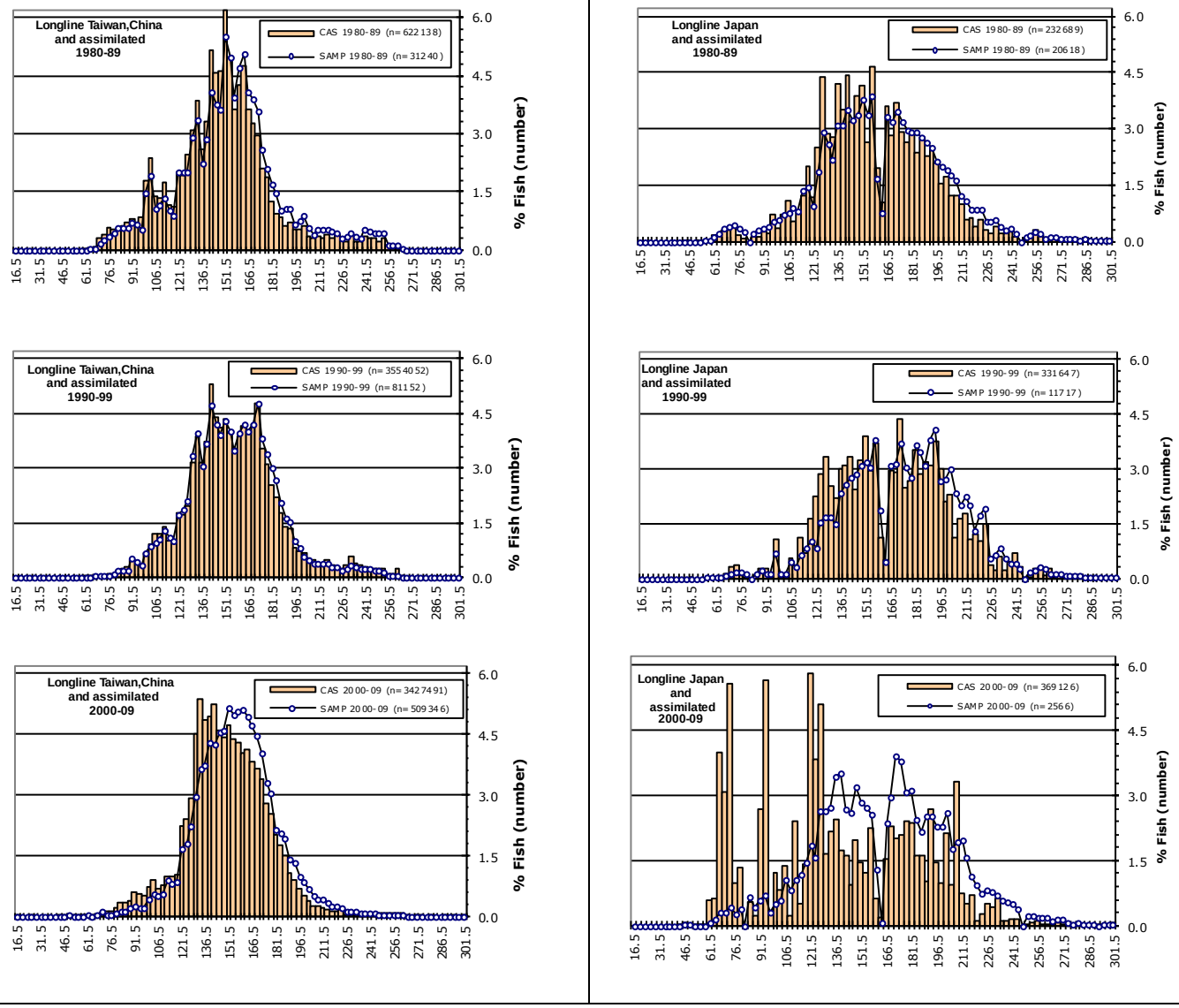


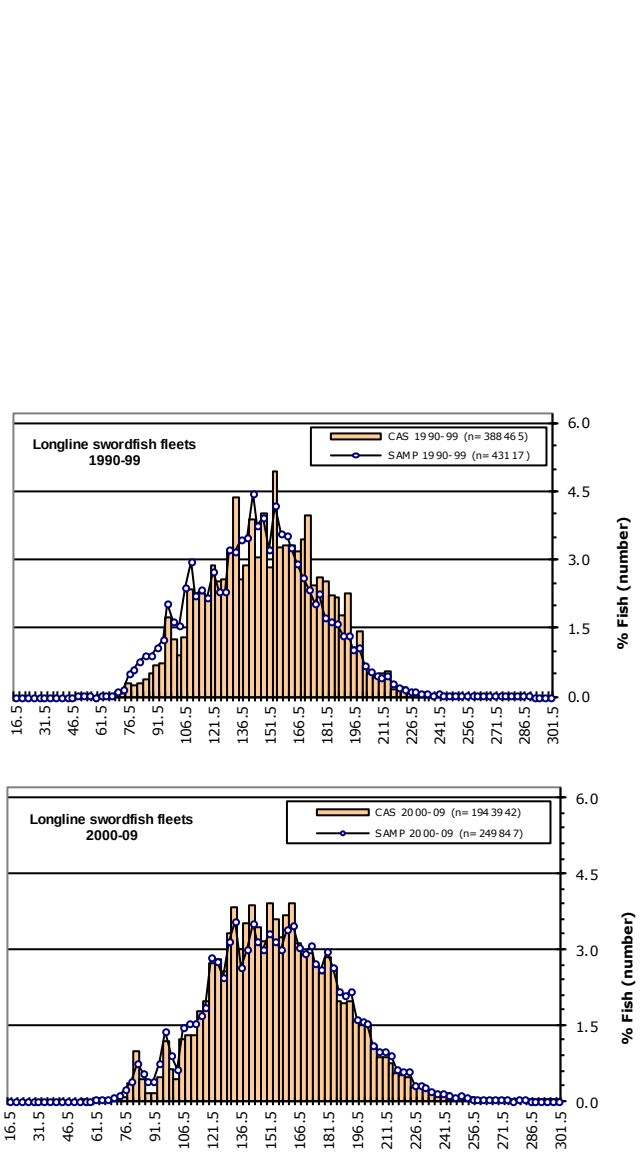
Figure 18: Proportion that the numbers of swordfish sampled (blue line)/estimated (CAS; orange bars) under each 3cm length class (in number) make out of the total numbers of swordfish sampled/ estimated over the entire time-area series (1950-2009), all fisheries combined

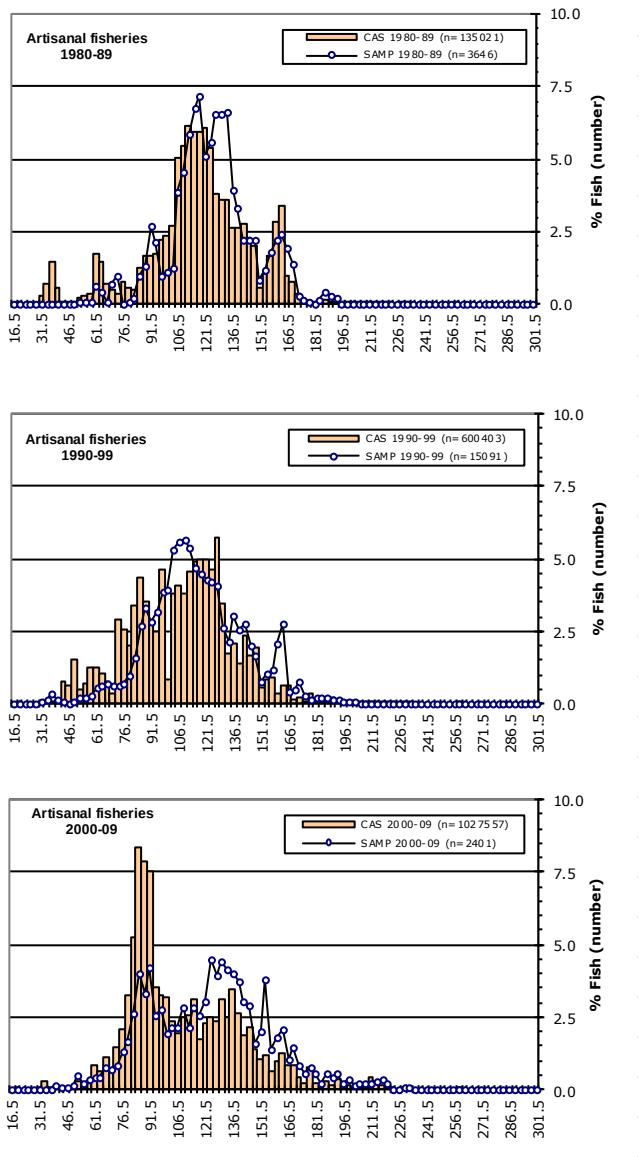


Figures 19-24: Proportion that the numbers of swordfish sampled (blue line)/estimated (CAS; orange bars) under each 3cm length class (in number) make out of the total numbers of swordfish sampled/estimated over different periods, by fishery

