

CURVY? HOW AN UNCONVENTIONAL MEASURING SYSTEM ADOPTED BY OBSERVERS CAN BIAS THE SCIENTIFIC UNDERSTANDING IN MEDITERRANEAN SWORDFISH (*XIPHIAS GLADIUS* L. 1758) AND IN THE ICCAT DATABASE

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SUMMARY

The accurate fish body length measurements are an essential element of many scientific processes, including important biological ones and stock assessments. The length measurements are usually standardised by species. For swordfish, the basic length measurement is always the straight LJFL. In very recent years, some observers' teams adopted a different methodology for measuring the LJFL in swordfish. Besides several specific warnings during various ICCAT SCRS SWO SG meetings, these unconventional measurements are still taken, affecting both the scientific results of the Group and the ICCAT Task II data base for the species, because of the mixing of various length measurement systems. This short paper points out this situation, explaining in details the standards, the problem, the consequences and the need to use the conventional measurement methodology or, in sub-order, to propose a new code for these specific LJFL to both Subcomstat and the SWO SG, for avoiding problems in the ICCAT SWO Task II data base.

RÉSUMÉ

Les mesures précises de la longueur du corps des poissons sont un élément essentiel de nombreux processus scientifiques, notamment des processus biologiques importants et des évaluations de stocks. Les mesures de longueur sont généralement normalisées pour chaque espèce. Pour l'espadon, la mesure de base de la longueur de la jambe est toujours la LJFL droite. Ces dernières années, certaines équipes d'observateurs ont adopté une méthodologie différente pour mesurer la LJFL de l'espadon. Malgré plusieurs avertissements spécifiques au cours de diverses réunions du SG du SCRS SWO de l'ICCAT, ces mesures non conventionnelles sont toujours utilisées, ce qui affecte à la fois les résultats scientifiques du Groupe et la base de données de la Tâche II de l'ICCAT pour cette espèce, en raison du mélange de divers systèmes de mesure de la longueur. Ce bref document met en évidence cette situation, expliquant en détail les normes, le problème, les conséquences et la nécessité d'utiliser la méthodologie de mesure conventionnelle ou, en sous-ordre, de proposer un nouveau code pour ces LJFL spécifiques à Subcomstat et au SWO SG, afin d'éviter les problèmes dans la base de données ICCAT SWO Task II.

RESUMEN

Las mediciones precisas de la longitud del cuerpo de los peces son un elemento esencial de muchos procesos científicos, incluidos los importantes por la biología y la evaluación de las poblaciones. Las determinaciones de longitud suelen estar estandarizadas por cada especie. En el caso del pez espada, la medida básica es siempre la LJFL recta. En los últimos años, algunos equipos de observadores han adoptado una metodología diferente para medir la LJFL en el pez espada. Además de varias advertencias específicas durante varias reuniones del SG SWO del SCRS de la CICAA, estas mediciones no convencionales se siguen realizando, lo que afecta tanto a los resultados científicos del Grupo como a la base de datos de la Tarea II de la CICAA para la especie, debido a la mezcla de varios sistemas de medición de la longitud. Este breve documento señala esta situación, explicando en detalle las normas, el problema, las consecuencias y la necesidad de utilizar la metodología de medición convencional o, en suborden, proponer un nuevo código para estas LJFL específicas tanto a Subcomstat como al SG SWO, para evitar problemas en la base de datos de ICCAT SWO Task II.

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KEYWORDS

Swordfish, Xiphias gladius, Mediterranean Sea, domestic observers, lower jaw fork length, unconventional measurements, curve length, straight length, length mixing, impact on biological understanding, impact on ICCAT data base.

1. Introduction

Length measurements are the basis of the modern halieutic science since more than a century. They are used for understanding the various components of a given fish species or population or stock, for following the cohorts dynamics, for the length/weight correlations, for the length/age correlations, the natural mortality at length, the fishing mortality at length, the mean size in a given fishery, for understading the evolution of the catches but also for defining the length at first maturity and the length when 50% or 100% of the species is mature, and any other additional use.

Therefore, correct length measures are essentials and, for this reason, standardised methodologies have been adopted since ever, sometimes different from species to species for better responding to the various anatomical features. In biometry, many measures are obviously needed, but all mesures have standardised descriptions and codes, for always comparing the same measure.

Ichthyometers are the tools used for small fish and they provide a standard method for length measurements (mostly for total length or fork length), while callipers are used for other biometric measurements.

The tools are different for large fish species. In the last part of the XIX century and in the first part of the XX century, several scientists used large ichthyometers, sorts of giant callipers, but they were not very comfortable and practical to use, even if the measurement was quite precise. These tools were tentatively used also in recent times by several research teams, but working on board with long ichthyometers was very difficult and moving around on landing places was not easy as well. As a consequence, rigid (folding) or flexible metres (steel or fiberglass measuring tapes) are the most used tools for practical reasons, even if measurements can be slightly biased.

