

## AN UPDATE OF THE SWORDFISH FISHERY IN THE LIGURIAN SEA (WESTERN MEDITERRANEAN)

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### SUMMARY

*Nominal indices of relative abundance for swordfish caught by the Ligurian longline fishery are updated with 2014 and 2015 data. The trend in CPUE for the mesopelagic longline indicates that relative abundance for 2014 has strongly increased from 2013 levels, but dropped during the following season 2015. Average sizes of fish, after the decrease showed in the previous years, remain quite constant. During the winter months fishing is active using the American Type longline: a comparison of the two gears in terms of catches, CPUEs and size/frequency distributions is reported.*

### RÉSUMÉ

*Les indices nominaux d'abondance relative de l'espadon capturé par la pêche palangrière ligurienne ont été mis à jour avec des données de 2014 et 2015. La tendance de la CPUE pour la palangre mésopélagique indique que l'abondance relative de 2014 a fortement augmenté par rapport aux niveaux de 2013, mais a chuté pendant la saison de 2015. Les tailles moyennes des poissons, après la diminution de ces dernières années, sont restées relativement constantes. Pendant les mois d'hiver, la pêche est active et a recours à la palangre de type américain. Une comparaison des deux engins en termes de capture, CPUE et distributions des fréquences de tailles est présentée.*

### RESUMEN

*Se presentan los índices nominales de abundancia relativa para el pez espada capturado por la pesquería de palangre de Liguria, actualizados con los datos de 2014 y 2015. La tendencia en la CPUE para el palangre mesopelágico indica que la abundancia relativa para 2014 ha aumentado enormemente respecto a los niveles de 2013, pero cayó durante la siguiente temporada de 2015. Las tallas medias de los peces, después del descenso mostrado en años anteriores, permanecen bastante constantes. Durante los meses de invierno, la pesca es activa y se usa el palangre tipo americano: se presenta una comparación de los dos artes en términos de capturas, CPUE y distribuciones de frecuencias de tallas.*

### KEYWORDS

*Swordfish (Xiphias gladius), CPUE, Size, Ligurian Sea, Western Mediterranean*

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## 1. Introduction

The last assessment of Mediterranean swordfish by the International Commission for the Conservation of Atlantic Tunas (ICCAT) was performed in 2014 (Anon. 2015). During the session, standardized CPUE data arising from surface longline (LLSWO) in the Ligurian Sea from 1990 to 2009 were introduced (Garibaldi and Tserpes, 2015), together with the data recorded for the mesopelagic longline introduced since 2010 by all vessels of the Ligurian pelagic fleet for the period 2010-2013 (Garibaldi, 2015). This manuscript reports data obtained from the 2014 e 2015 fishing seasons and provides an account of recent trends in the swordfish fishery, as well as an overview of recent size changes in the two main gears used (mesopelagic longline and American type longline).

## 2. Material and methods

### 2.1 Description of the fishery and gears

The Ligurian swordfish long line fishery is carried out by a small fleet (about 40 boats involved) and shows artisanal characteristics: a) more than 30% are small-medium in size (less than 10 m LOA), the largest one being less than 15m LOA; b) crew are made of 2–3 fishermen c) the fishing operations have a daily rhythm. Catches obtained by the Ligurian longline fleet represented from 5% to more than 10% of the total Italian swordfish catches in the last 5 years, depending on different years. Traditionally the swordfish fishing season starts in June (in May some attempts could be made, but generally with scarce success), and ends in September.

Up to 2009, the main gear used was the traditional drifting LLSWO, displaced strictly at surface (max depth 15m), but since 2010 quite all boats introduced the new mesopelagic longline (MESOLLSWO) and only a residual activity was carried out with LLSWO in 2010 and 2011 by a limited number of boats. The mesopelagic longline is used from June to September, when it enters into force on the period of detention of fishing. A detailed description of the gears is reported in Garibaldi (2015). Moreover, since 2011 all boats introduced the American Type swordfish longline (AM-LLSWO), equipped with lights as attraction devices; this gear is used mainly during the winter season (December-January) and only occasionally during summer. In the past, before the introduction of the conservation measures, October and sometimes November represented very good fishing period, with high CPUE values. In **Figure 1** is reported the monthly timing of the three different gears in the Ligurian Sea.

### 2.2 Monitoring and sampling activities

Monitoring of the swordfish fishery have always been carried out in two main harbours, following the same scheme, on a daily basis at Sanremo and weekly at Imperia. In the last years the harbour of Loano was added to the monitoring activities. During each day of observation at landings, information about total catches and effort were recorded and all the catches were measured, as lower jaw fork length (LJFL) and weighted (gutted weight, GW). Activities were also carried out directly onboard the fishing vessels in order to collect information about by-catch and discards.