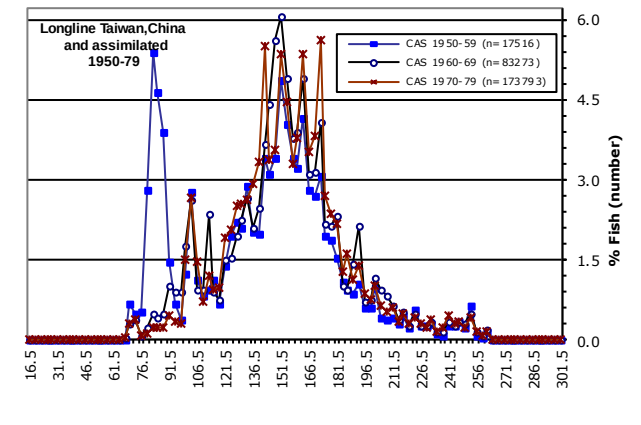


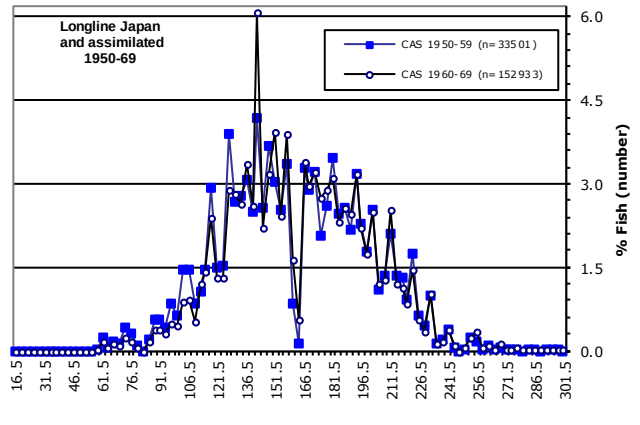
Figures 25-29 (cont.): Proportion that the numbers of swordfish sampled (blue line)/estimated (CAS; orange bars) under each 3cm length class (in number) make out of the total numbers of swordfish sampled/estimated over different periods, by fishery





Figures 30-31: Proportion that the numbers of swordfish estimated (CAS) under each 3cm length class (in number) make out of the total numbers of swordfish estimated over periods in which no samples were available, by fishery

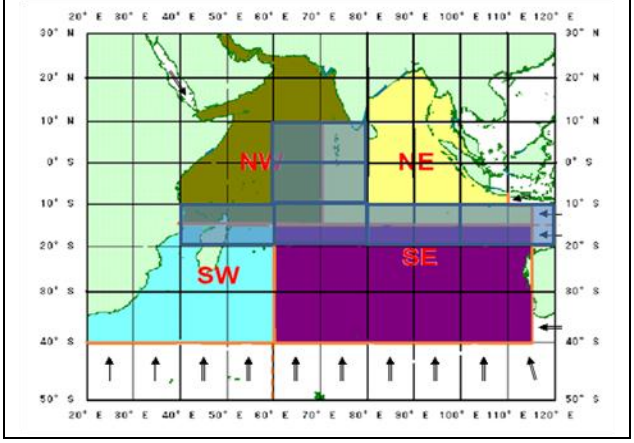




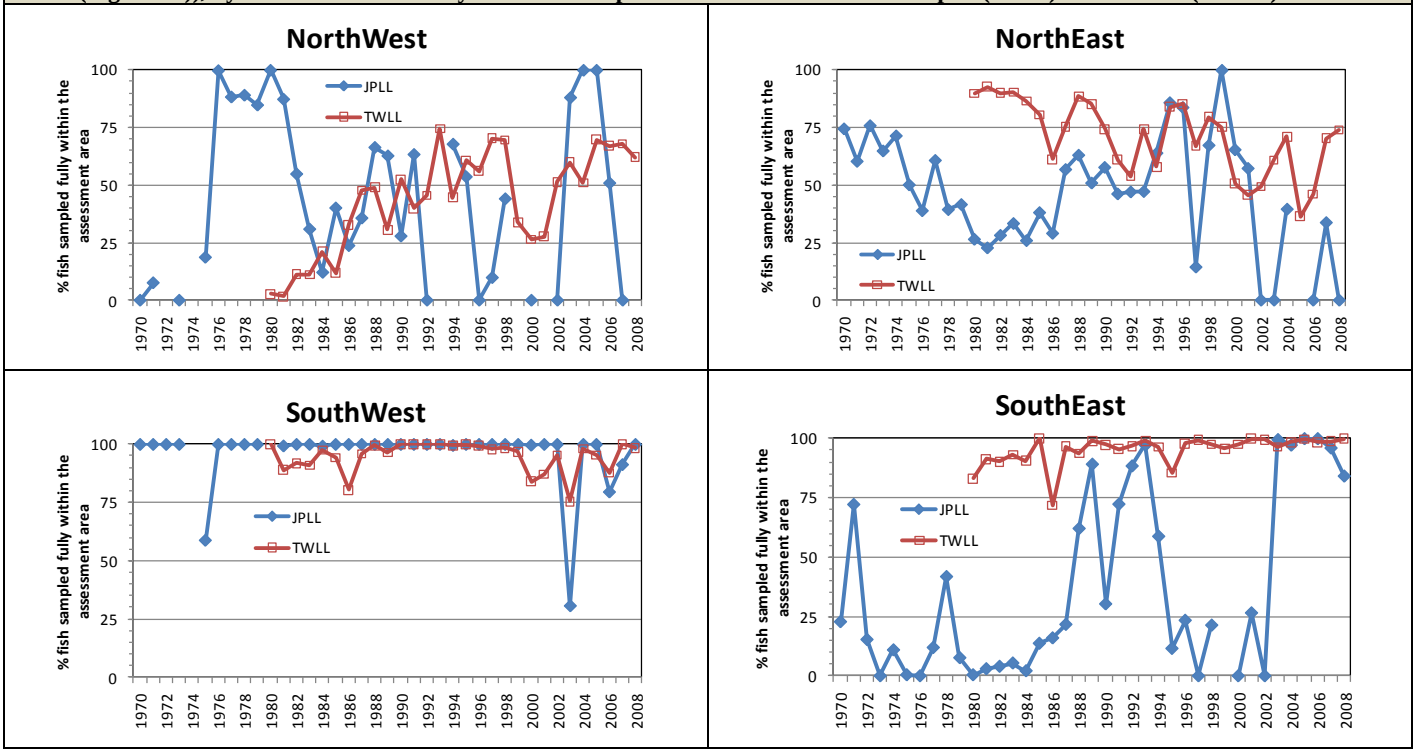
The following reasons may explain the referred discrepancies:

- No weighting applied in the aggregation of samples under the strata selected for the assessment: No weighting procedure is used in the allocation of the individual samples available to the fishery, area and period concerned. The samples available for each assessment area, fishery, year and quarter are aggregated by summing up all the specimens sampled by length class from all the fleets and gears concerned and over the entire area and period. However, the sample weights derived from the samples may represent various levels of coverage, depending on the strata involved.
- Catches at size derived from samples containing a low number of specimens: The shape of some CAS distributions tends to suggest that the number of specimens from which the catches at size were derived is too low. The minimum number of specimens needed for a sample to be raised to total catches, 30 specimens, is the same for all species. This number may be insufficient for species having a wide length frequency distribution, as it is the case with the swordfish.
- The samples available are not representative of the fishery concerned: In recent years the majority of the samples available for the longline fishery of Japan come from training vessels. The representativeness of the samples collected on training vessels is uncertain, as these vessels do not necessarily operate the same areas or use the same fishing techniques as the commercial vessels from Japan.

Figure 32: 10-20 areas (grey shading) that overlap two or more of the assessment areas used for Indian Ocean swordfish



Figures 33-36: Proportion that the number of swordfish from samples that fall fully within an assessment area makes out of the total number of swordfish allocated to the area (following the disaggregation of samples from areas overlapping two or more assessment areas (Figure 34)), by assessment area and year. Data are presented for the fisheries of Japan (JPLL) and Taiwan (TWLL).