As a matter of fact, vertically aligning the sign on the metre with the reference point on the fish body always implies a small bias, caused by the observer's position and by the shape of the fish body (flatter the body, more precise is the measurement). In the '80s and '90s, one of us (Di Natale) participated to several trials organised by Prof. Pasquale Arena for assessing these biases in a big tuna factory in Palermo. After measuring many hundreds of medium-large and giant bluefin tunas both with a giant calliper and a steel flexible tape metre, the average bias of well-trained observers was not more than ± 2 cm and, therefore, it was decided to use the flexible tape, because the possible error will be not relevant in terms of size class attribution.

The same conclusions are commonly accepted by all Institutions and RFMOs.

Independently from the methodology for collecting the length data, it is always important fully following the standards for making the studies comparable for the same measure, including the consequent conclusions.

These points are particularly relevant for those fish having different lengths and shape of the jaws, as the swordfish and the billfishes have. Furthermore, since the beginning, it was decided that the most reliable length was not the total length, because the bill could be sometimes broken for accidents or partly curved for natural issues, but the lower jaw one, because there is less natural morphological variability and there are less casualties.

For the swordfish (*Xiphias gladius*, Linnaeus 1758) (code: SWO), a world-wide species, it was decided to conventionally use the straight lower jaw fork length (code: FL or LJFL) as the reference length, as also recommended by the ICCAT SCRS SWO SG in all meetings.

2. The legal framework for the LJFL measurements

Most of the rules for taking the length measurements are usually set by the competent RFMO and by the various CPCs. The details are often based on images and sometimes specified by descriptions.

For swordfish, the LJFL is the reference measure for the minimum size regulation in ICCAT.

ICCAT, in the past, had specific images for the swordfish, but the new web site don't have them anymore. *Mutatis mutandis*, the ICCAT web site has the new Species ID Cards for Istiophoridae, which can be considered widely valid for all billfishes, maybe including the swordfish (which is anyway a Xiphidae and not an Istiophoridae), at least as concerns the length measurements (**Figure 1**). Therefore, according to ICCAT, the LJFL is a straight measure. This consideration is also confirmed by the ICCAT table Codes_FreqTypes, where there are three different codes for this measurement, one general coded as "FL = Lower Jaw TO Fork Length", another specific for billfishes coded as "LJFL = Lower Jaw TO Fork Length (billfish)" and a third general one coded as "CFL = Curved measurement of Fork Length". The third one clearly implies that the previous two codes are straight measurements.

This is even clearer in the ICCAT Glossary (<https://www.iccat.int/Documents/SCRS/Other/glossary.pdf>), where the LJFL (Lower Jaw-Fork Length) is defined as "Projected straight distance between the tip of the lower jaw and the fork of the tail" on page 10.

A confusion could be possibly induced by the latest version of the ICCAT Manual, Chapter 4, part 4.3 Estimating Catch-at-Age (https://www.iccat.int/Documents/SCRS/Manual/CH4/CH4_3-ENG.pdf). There is no specific mention of the swordfish (Xiphidae), but billfishes (Istiophoridae) have a dedicated text on page 33:

"The preferred and most reliable measure of body length for billfish is the lower jaw-fork length (LJFL) (see figure 4.3.4) (**Figure 2** in this paper). For small fish, callipers are practical and provide an accurate straight line measurement. However, field use of callipers for large billfishes, which have a maximum length of over four metres, is impractical.

For purposes of standardisation, it is preferred that all length measurements of large fish be taken with a tape (fibreglass or steel if possible) over the body contour of the fish (curved body length). However, straight measurements by placing the fish over a board that has length scales are also acceptable.

As there is a difference in the value between straight and curved measurements, the measurements taken and equipment used must be clearly recorded on the sampling sheets and reported to the ICCAT with the data."

Therefore, according to the text, the accurate measure at least for small fish (and this is the case of the minimum size for the swordfish) is the straight one. In any case, a curved measurement shall be clearly identified when providing the data to ICCAT or to SCRS SWO SG.

The United States of America are very precise and clear about the LJFL measurement in swordfish. The NOAA (<https://www.fisheries.noaa.gov/action/atlantic-swordfish-commercial-minimum-sizes-and-retention-limits>) specifies the following methodology: "Measure lower-jaw fork length in a straight line from the tip of the lower jaw to the fork of the tail", including a simple and clear image (**Figure 3**).

The European Union, from time to time, publishes an updating Regulation concerning the conservation of fisheries resources and the protection of marine ecosystems through technical measures. The latest available one is the UE Regulation of the European parliament and of the Council of 20 June 2019 (UE Reg 2019/1241 on 20 June 2019, <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1241&from=EN>). In this Regulation, on page L198/148, appendix IV, there are listed the provisions for the "Measurements of the size of a marine organism" and, as concerns the swordfish, the text reports "The size of swordfish (*Xiphias gladius*) shall be measured, as shown in Figure 9, as the lower jaw to fork length (LJFL)". The original figure 9 of the EU Regulation is here included as **Figure 4** and it is very clear that the LJFL is a straight measure.