### 2.3 Data analysis

Nominal CPUE values, length-frequency distributions, length-weight relationships and observations on sex ratio and GSI were obtained from data collected, both for MESOSWOLL and AMSWOLL. The standardization of data derived from MESOSWOLL is very difficult because many factors could affect the fishing capacity of the gear itself, fishery-dependent factors (i.e. soaking time) and environmental factors (i.e sea currents intensity); an attempt to standardize data is still in progress.

## 3. Results

### 3.1 CPUEs

The entire long line CPUE time series covering 26 consecutive fishing seasons (1990-2015) for the different gears is reported in **Figure 2**, both in weight (**Figure 2a**) and numbers (**Figure 2b**).

### 3.1.1 MESOLLSWO

About MESOLLSWO, in 2010 the newly introduced gear reached the highest CPUE value ever observed in the area (344,1 kg/1000 hooks). After this peak, a dramatic drop was recorded in the following two years (2011 and 2012), showing a slight recovery in 2013, a rise in 2014 and a new decrease in 2015. Comparing the two graphs, in weight and numbers, it can be considered that the high value in weight of the first year was due not to a high number of individuals, but to their larger size.

### 3.1.2 American Type SWOLL

This gear is used only occasionally by a limited number of boats during summer, but is largely used in winter months, when the MESOSWOLL is not suitable because of the strong currents and bad atmospheric and sea conditions. Summer data might be too scarce to be representative of the fishery, but it is clearly evident a steady trend in the increase of CPUE values (both in weight and in number) in winter.

### 3.2 Swordfish size-frequency distributions

The size distributions recorded for MESOLLSWO separately for the 6 years of activity are reported in **Figure 3**. The trends over the six years shows that in 2010 individuals of large size were more abundant in the catches than in the following years. Moreover, in 2012 a large recruitment of juveniles, representing the cohort 2011, appeared in the catches; this cohort can also be followed in 2013 and 2014. Catches composition obtained by the American longline is completely different: the size frequency distribution of fish caught by this gear is reported in **Figure 4**; it shows a completely different pattern, also if compared to the old surface SWOLL.

#### 3.2.1 Swordfish average size

The time series of the mean size values of swordfish is presented in **Figure 5**: while the highest value for the traditional LLSWO was achieved in 2006, with 131.7cm LJFL, in the first year of use for the MESOLLSWO it was 143.87cm LJFL. After that within a couple of years it was gradually reduced to an average size ranging from 125 and 130 cm LJFL. The average size of fish caught by Am. SWOLL, as it could be argued by examining the length frequencies distribution, it is clearly smaller, being less than 110 cm LJFL in the last year.

## 4. Discussion

The last session of the Mediterranean swordfish Stock Assessment held in 2014, led to the conclusion that the Mediterranean swordfish stock is overexploited and in conditions of light overfishing. (Anon, 2015). The introduction of the mesopelagic long line in the Ligurian Sea as well as in all Italian seas has revealed the unexpected presence of a bulk of large spawners, that found their refuge in the deep. The size frequency distributions of swordfish caught by MESOLLSWO are completely different from those recorded in past by the means of the traditional surface LLSWO (Garibaldi, 2015). Our view is that until the introduction of MESOSWOLL, we recorded in the catches mostly the “juvenile” fraction of the stock, without suspecting the presence of this fraction of large spawners, not available to the fishery; they allowed to maintain an adequate level of annual recruitment, even if fishing activities were addressed to juveniles or sub-adults (SWOLL) and YOY (Albacore Longline). So, probably, the exploitation made by surface longlines, based on the first 3 age classes, only in part has led to the erosion of the stock. As a matter of fact, “surface” fisheries were carried out since the origin, showing, in the Ligurian Sea, CPUE’s variations by years, with no particular trends over a twenty years period. Now the situation has changed and we probably lost a part of these large spawners; after 6 years the mean swordfish size dropped to the values recorded in the past for driftnets (Di Natale *et al.*, 1995) and slightly higher than the traditional SWOLL. On the other hand, the impact of the AMSWOLL is more important on the younger fraction of the population, especially during winter months.

In conclusion, the use of MESOSWOLL has positive effects on juveniles, given that catches of undersized swordfish are negligible and specimens smaller than 100cm LJFL represent less than 10% of the total catches. On the other hand, it must be noted the rapid decline of the average size, along with the drop in CPUE values. This confirms that the real size structure of the Mediterranean swordfish stock in the past was probably the one obtained merging the SWOLL with the MESOSWOLL size frequency distributions, as shown in Garibaldi (2015). Now this composition has changed, shifting towards smaller sizes, in a situation very similar to that recorded in the past for surface gears (driftnets and longlines).