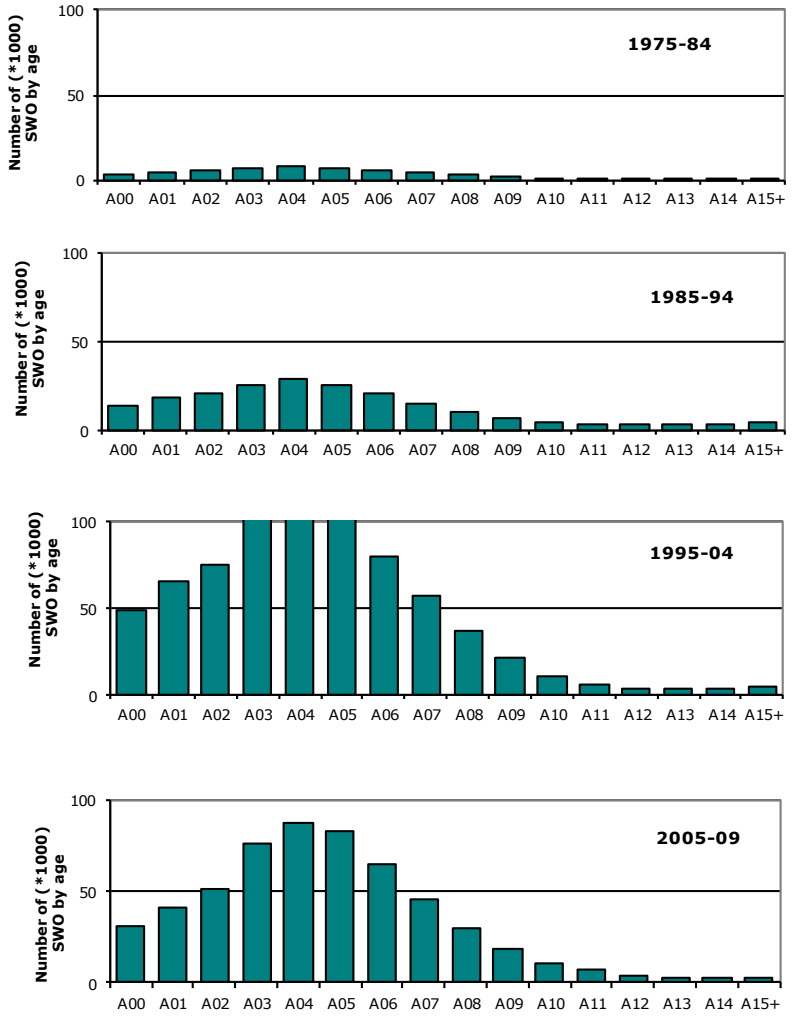
It is important to note that some length classes (159-162cm165-168cm) are poorly represented in the length frequency distributions derived from both the samples and the CAS for Japan over the entire time series. These gaps originate in the conversion (deterministic) from measurements of swordfish from the eye to the fork of the tail into lower-jaw fork length, as the measurements reported by Japan for the swordfish refer mostly to eye-fork length measurements aggregated into 5cm length classes.

In addition, the Secretariat had to assign samples/CAS from areas overlapping assessment areas to the assessment areas concerned (Figures 33-36). As much as 40% of the swordfish sampled on the fisheries of Japan and Taiwan,China come from 10 latitude by 20 degrees longitude grids that overlap two or more assessment areas (shown in Figure 32).

Catch-at-age tables (CAA)

The total numbers of swordfish by age class estimated for different periods are shown in **Figure 37**; the numbers of swordfish obtained by age class, fishery, area and year are shown in **Appendix VIII**. The estimates of catches-at-age are likely to be affected by a lack of data for some fisheries and periods (see the previous sections).

Figure 37: Average numbers of swordfish (SWO) by age class (classes 15 and above are represented as 15+) and fishery estimated for 1975-84, 1985-94, 1995-04 and 2005-09



APPENDIX I
Examples of Input Tables

a. NC_{INPUT}

CID	TimeStamp	Species	Fishery	Year	Quarter	Area	TotalMT	TotalNO	SampledMT	SampledNO
3	21-Jun-10	SWO	ALGI	2004	1	NE	1101	34248	2	68

Where:

Field	Description
CID	Unique row identifier (for each stratum Species-Fishery-Year-Quarter-Area)
TimeStamp	The date the table was created
Species	IOTC Species code
Fishery	Assessment Fishery (Appendix III, page 24)
Year	Year
Quarter	Quarter [January-March(1), April-June(2), July-September(3), October-December(4)]
Area	Assessment Area (Figure 4, page 8)
TotalMT	Total catch estimated in metric tons
Totalno	Total catch estimated in number of fish
Sampledno	Catch sampled in number of fish
SampledMT	Catch sampled in metric tons

b. LF_{INPUT}

CID	TimeStamp	Species	Fishery	Year	Quarter	Area	TotalMT	Totalno	Sampledno	FirstClassLow	SizeInterval	L001		L150
3	21-Jun-10	SWO	ALGI	2004	1	NE	1101	34248	68	15	3	0		0

Where:

Field	Description
CID	Unique row identifier (for each stratum Species-Fishery-Year-Quarter-Area)
TimeStamp	The date the table was created
Species	IOTC Species code
Fishery	Assessment Fishery (Appendix III, page 24)
Year	Year
Quarter	Quarter [January-March(1), April-June(2), July-September(3), October-December(4)]
Area	Assessment Area (Figure 4, page 8)
TotalMT	Total catch estimated in metric tons
Totalno	Total catch estimated in number of fish
Sampledno	Catch sampled in number of fish $\left(\sum_{L001}^{L150}\right)$
FirstClassLow	Length corresponding to the first size class bin, in cm (15cm for swordfish)
SizeInterval	Interval (cm) between consecutive length classes (3cm)
L001…L150	Number of fish measured for length class 15cm(inclusive) to 18cm(exclusive), 18-21, 21-24, etc.

Examples of Input Tables (cont.)

a. CAS INPUT

CID	TimeStamp	Species	Fishery	Year	Quarter	Area	TotalMT	Totalno	Sampledno	FirstClassLow	SizeInterval	L001		L150
1	21-Jun-10	SWO	ALGI	2003	4	NW	115	2913	0	15	3	0		0

Where:

Field	Description
CID	Unique row identifier (for each stratum Species-Fishery-Year-Quarter-Area)
TimeStamp	The date the table was created
Species	IOTC Species code
Fishery	Assessment Fishery (Appendix III, page 24)
Year	Year
Quarter	Quarter [January-March(1), April-June(2), July-September(3), October-December(4)]
Area	Assessment Area (Figure 4, page 8)
TotalMT	Total catch estimated in metric tons
Totalno	Total catch estimated in number of fish $\left(\sum_{L001}^{L150}\right)$
Sampledno	Catch sampled in number of fish
FirstClassLow	Length corresponding to the first size class bin, in cm (15cm for swordfish)
SizeInterval	Interval (cm) between consecutive length classes (3cm)
L001…L150	Total number of fish caught estimated for length class 15cm(inclusive) to 18cm(exclusive), 18-21, 21-24, etc.

b. CAA INPUT

METHOD	CID	TimeStamp	Species	Fishery	Year	Quarter	Area	Totalno	A00	..	A15+
DMSP2	**3**	**23-Jun-10**	**SWO**	**ALGI**	**2004**	**1**	**NE**	**34248**	**5011**	**..**	**18**

Where:

Field	Description
Method	Method used to estimate catch at age (Sheng-Ping Wang, pers.com.)
CID	Unique row identifier (for each stratum Species-Fishery-Year-Quarter-Area)
TimeStamp	The date the table was created
Species	IOTC Species code
Fishery	Assessment Fishery (Appendix III, page 24)
Year	Year
Quarter	Quarter [January-March(1), April-June(2), July-September(3), October-December(4)]
Area	Assessment Area (Figure 4, page 8)
Tno	Total catch estimated in number of fish $\left(\sum_{A00}^{A15+}\right)$ (Note that the total numbers shown for each stratum refer to Nominal Catches and may differ from the values obtained by adding the specimens for all age classes due to rounding)
A00…A15+	Number of fish estimated for age class 0 (A00 i.e. fish between 0 and 1 year old) and age class 15+ (A15+ i.e. fish 15 or more year old)

APPENDIX II

Areas allocated to Fleet-Gear strata in the Catch-and-Effort and Size Frequency datasets for the assessments of Swordfish