The Italian Government (Direction General for Fishery and Aquaculture, Ministry of Merchant Marine³ as for the official name at that time), in the early '90s, when there were many problems related to the swordfish fisheries, mostly due to the driftnets issues and to the problem of small-size catches (both deliberate and incidental) in longlines, in agreement with the Italian Scientific Coordination for Large Pelagic Species, issued a Circular reporting the details for the LJFL measurements. The specifications for the swordfish measurement, here translated, were very clear, even for avoiding any legal dispute at the Courts: "Lower Jaw Fork Length: straight measure from the tip of the lower jaw (with closed mouth) to the posterior edge of the caudal fork centre". This

³ The Italian Ministry of Merchant Marine was cancelled in 1993, when it was incorporated in the Ministry of Infrastructures and Transports, for later moving the competences on fishery within the Ministry of Agriculture, Food and Forestry Resources and then to the current Ministry of Agriculture, Food and Forestry Policies.

detailed methodology, used as the reference by Italian Courts in disputes with several fishermen, was never modified. Of course, for decades, all the Italian institutions working on swordfish (the Universities of Bari, Bologna, Cagliari, Genoa, and Messina, the CNR of Messina, the Fishery Laboratories of Bari and Fano, UNIMAR and Aquastudio Research Institute) always used the conventional straight LJFL in all data collection and research activities, including the EC DCR and DCF ones, and these data were also used for the ICCAT SCRS MED SWO assessments.

More recently, the Ministry for the Agriculture, Food and Forestry Policies released the Ministerial Decree (D.M.) on 3 June 2015 (<https://www.gazzettaufficiale.it/eli/id/2015/07/15/15A05453/sg>), including the minimum size for the swordfish and showing how the measures shall be taken. Stragely, the Decree reports (art. 4, point 7) that the total length shall be the UJFL for the swordfish having the bill and the LJFL for the swordfish without the bill (**Figure 5**). The Decree makes reference to point 7 and 8 of ICCAT Rec. 13/04, but point 7 of this Recommendation mentions that it is forbidden to remove any external part of the fish, while point 8 specifies the minimum LJFL size of 90 cm. The Decree also makes reference to art. 87 of the Italian Decree by the President of the Italian Republic on 2 October 1968, no. 1639/68, therefore continuing to apply the minimum size considered as UJFL at that time (140 cm), but it is also obviously taking into account the ICCAT and the EU minimum size (LJFL) at 90 cm. Considering that usually the bill in a swordfish is about 1/3 of the total length (UJFL), there is no incoherence between the two measurements (UJFL and LJFL) indicated by the Decree. Annex 5 of the Decree is certainly creating some confusion (mostly induced by the labels of the two figures, because the UJFL is indicated for the fish having the bill and the LJFL is indicated for the swordfish without the bill), but anyway, the specification to take a curved measure is not mentioned in both cases, therefore both measures shall be taken in a straight mode.

3. The issue.

All scientific teams working on the swordfish, at least in the Mediterranean area, but it is supposed in all ICCAT Convention area, have been always used to measure the LJFL in a straight manner. Therefore, all their size data were provided to the ICCAT Task 2 Data base always as LJFL and these were used in all calculations made by the ICCAT SCRS SWO SG and individual scientists. All biological information and correlations have been based on these length data.

Since 2017, at the ICCAT SCRS SWO SG, it was noticed that some observers' data were based on unconventional measures. During the discussion in the SWO (MED) SG, some participants also mentioned that they were using a curved measure, but this was never specified in writing or on the papers presented by these observers. The data presented in different papers (Lombardo *et al.*, 2017a, 2017b) showed length (LJFL)/weight (RWT) and length (LJFL)/weight (GWT) correlations significantly different from the ones used so far by ICCAT or proposed by previous authors.

The discussion at the SCRS SWO SG was resumed in 2018, based on a brochure used for training the observers, where the image was wrongly designed and the LJFL was wrongly defined as "Low Jaw Fish Length", even if the description in Italian was correct (**Figure 6**). Besides the presence of the ICCAT logo, the brochure was not edited by ICCAT but (according to the logos on each page) by Oceanis srl, the Polytechnic University of Marche and by Cofrepêche. The observers participating to the meeting ensured that the measure was duly taken at the lower jaw, but it was not specified if it was curved or straight, while the papers presented at the meeting were not providing this detail (Gioacchini *et al.*, 2018; Lombardo *et al.*, 2018). Even if it should be supposed that the straight length was used for the LJFL, a warning was verbally provided by the SWO SG Chairs to all participants for preventing any unconventional measurement.

In the following years, the situation remained unchanged and several papers were produced on various SWO issues, using the LJFL, including some papers having a particular importance for better defining the regulations (i.e.: age at maturity and minimum size regulation) (Gillespie *et al.*, 2019, 2020; Gioacchini *et al.*, 2019; Marisaldi *et al.*, 2019a, 2019b; Pignalosa *et al.*, 2019a, 2019b, 2019c; Righi *et al.*, 2020). Observers' manuals were considered confidential and were not officially available, while some presentations in various places always showed a curved measurement for LJFL in swordfish.