Fleet	Gear	Assessment Area
AUS	ELL	SE
AUS	HAND	SE
FRA-REU	ELL	SW
FRA-REU	TROL	SW
FRAT	ELL	NW
FRAT	HAND	NW
FRAT	TROL	NW
IDN	FLL	NE
IDN	GILL	NE
IDN	HAND	NE
KEN	TROL	NW
LKA	FLL	NE
LKA	G/L	NE
LKA	GILL	NE
LKA	HAND	NE
LKA	TROL	NE
MDG	ELL	SW
MDV	FLL	NE
MUS	ELL	SW
NEI-DFRZ	TLL	SW
NEI-IDN	FLL	NE
OMN	FLL	NW
PAK	GILL	NW
SYC	ELL	NW
SYC	HAND	NW
THA	FLL	NE
TZA	BB	NW
TZA	OTHER	NW
TZA	PSS	NW
TZA	TROL	NW
ZAF	ELL	SW
ZAF	LL	SW
ZAF	SLL	SW
ZAF	SPOR	SW
ZAF	TLL	SW

APPENDIX III

Fisheries allocated to Fleet-Gear strata in the Nominal Catch, Catch-and-Effort and Size Frequency datasets for the assessments of Swordfish

Artisanal fisheries other than hand line and recreational fisheries

Fishery	Fleet	Gear
ALGI	FRA-REU	TROL
ALGI	FRAT	TROL
ALGI	IDN	GILL
ALGI	IND	GILL
ALGI	IND	LIFT
ALGI	IND	TRAW
ALGI	IND	TROL
ALGI	KEN	TROL
ALGI	LKA	G/L
ALGI	LKA	GILL
ALGI	LKA	HATR
ALGI	LKA	TROL
ALGI	LKA	UNCL
ALGI	PAK	GILL
ALGI	TWN	GILL
ALGI	TZA	BB
ALGI	TZA	OTHER
ALGI	TZA	PSS
ALGI	TZA	TROL

Longline fisheries targeting Swordfish

Fishery	Fleet	Gear
AUEL	AUS	ELL

Fishery	Fleet	Gear
EUEL	ESP	ELL
EUEL	ESP	LLEX
EUEL	GBR	ELL
EUEL	GBR	LL
EUEL	GIN	ELL
EUEL	KEN	ELL
EUEL	NEI-DFRZ	ELL
EUEL	PRT	ELL
EUEL	PRT	LL
EUEL	PRT	LLD
EUEL	PRT	SLL
EUEL	SEN	ELL
EUEL	TZA	ELL
EUEL	TZA	LL
EUEL	URY	ELL
EUEL	ZAF	ELL
EUEL	ZAF	LL
EUEL	ZAF	SLL
EUEL	ZAF	TLL

Fishery	Fleet	Gear
ISEL	FRA-REU	ELL
ISEL	FRAT	ELL
ISEL	MDG	ELL
ISEL	MUS	ELL
ISEL	MUS	LL
ISEL	SYC	ELL

Other longline fisheries, and handline and recreational fisheries

Fishery	Fleet	Gear
JPLL	JPN	LL
JPLL	KOR	LL
JPLL	OMN	LL
JPLL	THA	LL

Fishery	Fleet	Gear
TWFL	AUS	HAND
TWFL	BLZ	FLL
TWFL	CHN	FLL
TWFL	FRAT	HAND
TWFL	IDN	FLL
TWFL	IDN	HAND
TWFL	IND	FLL
TWFL	IND	HAND
TWFL	LKA	FLL
TWFL	LKA	HAND
TWFL	LKA	LL
TWFL	LKA	LLCO
TWFL	MDV	FLL
TWFL	MYS	FLL
TWFL	NEI-ICE	FLL
TWFL	NEI-IDN	FLL
TWFL	OMN	FLL
TWFL	SYC	HAND
TWFL	THA	FLL
TWFL	TWN	FLL
TWFL	VUT	FLL

Fishery	Fleet	Gear
TWLL	BLZ	LL
TWLL	CHN	LL
TWLL	IDN	LL
TWLL	IND	LL
TWLL	IND	LLEX
TWLL	IRN	LL
TWLL	MDG	LL
TWLL	NEI-DFRZ	LL
TWLL	NEI-DFRZ	TLL
TWLL	PHL	LL
TWLL	SUN	LL
TWLL	SYC	LL
TWLL	TWN	LL

APPENDIX IV

Industrial fleets for which no catches per time and area are available and alternate fleets whose data were used for substitution

Fleet Code	Fleet Name	Gear Code	IOTC Area	Year From	Year To	Alternate Fleet Code	Alternate Gear Code
BLZ	Belize	FLL	IO_Eastern	2001	2008	TWN	LL
BLZ	Belize	FLL	IO_Western	2001	2009	TWN	LL
BLZ	Belize	LL	IO_Eastern	2001	2008	TWN	LL
BLZ	Belize	LL	IO_Western	2001	2008	TWN	LL
BLZ	Belize	PS	IO_Eastern	2001	2002	ESP	PS
BLZ	Belize	PS	IO_Western	2001	2002	ESP	PS
GBR	United Kingdom	LL	IO_Western	2004	2004	ESP	ELL
GIN	Guinea	ELL	IO_Eastern	2004	2009	ESP	ELL
IDN	Indonesia	LL	IO_Eastern	2001	2009	TWN	LL
IRN	Iran, Islamic Republic	LL	IO_Western	1976	2002	TWN	LL
IRN	Iran, Islamic Republic	PS	IO_Eastern	1996	1998	ESP	PS
IRN	Iran, Islamic Republic	PS	IO_Western	1992	2009	ESP	PS
KEN	Kenya	ELL	IO_Eastern	2005	2009	ESP	ELL
KEN	Kenya	ELL	IO_Western	1980	2009	TWN	LL
MDG	Madagascar	ELL	IO_Western	2002	2009	ESP	ELL
MDG	Madagascar	LL	IO_Eastern	2005	2005	TWN	LL
MDG	Madagascar	LL	IO_Western	2005	2005	TWN	LL
MUS	Mauritius	LL	IO_Western	1978	1987	TWN	LL
MYS	Malaysia	FLL	IO_Western	2006	2006	MUS	LL
MYS	Malaysia	PS	IO_Eastern	2008	2009	JPN	PS
NEI-DFRZ	NEI-Deep-freezing	ELL	IO_Eastern	2002	2009	ESP	ELL
NEI-DFRZ	NEI-Deep-freezing	ELL	IO_Western	2002	2009	ESP	ELL
NEI-DFRZ	NEI-Deep-freezing	LL	IO_Eastern	1985	2009	TWN	LL
NEI-DFRZ	NEI-Deep-freezing	LL	IO_Western	1985	2009	TWN	LL
PAK	Pakistan	LL	IO_Western	1991	2000	TWN	LL
SEN	Senegal	ELL	IO_Eastern	2005	2006	ESP	ELL
SEN	Senegal	ELL	IO_Western	2003	2006	ESP	ELL
SUN	Soviet Union	LL	IO_Eastern	1977	1985	TWN	LL
SUN	Soviet Union	LL	IO_Western	1964	1989	TWN	LL
SUN	Soviet Union	PS	IO_Eastern	1985	1985	NEI-OTH	PS
TZA	Tanzania	ELL	IO_Eastern	2006	2009	ESP	ELL
TZA	Tanzania	ELL	IO_Western	2005	2009	ESP	ELL
URY	Uruguay	ELL	IO_Western	2001	2006	ESP	ELL
VUT	Vanuatu	FLL	IO_Eastern	2009	2009	TWN	LL

APPENDIX V

Swordfish: Substitution scheme used for the estimation of Catches-at-Size (Fleet-Gear)

Gear	Fleet	GearA	FleetA	GearA2	FleetA2	GearA3	FleetA3
BB	TZA	BB	AG1	BB	AG1	SURF	AG1
ELL	AUS	ELL	AG1	ELL	AG1	LL	AG1
ELL	ESP	ELL	AG2	ELL	AG1	LL	AG1
ELL	FRA-REU	ELL	AG3	ELL	AG1	LL	AG1
ELL	FRAT	ELL	AG3	ELL	AG1	LL	AG1
ELL	GBR	ELL	AG2	ELL	AG1	LL	AG1
ELL	GIN	ELL	AG2	ELL	AG1	LL	AG1
ELL	KEN	ELL	AG2	ELL	AG1	LL	AG1
ELL	MDG	ELL	AG3	ELL	AG1	LL	AG1
ELL	MUS	ELL	AG3	ELL	AG1	LL	AG1
ELL	NEI-DFRZ	ELL	AG2	ELL	AG1	LL	AG1
ELL	PRT	ELL	AG2	ELL	AG1	LL	AG1
ELL	SEN	ELL	AG2	ELL	AG1	LL	AG1
ELL	SYC	ELL	AG4	ELL	AG1	LL	AG1
ELL	TZA	ELL	AG2	ELL	AG1	LL	AG1
ELL	URY	ELL	AG2	ELL	AG1	LL	AG1
ELL	ZAF	ELL	AG3	ELL	AG1	LL	AG1
FLL	BLZ	FLL	AG1	FLL	AG1	LL	AG1
FLL	CHN	FLL	AG3	FLL	AG1	LL	AG1
FLL	IDN	FLL	AG3	FLL	AG1	LL	AG1
FLL	IND	FLL	AG2	FLL	AG1	LL	AG1
FLL	LKA	FLL	AG3	FLL	AG1	LL	AG1
FLL	MDV	FLL	AG2	FLL	AG1	LL	AG1
FLL	MYS	FLL	AG3	FLL	AG1	LL	AG1
FLL	NEI-ICE	FLL	AG3	FLL	AG1	LL	AG1
FLL	NEI-IDN	FLL	AG3	FLL	AG1	LL	AG1
FLL	OMN	FLL	AG2	FLL	AG1	LL	AG1
FLL	THA	FLL	AG3	FLL	AG1	LL	AG1
FLL	TWN	FLL	AG3	FLL	AG1	LL	AG1
FLL	VUT	FLL	AG3	FLL	AG1	LL	AG1
G/L	LKA	GILL	AG1	GILL	AG1	GILL	AG1
GILL	IDN	GILL	AG2	GILL	AG2	GILL	AG1
GILL	IND	GILL	AG1	GILL	AG1	GILL	AG1
GILL	LKA	GILL	AG1	GILL	AG1	GILL	AG1
GILL	PAK	GILL	AG1	GILL	AG1	GILL	AG1
GILL	TWN	GILL	AG3	GILL	AG1	GILL	AG1
HAND	AUS	HAND	AG1	HAND	AG1	LL	AG1
HAND	FRAT	HAND	AG2	HAND	AG1	LL	AG1
HAND	IDN	HAND	AG5	HAND	AG1	LL	AG1
HAND	IND	HAND	AG3	HAND	AG1	LL	AG1
HAND	LKA	HAND	AG3	HAND	AG1	LL	AG1
HAND	SYC	HAND	AG4	HAND	AG1	LL	AG1
HATR	LKA	HAND	AG3	HAND	AG1	LL	AG1

Gear	Fleet	GearA	FleetA	GearA2	FleetA2	GearA3	FleetA3
LIFT	IND	LIFT	AG1	LIFT	AG1	GILL	AG1
LL	BLZ	LL	AG1	LL	AG1	LL	AG1
LL	CHN	LL	AG1	LL	AG1	LL	AG1
LL	GBR	ELL	AG2	ELL	AG1	LL	AG1
LL	IDN	LL	AG1	LL	AG1	LL	AG1
LL	IND	LL	AG2	LL	AG1	LL	AG1
LL	IRN	LL	AG2	LL	AG1	LL	AG1
LL	JPN	LL	AG3	LL	AG2	LL	AG2
LL	KOR	LL	AG4	LL	AG2	LL	AG2
LL	LKA	LL	AG2	LL	AG2	LL	AG2
LL	MDG	LL	AG5	LL	AG2	LL	AG2
LL	MUS	ELL	AG2	ELL	AG1	LL	AG1
LL	NEI-DFRZ	LL	AG1	LL	AG1	LL	AG1
LL	OMN	LL	AG2	LL	AG1	LL	AG1
LL	PHL	LL	AG1	LL	AG1	LL	AG1
LL	PRT	ELL	AG2	ELL	AG1	LL	AG1
LL	SUN	LL	AG1	LL	AG1	LL	AG1
LL	SYC	LL	AG1	LL	AG1	LL	AG1
LL	THA	LL	AG3	LL	AG2	LL	AG2
LL	TWN	LL	AG1	LL	AG1	LL	AG1
LL	TZA	LL	AG1	LL	AG1	LL	AG1
LL	ZAF	ELL	AG3	ELL	AG1	LL	AG1
LLCO	LKA	HAND	AG3	HAND	AG1	LL	AG1
LLD	PRT	ELL	AG2	ELL	AG1	LL	AG1
LLEX	ESP	ELL	AG2	ELL	AG1	LL	AG1
LLEX	IND	LL	AG2	LL	AG1	LL	AG1
OTHER	TZA	OTHER	AG1	OTHER	AG1	GILL	AG1
PSS	TZA	BB	AG1	BB	AG1	SURF	AG1
SLL	PRT	ELL	AG2	ELL	AG1	LL	AG1
SLL	ZAF	ELL	AG3	ELL	AG1	LL	AG1
SPOR	ZAF	HAND	AG2	HAND	AG1	LL	AG1
TLL	NEI-DFRZ	ELL	AG3	ELL	AG1	LL	AG1
TLL	ZAF	ELL	AG3	ELL	AG1	LL	AG1
TRAW	IND	OTHER	AG1	OTHER	AG1	GILL	AG1
TROL	FRA-REU	TROL	AG1	TROL	AG1	SURF	AG1
TROL	FRAT	TROL	AG1	TROL	AG1	SURF	AG1
TROL	IND	TROL	AG3	TROL	AG1	SURF	AG1
TROL	KEN	TROL	AG2	TROL	AG1	SURF	AG1
TROL	LKA	TROL	AG3	TROL	AG1	SURF	AG1
TROL	TZA	TROL	AG2	TROL	AG1	SURF	AG1
UNCL	LKA	SURF	AG1	SURF	AG1	SURF	AG1