In 2021, the four-language versions of the Manual for National Observers, Training Handbook on Fishing Season Training, Monitoring, Research) for Bluefin Tuna and Swordfish (Pignalosa *et al.*, 2020, 2021a, 2021b, 2021c) finally were made available. All manuals have both the Oceanis srl and Cofrepêche logos, but in addition each edition has other logos: the Italian and the Spanish Editions have the logo of the Italian Ministry for Agriculture, Food and Forestry Policies, while the English and Arabic versions have the logo of the Maltese Ministry for the Environment, Sustainable Development and Climate Change. All these manuals have the same indications about how to take the LJFL (**Figure 7**) as a curved measure.

The ICCAT Task 2 Data Base for the swordfish includes the LJFL without any other specification, but it is implicit that now it includes both the straight LJFL and several sets of curved LJFL..

4. Discussion

The different methodologies for measuring a fish are usually within the freedom of each researcher. When the data are used by groups or national or international organisations, one of the basic requirements is to have well-defined measurements, for making the analyses and all studies really comparable among them. This is particularly important when dealing with a species like the swordfish, for which a minimum size regulation is in place.

When the ICCAT SCRS SWO SG made its studies and discussions, it was always clear that the basic size measurement for the swordfish was the LJFL taken as a straight one. This was always the methodology used, as far as we know, by all research teams and it was explicated several times in the last years, particularly by the Chair of the Mediterranean Swordfish SG.

As a matter of fact, all curved measurements imply that the measure is affected by the fish condition, both for UJFL and LJFL in swordfish: fish which are healthy, with a normal stomach content, have a curved fork length higher than a thin fish with diseases and an empty stomach, and certainly smaller than a fish having a full stomach or totally mature gonads or both. In the three cases, the measure will be certainly bigger than the straight length. The almost cylindrical shape of the swordfish body increases the difference.

Just for providing some examples, a juvenile swordfish, having a total straight LJFL of 90 cm (the minimum legal size), with a maximum diameter of just 15 cm, shows a curved LJFL of about 94 cm, a swordfish, having a total straight LJFL of 170 cm, with a maximum diameter of just 24 cm, shows a curved LJFL of about 177 cm, while a swordfish having a total straight LJFL of 190 cm, with a maximum diameter of 26 cm, shows a curved LJFL of about 199 cm. Of course, these curved measures can be different depending on the condition factor. On the opposite, for example, a juvenile swordfish having a curved LJFL of 90 cm will have a straight FL of 86 cm and this will be legally relevant when considering that 90 cm LJFL is the minimum legal size. **Figure 8** visually shows various curved LJFL compared to a straight LJFL.

The curved length is also affected by the size of the fish: in juvenile swordfish, the difference between curved length and straight length can be relatively constant and possibly not so big, but in adults the difference can be very remarkable. The sex can induce a further difference as well as the curved position of the body. Being the difference between curved length and straight length not a constant, it is usually very difficult to detect a reliable equation for the conversion, and it is normally necessary to have various equations for different condition factors and ages/size classes.

For this reason, and for avoiding any interpretation problem when enforcing a minimum size regulation, the straight fork length (LJFL) is always necessary. As mentioned before, the upper jaw fork length (UJFL) is usually considered only for some meristic or morphometric studies in swordfish, because the bill can be partly broken or naturally curved, introducing a further bias in the measurement.

At the same time, it is always necessary, either for the straight measurement or for the curved measurement, that the fish to be sized should be lying over a plan surface, because any curved asset bias the measurement.

In all cases, if an ICCAT code is used for a measure, it must be very clear if it is a straight or a curved measure.

The fortuite discovery that some observers' teams are receiving instructions from at least 2016 for collecting the LJFL using a curved measurement was initially creating a certain worry in the ICCAT SCRS MED SWO SG, because it was clear that the different measurement system, which was not made clear in any communication or scientific paper, was going to create a bias in the results and a problem to the ICCAT Task 2 SWO Data Base. For this reason, a verbal general warning was provided during the meeting. At that time, the situation was concerning just one team of national observers. Unfortunately, the situation continued over the years and it is now clear that the same methodology was extended and exported to other teams of national observers in various CPCs.

It is now inevitable that the ICCAT Task 2 SWO Data Base is including under the same code two different sets of LJFL: the straight one, used by most of the scientists, and the curved one, used by some observers' teams. At the same time, all scientific papers which used these observers' LJFL curved measurements since 2017 should be re-analised, because their results are not comparable with papers which used the straight LJFL. This is particularly relevant i.e. when the papers were defining and identifying a new L_{50} or L_0 , detecting differences with previous studies, or when the age-length keys were analysed.

The mixing of different LJFL measurements in Task 2 Data Base inevitably introduced also some biases in the stock assessments for this species, which somehow affected the results since 2016 and particularly the age slicing. They also affected all ICCAT SCRS SWO SG considerations about the percentage of undersize fish in the catches, even if in a minor manner.

It is absolutely not clear if this unusual measuring approach was induced by a defined choice made by somebody or by a misreading or misunderstanding of the ICCAT Manual. It is also evident that some regulations are not very clearly setting the method for measuring a swordfish, while others introduces further confusion.