APPENDIX VI

Swordfish: Length-age key used to convert CAS into CAA

FL_Low	FL_High	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15+
	<30	**1.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	33	**0.99**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
33	36	**0.99**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	39	**0.99**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	42	**0.98**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
42	45	**0.97**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45	48	**0.96**	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
48	51	**0.94**	**0.06**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
51	54	**0.92**	**0.08**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
54	57	**0.90**	**0.10**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
57	60	**0.87**	**0.13**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60	63	**0.83**	**0.17**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
63	66	**0.79**	**0.21**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
66	69	**0.75**	**0.25**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
69	72	**0.70**	**0.30**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
72	75	**0.65**	**0.35**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
75	78	**0.60**	**0.39**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
78	81	**0.55**	**0.43**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
81	84	**0.50**	**0.47**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84	87	**0.45**	**0.50**	**0.05**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
87	90	**0.40**	**0.52**	**0.08**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
90	93	**0.35**	**0.52**	**0.12**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93	96	**0.31**	**0.51**	**0.17**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96	99	**0.26**	**0.48**	**0.24**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
99	102	**0.22**	**0.45**	**0.30**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
102	105	**0.18**	**0.40**	**0.36**	**0.05**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
105	108	**0.15**	**0.35**	**0.42**	**0.08**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
108	111	**0.13**	**0.30**	**0.45**	**0.11**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
111	114	**0.10**	**0.25**	**0.47**	**0.16**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
114	117	**0.08**	**0.21**	**0.47**	**0.21**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
117	120	**0.07**	**0.17**	**0.44**	**0.27**	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	123	**0.06**	**0.14**	**0.40**	**0.33**	**0.07**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
123	126	**0.04**	**0.11**	**0.35**	**0.38**	**0.11**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
126	129	**0.04**	**0.08**	**0.28**	**0.42**	**0.16**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
129	132	**0.03**	**0.06**	**0.22**	**0.44**	**0.21**	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
132	135	**0.02**	**0.04**	**0.16**	**0.43**	**0.28**	**0.06**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
135	138	**0.02**	**0.03**	**0.11**	**0.40**	**0.34**	**0.09**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
138	141	**0.01**	**0.02**	**0.07**	**0.35**	**0.39**	**0.14**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
141	144	**0.01**	**0.01**	**0.04**	**0.29**	**0.42**	**0.19**	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
144	147	**0.01**	**0.01**	**0.02**	**0.22**	**0.42**	**0.25**	**0.06**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
147	150	0.00	**0.01**	**0.01**	**0.16**	**0.41**	**0.31**	**0.09**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
150	153	0.00	0.00	**0.01**	**0.11**	**0.36**	**0.35**	**0.13**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
153	156	0.00	0.00	0.00	**0.07**	**0.31**	**0.38**	**0.18**	**0.04**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
156	159	0.00	0.00	0.00	**0.04**	**0.25**	**0.39**	**0.23**	**0.07**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
159	162	0.00	0.00	0.00	**0.03**	**0.19**	**0.38**	**0.28**	**0.10**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
162	165	0.00	0.00	0.00	**0.01**	**0.13**	**0.35**	**0.32**	**0.14**	**0.04**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00
165	168	0.00	0.00	0.00	**0.01**	**0.09**	**0.30**	**0.35**	**0.19**	**0.06**	**0.01**	0.00	0.00	0.00	0.00	0.00	0.00
168	171	0.00	0.00	0.00	0.00	**0.06**	**0.24**	**0.36**	**0.23**	**0.09**	**0.02**	0.00	0.00	0.00	0.00	0.00	0.00
171	174	0.00	0.00	0.00	0.00	**0.03**	**0.19**	**0.34**	**0.28**	**0.12**	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00
174	177	0.00	0.00	0.00	0.00	**0.02**	**0.14**	**0.31**	**0.31**	**0.16**	**0.05**	0.00	0.00	0.00	0.00	0.00	0.00
177	180	0.00	0.00	0.00	0.00	**0.01**	**0.09**	**0.27**	**0.33**	**0.21**	**0.08**	**0.01**	0.00	0.00	0.00	0.00	0.00
180	183	0.00	0.00	0.00	0.00	**0.01**	**0.06**	**0.22**	**0.33**	**0.25**	**0.12**	**0.01**	0.00	0.00	0.00	0.00	0.00
183	186	0.00	0.00	0.00	0.00	0.00	**0.04**	**0.17**	**0.31**	**0.29**	**0.16**	**0.03**	0.00	0.00	0.00	0.00	0.00
186	189	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.12**	**0.28**	**0.31**	**0.20**	**0.05**	**0.01**	0.00	0.00	0.00	0.00
189	192	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.08**	**0.23**	**0.32**	**0.24**	**0.09**	**0.02**	0.00	0.00	0.00	0.00
192	195	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.05**	**0.18**	**0.30**	**0.27**	**0.14**	**0.04**	**0.01**	0.00	0.00	0.00
195	198	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	**0.14**	**0.26**	**0.28**	**0.20**	**0.07**	**0.02**	0.00	0.00	0.00
198	201	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.09**	**0.22**	**0.28**	**0.25**	**0.10**	**0.03**	**0.01**	0.00	0.00
201	204	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.06**	**0.17**	**0.26**	**0.29**	**0.15**	**0.05**	**0.01**	0.00	0.00
204	207	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**	**0.12**	**0.22**	**0.30**	**0.20**	**0.08**	**0.03**	**0.01**	0.00
207	210	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.09**	**0.18**	**0.29**	**0.24**	**0.12**	**0.05**	**0.01**	0.00
210	213	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.06**	**0.14**	**0.26**	**0.26**	**0.16**	**0.07**	**0.03**	**0.01**
213	216	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.04**	**0.11**	**0.20**	**0.26**	**0.20**	**0.11**	**0.05**	**0.02**
216	219	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.07**	**0.16**	**0.25**	**0.24**	**0.15**	**0.07**	**0.03**
219	222	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.05**	**0.11**	**0.22**	**0.25**	**0.19**	**0.11**	**0.05**
222	225	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.03**	**0.07**	**0.18**	**0.25**	**0.23**	**0.15**	**0.08**
225	228	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.04**	**0.13**	**0.23**	**0.25**	**0.20**	**0.12**
228	231	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.02**	**0.09**	**0.19**	**0.27**	**0.24**	**0.17**

FL_Low	FL_High	A0	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15+
231	234	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.01**	**0.06**	**0.16**	**0.25**	**0.28**	**0.23**
234	237	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.04**	**0.12**	**0.23**	**0.30**	**0.30**
237	240	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.09**	**0.21**	**0.32**	**0.36**
240	243	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.06**	**0.18**	**0.32**	**0.42**
243	246	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.04**	**0.15**	**0.32**	**0.48**
246	249	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	**0.12**	**0.30**	**0.55**
249	252	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.10**	**0.29**	**0.59**
252	255	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.08**	**0.27**	**0.64**
255	258	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.06**	**0.24**	**0.69**
258	261	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.05**	**0.22**	**0.72**
261	264	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	**0.20**	**0.77**
264	267	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	**0.18**	**0.79**
267	270	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	**0.16**	**0.82**
270	273	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.14**	**0.85**
273	276	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.12**	**0.87**
276	279	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.11**	**0.88**
279	282	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	**0.10**	**0.89**
282	285	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.08**	**0.92**
285	288	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.07**	**0.93**
288	291	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.06**	**0.94**
291	294	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**	**0.95**
294	297	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**	**0.95**
297	300	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**	**0.96**
>=300		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1.00**

APPENDIX VII

Swordfish: Total catches estimated, in number of fish and weight, by fishery (1950-09)

Swordfish catches by fishery in number of fish

Year	TWLL	TWFL	JPLL	AUEL	EUEL	ISEL	ALGI	Total
1950		609					1865	2474
1951		464					1545	2009
1952		448	155				1512	2115
1953		448	475				1530	2453
1954	374	428	2563				1484	4849
1955	1192	459	2579				1669	5900
1956	2427	372	6904				1534	11238
1957	2423	315	4886				1463	9087
1958	2683	295	7944				1400	12322
1959	4351	228	7994				1439	14012
1960	3574	228	9609				1498	14910
1961	4471	194	10972				1495	17133
1962	5619	146	13421				1542	20728
1963	8712	150	9835				1561	20258
1964	10342	87	12911				1397	24737
1965	8572	84	16677				1524	26857
1966	6345	86	17079				1716	25225
1967	4047	87	24941				1716	30792
1968	14108	89	16792				1729	32718
1969	16242	89	20695				1728	38755
1970	24736	87	22113				2014	48949
1971	17898	86	22925				1699	42607
1972	16201	86	23981				1964	42233
1973	10455	92	22345				1847	34740
1974	16724	416	17675				2258	37073
1975	18511	580	25749				2126	46966
1976	14411	461	17342				2239	34453
1977	14701	457	12032				2573	29765
1978	10118	603	31221				2641	44583
1979	26255	914	28470				2669	58308
1980	23571	1434	16309		126		9643	51082
1981	21726	1331	20782		169		4608	48615
1982	22651	2140	26160		197		19217	70366
1983	33770	957	27186		315		10863	73090
1984	27433	1374	23143				11491	63442
1985	35368	1304	32621				10061	79354
1986	56241	733	26126				11468	94568
1987	80514	1472	19618				20289	121894
1988	147855	4050	24806				22958	199669
1989	122234	35981	15937	1600			14423	190175
1990	90669	24647	19278				26207	160801
1991	95895	19358	13865	43		37	16468	145667
1992	180892	23406	27205	474		1390	21372	254738
1993	214413	23638	18773	6464	5349	9087	120759	398483
1994	256440	28747	42055	1932	16689	13320	71700	430884
1995	509292	34980	37020	1073	292	14100	66525	663283
1996	548141	49091	58382	395	447	31318	85905	773680
1997	449365	53964	49725	897	11581	41295	60871	667698
1998	421314	36487	46492	7940	39667	63736	59191	674828
1999	447007	46305	18851	22421	42593	55925	71405	704507
2000	522663	49736	32074	33640	21463	41245	132034	832855
2001	391313	49705	30884	44713	53722	35474	169190	775001
2002	388770	57462	21934	19095	107434	20683	182619	797997
2003	410955	104503	18841	29023	124148	25080	151868	864416
2004	290284	70538	42401	6974	195733	32851	80220	719000
2005	190064	54069	42405	4768	254988	41867	52767	640928
2006	183373	48906	34389	5195	230410	36807	66931	606010
2007	172161	51754	67865	5330	191260	45356	76168	609895
2008	145242	42703	57452	2400	131501	36053	57212	472564
2009	145660	57632	20880	6412	133663	26654	58548	449450

Swordfish catches by fishery in weight (tonnes)