5. Conclusions

According to the ICCAT Manual, there is no conversion factor between the straight LJFL and the curved LJFL for the swordfish, therefore this issue was never considered by the SCRS because it is implicit that, according to the various regulations, the preferred measure shall be the straight LJFL (https://www.iccat.int/Documents/SCRS/Manual/Appendices/Appendix%204%20III_SWO.pdf) as it was always considered by the many scientific teams working on this species since decades.

If a conversion factor between straight LJFL and curved LJFL will be adopted in the future, it should consider the condition factor and the fish size as one of the main necessary information. It would be also necessary to have a specific code for the curved LJFL and UJFL (e.g.: CLJFL and CUPJL). We suppose that the ICCAT SCRS SWO SG might help the Secretariat for improving the ICCAT Manual as specifically concerns the swordfish (*Xiphias gladius*).

It should be useful for all researchers that the ICCAT SCRS SWO SG recommends a common preferred methodology for measuring the LJFL in *Xiphias gladius*. This will be also useful for the ICCAT Commission.

It is recommended that all legal provisions concerning the minimum size for swordfish (*Xiphias gladius*) shall better and more clearly specify the straight methodology to be used for measuring both the LJFL for avoiding any possible misinterpretation.

According to the evidences provided in this paper, it is very clear that some observers' teams were collecting, since at least 2016, the curved LJFL, using also these measurements in several scientific papers for studying some biological correlations and maturity features. These data are now mixed-up in the ICCAT Task 2 SWO Data Base along with the straight LJFL data collected by other research teams. It is very evident that the two different types of measurements shall be duly distinguished and separated. This should be duly considered by the ICCAT SCRS SWO SG (including also the various teams working on the SWO Research programme), the ICCAT SCRS Subcomstat and the ICCAT Statistical Department.

Furthermore, according to the same evidences provided in this paper, the analyses and the data provided by Lombardo *et al.* (2017a, 2017b, 2018), Gioacchini *et al.* (2018, 2019); Gillespie *et al.* (2019, 2020), Marisaldi *et al.* (2019a, 2019b), Pignalosa *et al.*, (2019a, 2019b, 2019c) and Righi *et al.* (2020) should be reconsidered, taking into account that the results are related to the use of the curved LJFL and, therefore, their conclusions are necessarily different from all previous and contemporary papers which were based on the straight LJFL and cannot be easily compared at the moment.

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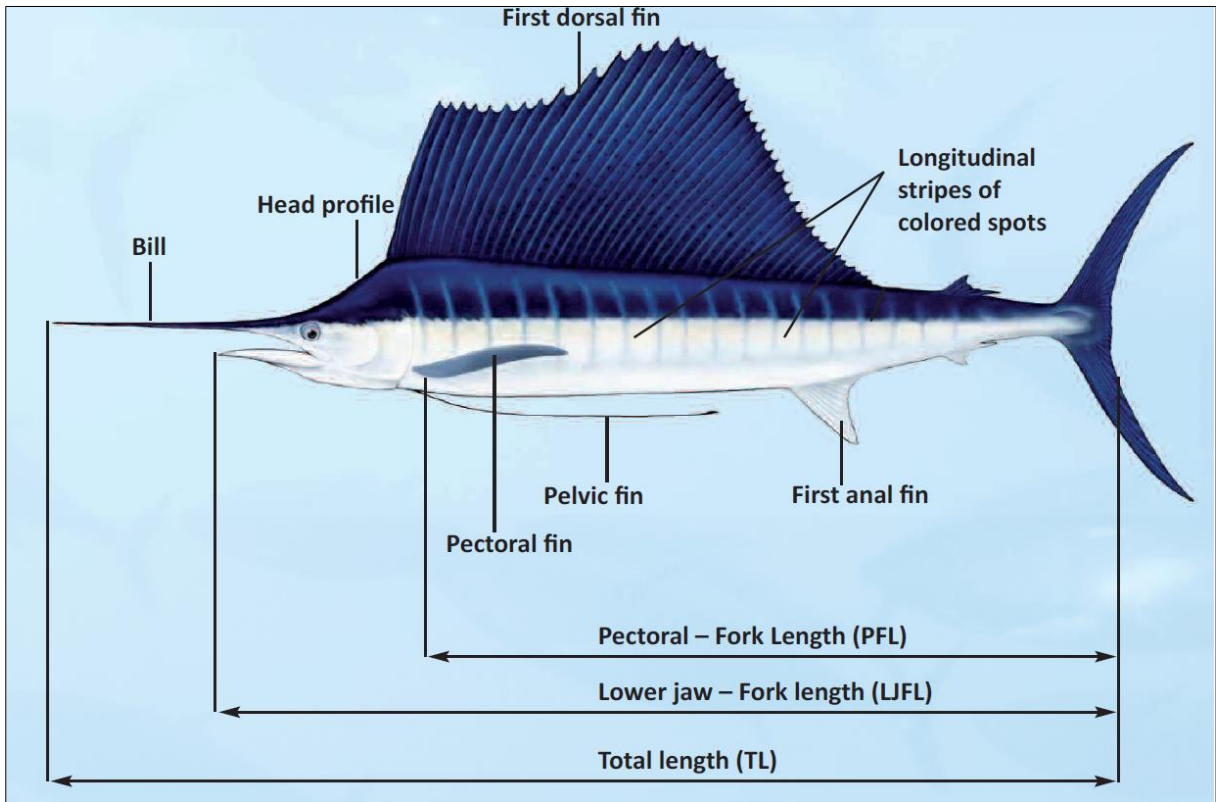


Figure 1. Descriptive features for billfishes, including the most important length measurements. ICCAT Species ID Cards, Guide for the Identification of Atlantic Istiophoridae.