Year	TWLL	TWFL	JPLL	AUEL	EUEL	ISEL	ALGI	Total
1950		5					43	49
1951		4					36	40
1952		4	10				35	49
1953		4	31				35	70
1954	19	4	162				34	219
1955	63	4	179				39	285
1956	119	4	460				36	618
1957	136	4	278				34	452
1958	150	4	482				32	668
1959	251	4	484				33	772
1960	201	4	577				35	816
1961	251	4	683				35	973
1962	301	4	839				36	1180
1963	454	4	637				36	1131
1964	549	4	843				37	1433
1965	462	4	1058				37	1561
1966	345	4	1125				38	1512
1967	249	4	1592				38	1882
1968	745	4	1178				38	1966
1969	825	4	1346				38	2214
1970	1302	4	1391				45	2743
1971	918	4	1226				38	2186
1972	916	4	1061				44	2025
1973	638	4	970				41	1653
1974	963	22	1049				50	2084
1975	954	30	1352				47	2384
1976	867	24	1017				50	1959
1977	886	24	1053				58	2020
1978	592	31	1790				59	2473
1979	1112	45	1136				60	2353
1980	1257	75	955		8		214	2508
1981	1092	70	1154		11		102	2430
1982	1452	118	1270		14		426	3280
1983	1916	56	1460		22		240	3694
1984	1735	77	1445				255	3512
1985	2012	69	2201				224	4506
1986	3460	45	1384				254	5143
1987	4107	80	1444				414	6046
1988	6217	191	1562				523	8493
1989	4655	996	1084	37			435	7207
1990	4669	1298	1100				505	7571
1991	5623	1205	936	3		2	330	8100
1992	10428	1514	1802	32		65	448	14289
1993	19516	1486	1497	189	207	278	2145	25318
1994	16088	2105	3714	115	694	729	1082	24527
1995	23764	1739	2391	62	19	792	1083	29849
1996	25326	2287	3180	22	29	1474	1155	33473
1997	22709	2815	3485	44	549	1810	1486	32898
1998	24676	2211	2501	337	1892	2918	1106	35642
1999	21862	2510	1575	1360	2307	2543	1337	33495
2000	21483	1952	1727	1798	1212	2060	3040	33272
2001	16687	1589	1347	2900	3116	1953	2358	29949
2002	16886	2272	1327	1343	6442	1141	2491	31902
2003	17925	3915	1220	1766	7484	1477	2624	36411
2004	15883	3766	1580	370	11319	1726	2512	37157
2005	10170	2731	1773	301	13159	2165	1454	31753
2006	9779	2424	2177	311	11541	1777	2292	30302
2007	8690	2402	2382	281	9972	1755	1588	27070
2008	7122	2197	1772	142	6966	1469	1501	21169
2009	7384	3183	1292	349	6815	1260	1168	21453

Swordfish: Total catches estimated, in number of fish and weight, by area (1950-09)

Swordfish catches by area in number of fish					
Year	NW	SW	NE	SE	Total
1950	1817		657		2474
1951	1455		554		2009
1952	1417		670	28	2115
1953	1432		937	84	2453
1954	1429	13	3204	203	4849
1955	2903	201	2721	75	5900
1956	5172	351	5162	553	11238
1957	3421	343	4880	442	9087
1958	3896	455	6482	1489	12322
1959	4991	1212	4917	2892	14012
1960	5143	1327	5426	3014	14910
1961	5351	2272	6272	3238	17133
1962	6845	4801	6750	2331	20728
1963	5847	3757	7034	3621	20258
1964	7828	6333	8054	2522	24737
1965	8079	3425	10969	4383	26857
1966	11417	4043	7345	2420	25225
1967	10462	4496	11994	3840	30792
1968	15830	3515	9627	3747	32718
1969	16972	6363	13530	1890	38755
1970	12920	9676	19120	7234	48949
1971	15926	6021	13595	7066	42607
1972	18691	9190	12348	2004	42233
1973	8175	15213	7806	3546	34740
1974	11361	6762	11736	7215	37073
1975	13581	5741	22258	5386	46966
1976	5545	8071	16373	4465	34453
1977	7421	5356	13582	3405	29765
1978	18231	5020	15136	6195	44583
1979	14756	12774	24235	6543	58308
1980	5439	7749	33784	4110	51082
1981	10216	7453	25368	5579	48615
1982	19928	11730	35737	2970	70366
1983	17892	9037	41140	5020	73090
1984	10955	11368	36442	4677	63442
1985	18041	12061	42417	6836	79354
1986	37838	9482	43278	3969	94568
1987	37236	8729	64259	11670	121894
1988	89933	16507	75245	17983	199669
1989	49543	8207	115373	17052	190175
1990	44976	31578	70912	13335	160801
1991	70537	19065	48785	7280	145667
1992	59272	124137	55706	15623	254738
1993	60656	152643	163991	21193	398483
1994	87237	171380	143186	29080	430884
1995	134875	331467	151135	45806	663283
1996	243759	218890	221833	89197	773680
1997	282994	127173	183103	74428	667698
1998	229528	193004	190419	61877	674828
1999	165396	181741	280792	76579	704507
2000	222876	248937	278837	82205	832855
2001	197184	148930	292311	136576	775001
2002	281106	133755	274881	108255	797997
2003	331363	70051	308466	154537	864416
2004	236297	118183	193429	171092	719000
2005	227625	183745	125559	103999	640928
2006	198671	171961	155864	79514	606010
2007	206269	156221	145901	101502	609895
2008	168553	126487	112278	65245	472564
2009	108112	128759	148344	64234	449450

Swordfish catches by area in weight (tonnes)					
Year	NW	SW	NE	SE	Total
1950	36		13		49
1951	29		11		40
1952	28		19	2	49
1953	28		37	5	70
1954	31	1	176	12	219
1955	127	14	139	4	285
1956	286	20	279	34	618
1957	154	22	249	27	452
1958	184	25	359	101	668
1959	271	60	256	185	772
1960	282	66	283	185	816
1961	312	115	343	202	973
1962	365	317	348	151	1180
1963	290	249	355	238	1131
1964	441	403	417	172	1433
1965	465	221	562	312	1561
1966	714	257	371	171	1512
1967	697	279	650	256	1882
1968	979	232	493	261	1966
1969	967	447	659	141	2214
1970	713	579	1033	418	2743
1971	852	239	671	425	2186
1972	812	480	605	128	2025
1973	420	668	357	208	1653
1974	591	451	587	454	2084
1975	557	380	1094	353	2384
1976	426	484	754	295	1959
1977	651	405	738	226	2020
1978	999	361	742	371	2473
1979	479	635	891	348	2353
1980	305	500	1428	277	2508
1981	676	377	1035	341	2430
1982	980	670	1404	225	3280
1983	800	660	1865	369	3694
1984	502	911	1769	331	3512
1985	811	1291	2108	295	4506
1986	2066	609	2326	141	5143
1987	2226	899	2488	433	6046
1988	4189	999	2627	678	8493
1989	2137	611	3916	542	7207
1990	2133	1723	3035	681	7571
1991	3934	1183	2456	525	8100
1992	3108	7550	2662	968	14289
1993	5506	13254	5536	1022	25318
1994	4861	11916	5909	1841	24527
1995	5843	16709	5234	2063	29849
1996	11944	9496	7644	4389	33473
1997	14091	5873	8126	4808	32898
1998	12293	10416	9123	3809	35642
1999	8705	8709	12292	3789	33495
2000	8928	10769	8626	4949	33272
2001	7891	8975	6531	6552	29949
2002	12241	7618	6242	5801	31902
2003	15074	4045	8767	8525	36411
2004	12232	6357	8545	10023	37157
2005	10893	9730	5253	5877	31753
2006	10280	8961	6567	4494	30302
2007	8711	7448	5620	5291	27070
2008	6623	6288	4526	3731	21169
2009	5058	6579	6079	3738	21453