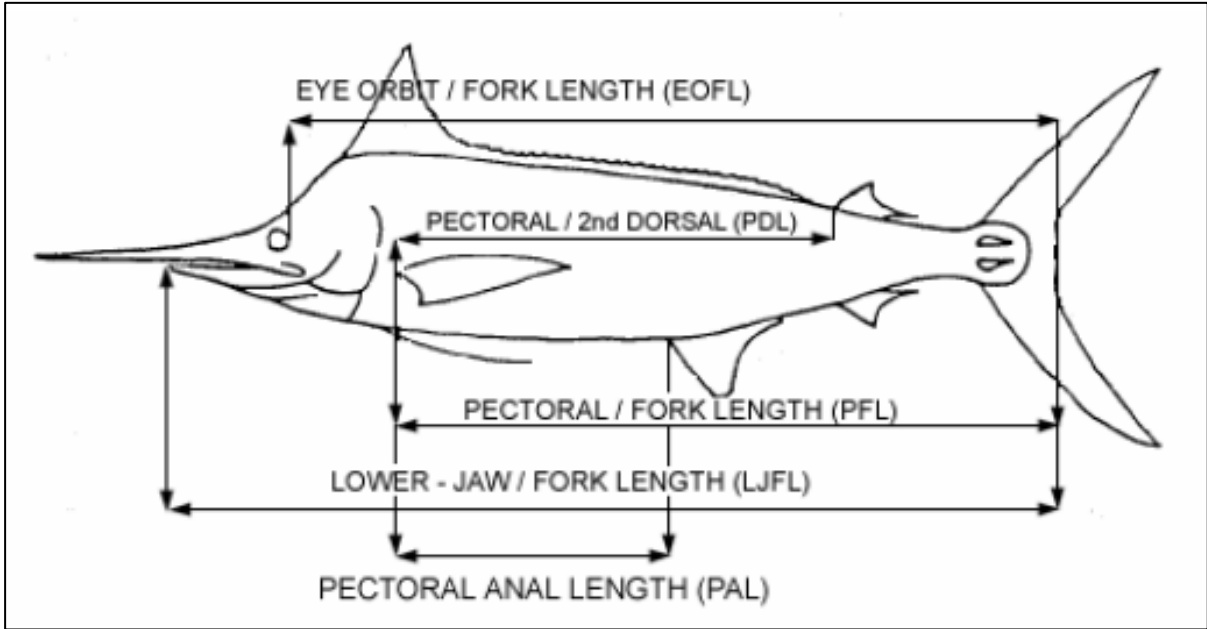


Figure 2. Alternative measures of billfishes. ICCAT Manual, Chapter 4.3. Estimating Catch-at-Age, page 33.

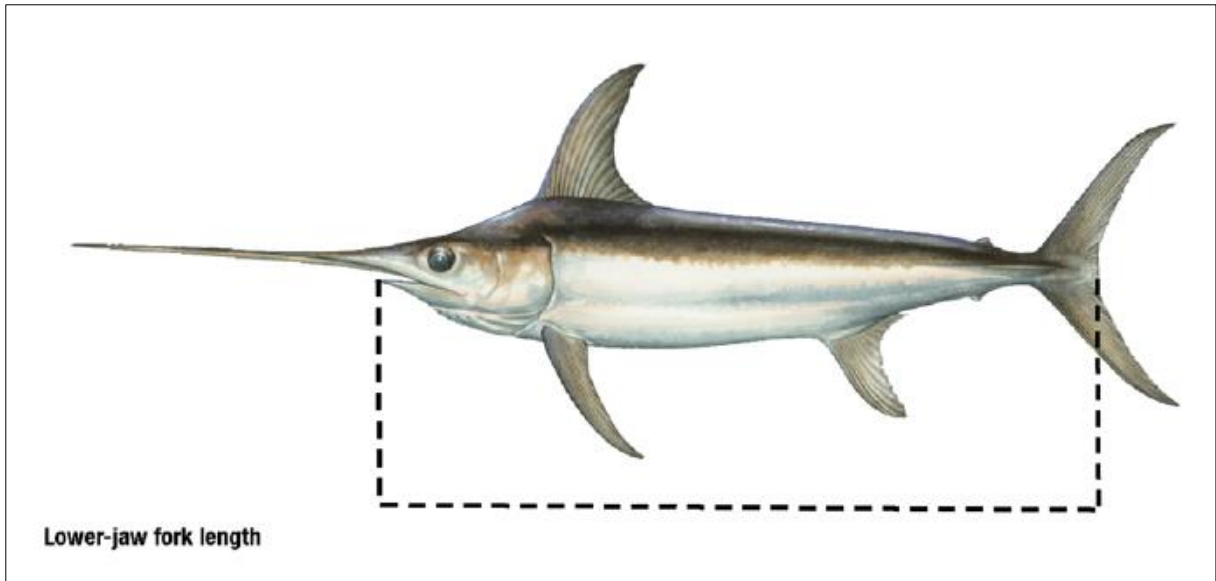


Figure 3. Lower Jaw Fork Length measurement figure from NOAA (<https://www.fisheries.noaa.gov/action/atlantic-swordfish-commercial-minimum-sizes-and-retention-limits>), illustration by Diane Rome Peebles.

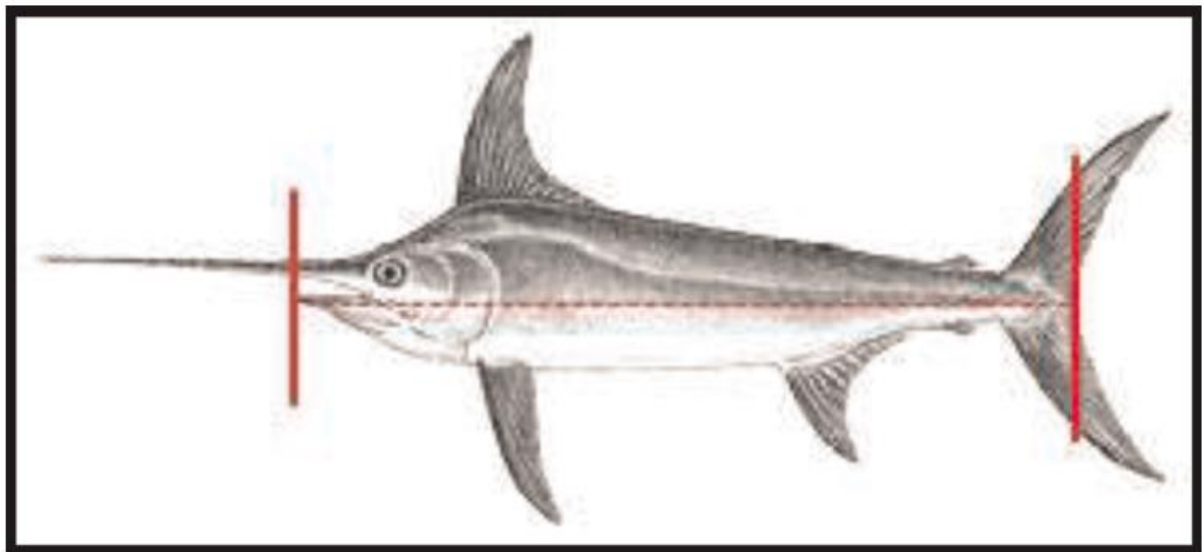
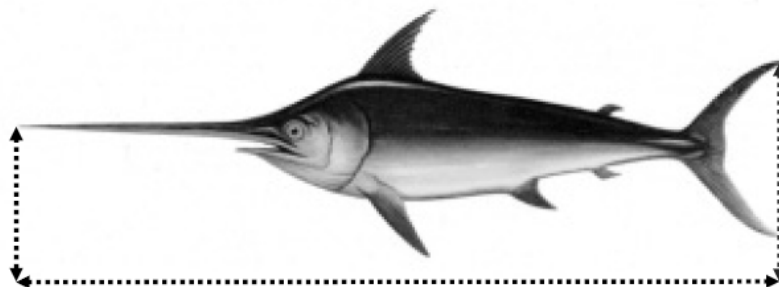


Figure 4. Lower jaw fork length as showed by the UE Reg 2019/1241 on 20 June 2019 (L.198/148, Annex IV) (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1241&from=EN>).

ALLEGATO

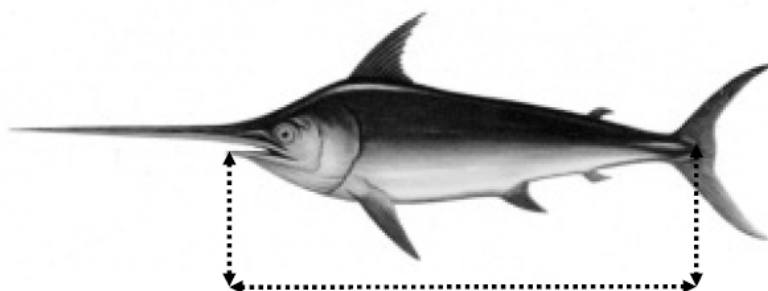
Taglia minima di cattura (art. 4, comma 7, del D.M. 03/06/2015)

FIGURA 1: ESEMPLARI MUNITI DI SPADA



NOTE: ai sensi dell'art. 87 del D.P.R. n.1639/1968, la taglia minima del pesce spada è fissata in 140 cm, che, ai sensi del successivo art. 90, devono essere misurati dall'estremità del rostro (spada) fino all'estremità più lunga della pinna caudale.