APPENDIX VIII

Swordfish: Total numbers of fish estimated by age class and year

Swordfish total number of fish by age group																	
Year	Age0	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15+	Total
1950	540	660	472	332	208	124	68	32	16	12	4						2468
1951	432	528	384	272	176	104	56	28	12	4	4						2000
1952	425	523	388	284	189	117	72	43	24	15	14	7	5	3	1	1	2111
1953	437	541	412	312	229	159	110	79	53	36	29	18	13	8	6	5	2447
1954	529	678	589	570	526	434	353	300	237	177	131	98	72	50	38	38	4820
1955	578	757	688	694	645	548	446	374	309	235	171	127	97	76	67	63	5875
1956	691	992	1114	1340	1365	1186	1006	874	728	557	395	288	224	180	148	135	11223
1957	595	861	1020	1191	1239	1082	831	628	469	334	232	167	123	98	93	106	9069
1958	714	1009	1263	1558	1605	1390	1128	929	746	559	408	305	224	167	141	161	12307
1959	700	1066	1403	1753	1921	1711	1350	1055	817	604	433	316	244	197	184	224	13978
1960	765	1174	1520	1882	2044	1743	1389	1123	887	666	483	356	263	205	188	221	14909
1961	814	1238	1649	2125	2340	1983	1595	1332	1089	833	603	438	327	249	225	272	17112
1962	937	1411	1837	2692	3137	2565	1928	1548	1257	954	683	497	364	283	256	360	20709
1963	918	1436	1849	2453	2909	2658	2088	1608	1218	893	631	453	328	250	230	319	20241
1964	855	1438	2058	3053	3732	3337	2605	2034	1576	1165	817	583	421	331	310	415	24730
1965	1056	1661	2342	3246	3804	3437	2711	2194	1763	1338	966	695	497	373	329	426	26838
1966	999	1402	2087	3086	3582	3177	2513	2060	1657	1259	904	681	517	412	381	484	25201
1967	1195	1628	2525	3797	4212	3630	2980	2566	2148	1686	1267	940	686	511	446	563	30780
1968	1240	1828	2526	3727	4741	4347	3372	2690	2178	1678	1240	909	661	510	463	584	32694
1969	1316	2003	3113	4103	5138	5777	5095	3852	2719	1865	1227	777	520	403	389	444	38741
1970	2286	3270	4054	5393	6728	6786	5541	4168	3063	2251	1678	1227	827	577	502	593	48944
1971	2313	3086	4191	5257	5981	5630	4624	3602	2686	1883	1189	710	445	314	297	375	42583
1972	3288	4457	4649	5525	5539	4524	3608	2973	2376	1791	1271	803	473	311	283	360	42231
1973	2213	3234	5385	4789	3955	3770	3219	2431	1721	1208	841	565	374	292	304	417	34718
1974	1801	2468	3640	4652	5082	4547	3573	2841	2268	1737	1269	921	692	535	471	572	37069
1975	3208	4346	5014	5823	5897	5194	4352	3791	3160	2258	1277	725	520	453	451	508	46977
1976	2329	2900	3123	3462	4082	4265	3790	2926	2095	1461	985	674	502	452	529	861	34436
1977	1338	1754	2253	2726	3264	3325	2968	2542	2107	1658	1274	1076	952	848	794	860	29739
1978	1802	2623	4233	5942	6386	5665	4776	3927	2899	1935	1176	834	639	531	509	693	44570
1979	3008	4400	7096	11132	10890	7744	5759	3836	2049	930	307	234	272	269	219	151	58296
1980	3108	3639	4947	6340	7730	7438	5845	4107	2743	1730	993	668	504	417	401	443	51053
1981	2361	3651	5369	6805	7566	6696	4748	3111	2247	1741	1364	926	619	459	417	506	48586
1982	5774	6027	8464	9923	9972	8836	6753	4648	3067	1997	1248	803	560	505	663	1103	70343
1983	4792	5080	6315	8876	10432	10413	8725	6249	4080	2630	1703	1138	770	587	575	702	73067
1984	3734	3918	5626	7905	9413	9030	7217	5220	3499	2197	1254	895	748	701	751	1335	63443
1985	4503	5940	8433	10411	10892	9982	7577	5320	3909	2926	2143	1532	1152	1047	1241	2336	79344
1986	5072	6567	8990	12593	14445	13392	9934	6543	4272	2827	1815	1270	1073	1266	1812	2682	94553
1987	6378	11302	16376	17309	17363	15705	11813	7595	4496	2719	1784	1552	1514	1577	1760	2647	121890
1988	10874	16222	20538	29925	35789	31482	21873	13846	8407	4797	2356	1317	833	579	442	382	199662
1989	13844	20269	23318	29643	35434	29676	18111	9254	4404	2029	819	472	373	463	750	1308	190167
1990	9773	14025	17743	21852	23170	22322	18904	12939	7415	3906	1874	1168	908	964	1407	2433	160803
1991	5399	6455	10394	16315	23287	25308	20802	13854	8003	4404	2380	1654	1262	1224	1715	3207	145663
1992	11126	12964	16626	26623	34694	35762	33803	28970	21146	13677	7925	4396	2112	1216	1318	2371	254729
1993	35562	49790	43010	44750	36484	25888	21950	20950	18370	14964	11966	12346	13625	14622	15809	18379	398465
1994	32183	38134	37869	46414	53762	50764	42587	33726	25299	17805	11560	7886	6055	5913	7791	13132	430880
1995	31411	40253	56498	90456	120647	114259	84877	55734	33689	18451	8122	4111	2171	1205	752	627	663263
1996	48907	54524	82515	114929	126387	115829	89670	61046	37492	20679	9187	4713	2696	1755	1515	1828	773672
1997	21445	37450	58056	90255	109918	102949	85616	64943	43354	25381	12017	6116	3468	2424	2065	2222	667679
1998	31081	40666	59848	83075	92680	94358	88714	69480	44288	24381	11215	6963	5697	6028	7254	9088	674816
1999	32373	51337	75528	106656	117123	102151	77802	52376	31324	17138	8232	5342	4673	5580	7348	9518	704501
2000	71066	90081	103195	138499	134511	99734	70165	47612	29571	16751	8405	5237	3533	3209	4360	6908	832837
2001	84836	115644	94816	115484	106423	77816	56315	42531	29833	18524	9736	5928	3835	2931	3515	6805	774972
2002	76461	97960	84430	116980	121409	97304	71234	49720	32944	20133	10594	6146	3927	2839	2553	3336	797970
2003	62361	78456	75078	140271	157672	121955	82621	55576	36766	22485	11754	6834	4396	3086	2451	2656	864418
2004	30965	43291	58027	85011	104402	109115	94664	70519	47606	29819	16954	10359	6538	4518	3585	3624	718997
2005	34976	44718	50167	79424	99060	97546	78764	56142	37330	23703	14215	8928	5565	3807	3135	3437	640917
2006	20782	33553	54399	84656	98464	94055	75217	53288	34709	21299	12115	7782	5335	3972	3223	3151	606000
2007	46626	54991	59375	83072	91732	84641	66186	46547	30462	18586	10174	6328	4140	2875	2187	1972	609894
2008	31428	37887	46616	67591	76088	68771	51118	34045	22085	14203	8855	5451	3242	2034	1547	1594	472555
2009	22665	32085	43433	62168	71636	65941	50901	36088	24576	16094	9806	5698	3226	2001	1509	1587	449414

APPENDIX IX

Marlins and Indo-Pacific sailfish

a. Regression equations used to convert from non-standard lengths into eye orbit to fork length

A/ Black Marlin (standard length is front eye orbit to fork of caudal fin)

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size range*	*Source*
Cleithrum-Keel length					***No equation available***
Lower-jaw - fork length	$aL+b$	a= 0.8972 b= -4.6673	13	Min:119 Max:314	***BRS (Ward, pers.com.) Eastern and western Australia (on IOTC-2005-WPTT-05)***
Weight gilled and gutted	aW^b	a= 41.56681 b= 0.309442	24	Min:8.6 Max:279	***PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands). With value of a (46.9705) divided by 1.13 to account for conversion of gilled-and-gutted weight into round weight***

B/ Blue Marlin (standard length is front eye orbit to fork of caudal fin)

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size range*	*Source*
Lower-jaw - fork length	$aL+b$	a= 0.9039 b= -7.248	26	Min:143 Max:295	***BRS (Ward, pers.com.) Eastern and western Australia (on IOTC-2005-WPTT-05)***
Weight gilled and gutted	aW^b	a= 46.0356637 b= 0.283377	154	Min:10 Max:381	***PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands) Value of a (52.0203) divided by 1.13 to account for conversion of gilled-and-gutted weight into round weight***

C/ Striped Marlin (standard length is front eye orbit to fork of caudal fin)

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size range*	*Source*
Lower-jaw - fork length	$aL+b$	a= 1.334 b= 0.8395	443	Min: Max:	***BRS (Ward, pers.com.) Eastern and western Australia (on IOTC-2005-WPTT-05)***
Weight round	aW^b	a= 51.3506 b= 0.300417	1427	Min:7 Max:100	***PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands)***
Weight gilled and gutted	aW^b	a= 45.443009 b= 0.300417	1427	Min:7 Max:100	***PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands) Value of a (51.3506) divided by 1.13 to account for conversion of gilled-and-gutted weight into round weight***

D/ Indo-Pacific sailfish (standard length is front eye orbit to fork of caudal fin)

Type Measurement	*Equation*	*Parameters*	*Sample size*	*Size range*	*Source*
Cleithrum-Keel length					***No equation available***
Lower-jaw - fork length	$\frac{(L+b)}{a}$	a= 0.8845 b= -3.7025	1166	Min:78 Max:232	***Wei-Chuan Chiang et al. , 2004; inverted EFL-FL equation (Male plus Female sexes pooled)***
Weight gilled and gutted	aW^b	a= 45.5076 b= 0.347166	35	Min:5 Max:38	***PIFSC Administrative report: (Updated Weight-on-Length Relationships for Pelagic Fishes Caught in the Central North Pacific Ocean and Bottom fishes from the Northwestern Hawaiian Islands) Value of a (51.4235) divided by 1.13 to account for conversion of gilled-and-gutted weight into round weight***