FIGURA 2: ESEMPLARI NON MUNITI DI SPADA



NOTE: ai sensi del par. 8 della Raccomandazione ICCAT 13-04, la taglia minima del pesce spada è fissata in 90 cm di lunghezza alla forca (misurata, cioè, dall'estremità della mascella superiore all'estremità del raggio più corto della pinna caudale). O, come alternativa, in 10 Kg. di peso vivo, ovvero 9 Kg. di peso eviscerato, ovvero 7,5 Kg. di peso eviscerato e senza branchie. La percentuale di tolleranza consentita, nella sola fase di cattura e/o sbarco, è del 5%.

Figure 5. Details of Annex 5 of the Italian Ministry Decree (D.M.) on 3 June 2015, showing the UJFL and LJFL measurements for the swordfish. Figure 1 of Annex 5 shows the measure to be taken for swordfish having the bill (UJFL), while Figure 2 of Annex 5 shows the measure to be taken for swordfish without the bill (LJFL). (https://www.gazzettaufficiale.it/do/atto/serie_generale/caricaPdf?cdimg=15A0545300500050110001&dgu=2015-07-15&art.dataPubblicazioneGazzetta=2015-07-15&art.codiceRedazionale=15A05453&art.num=5&art.tiposerie=SG).



Figure 6. Wrong figure representing the LJFL (and not the Low Jaw Fish Length) in swordfish on an observers' brochure edited in 2018 (the brochure was not edited or supported in any way by ICCAT, as the logo might suggest). On the opposite, the description in Italian is correct (Oceanis *et al.*, 2018).

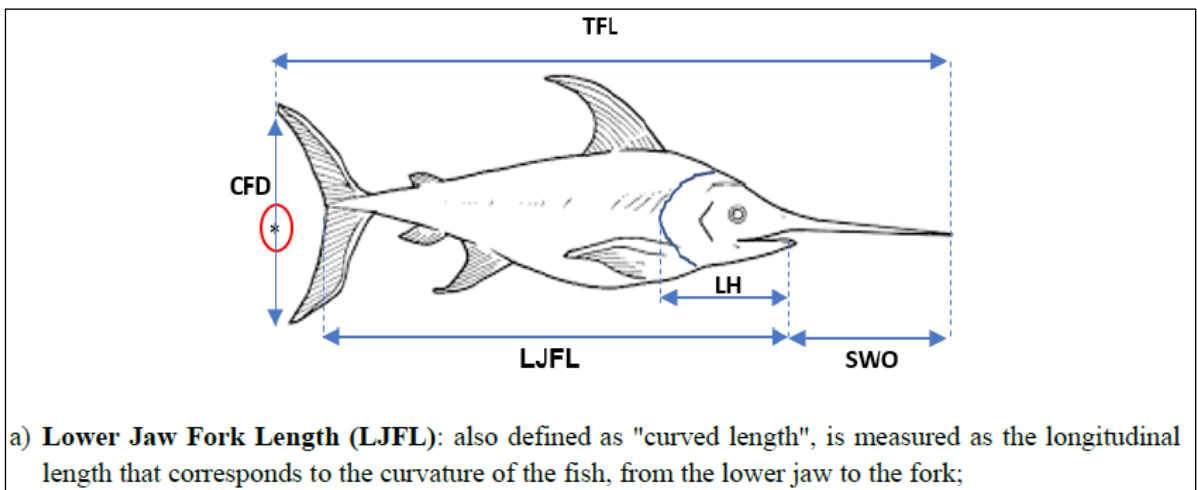


Figure 7. The instruction provided to the observers for measuring the LJFL in swordfish. According to the manual (in all four languages, Italian, Spanish, English and Arabic, it is clearly indicated that the LJFL shall be taken as a curve measurement (Pignalosa *et al.*, 2020, 2021a, 2021b, 2021c). <http://www.oceanissrl.it/public/allegati/trainingmanualforationalobserver2021inglese.pdf>

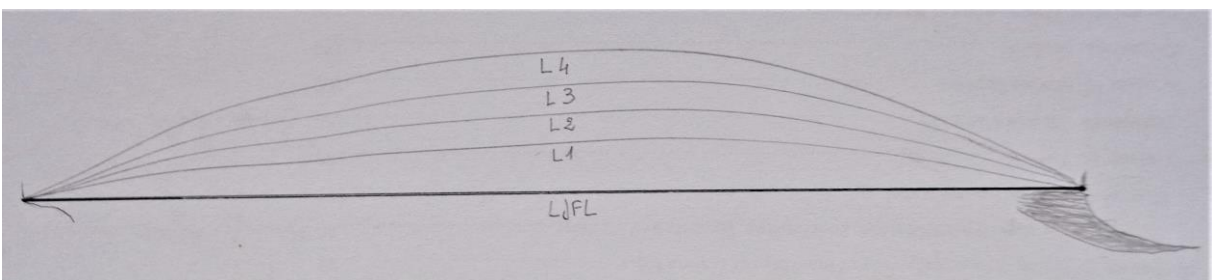


Figure 8. Graphic esemplification of various curved LJFL compared to a straight measurement of LJFL.