So far, all the technical measures taken for the recovery of the Mediterranean stock were addressed to the protection of juveniles, such as the introduction of the two periods of fishery closure (October-November and February-March), minimum conservation size, minimum hook size, etc. It remains as a matter of concern the possible depletion of spawners; some measures of conservation should be addressed also to protect this fraction of the population.

For a better stock and fishery management it should be necessary to differentiate fishery closures by gear, season, geographical areas and environmental parameters, taking into account the characteristics of the different fishing grounds (spatio-temporal closures).

### **Acknowledgements**

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Surface SWOLL (untill 2009)	Yellow		Black		Yellow		Green					
MESOSWOLL (since 2010)	Black		Red		Yellow		Green			Red		Black
Am. Type SWOLL (since 2011)	Green	Yellow	Red	Black	Yellow				Red		Green	
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
	Inactive			Occasional			Active			Closure		

Figure 1. Monthly timing of the different SWOLLs in the Ligurian Sea.

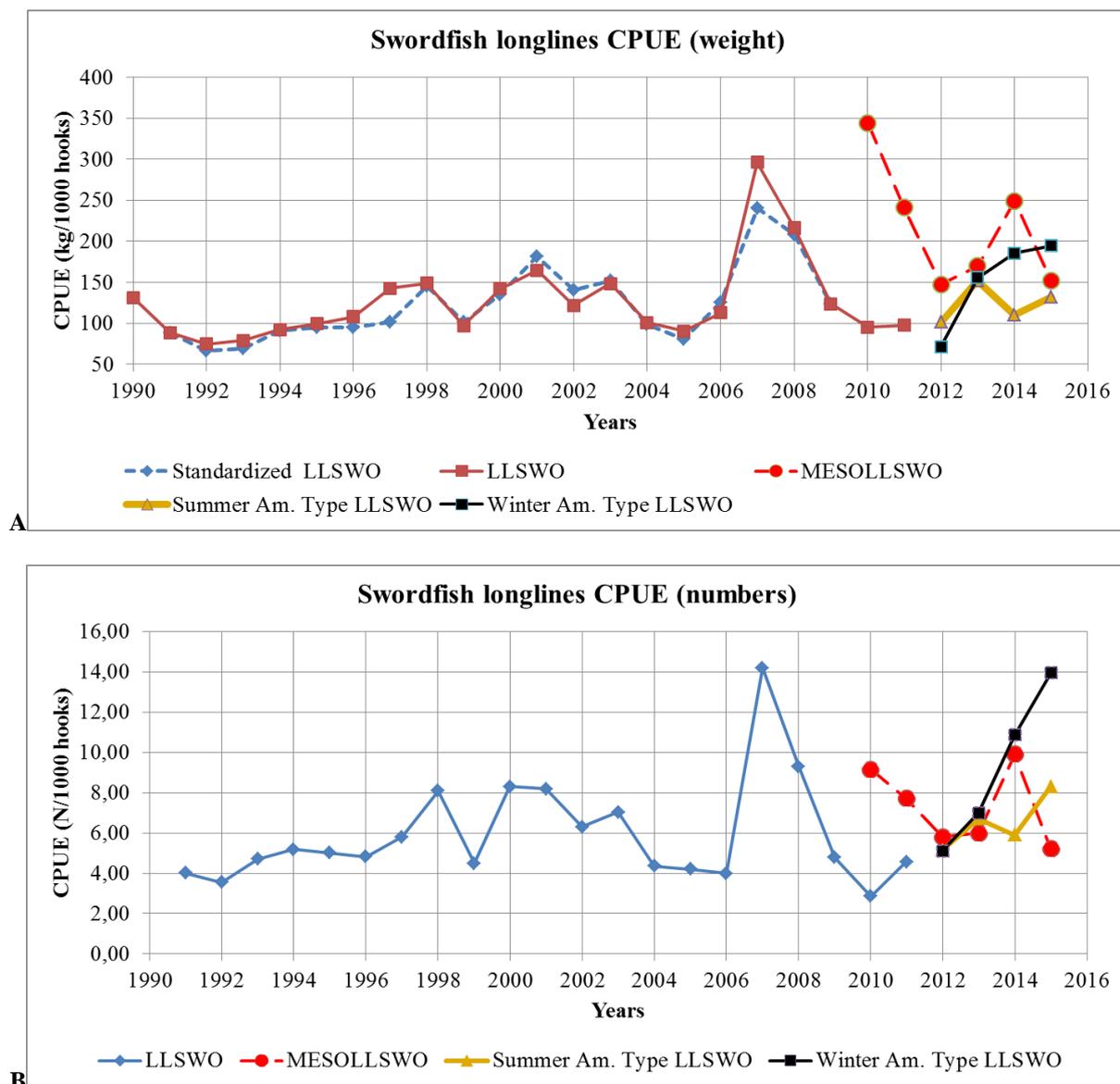
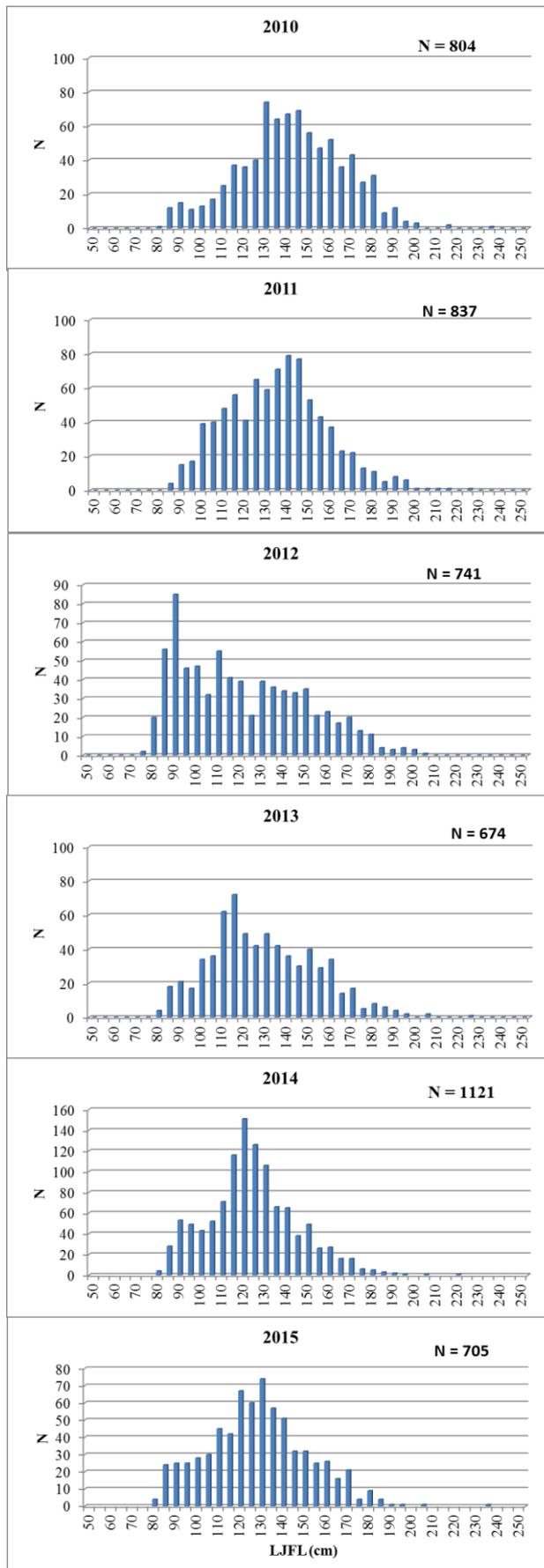
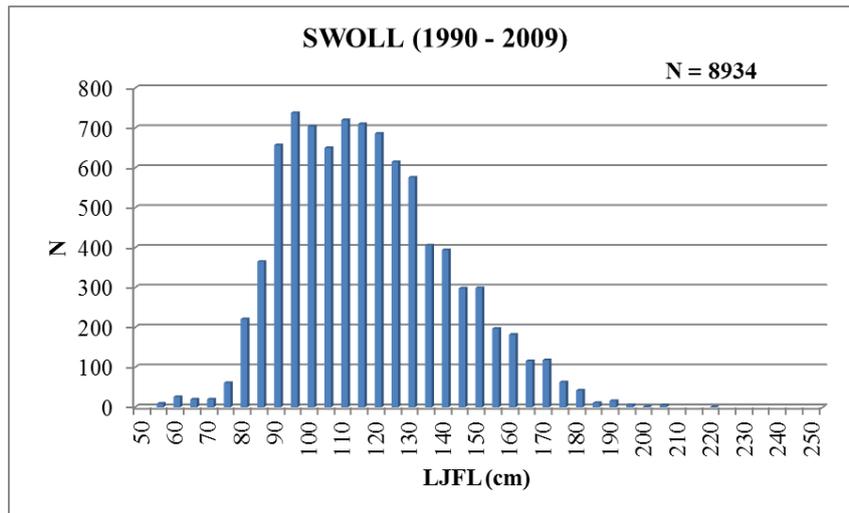


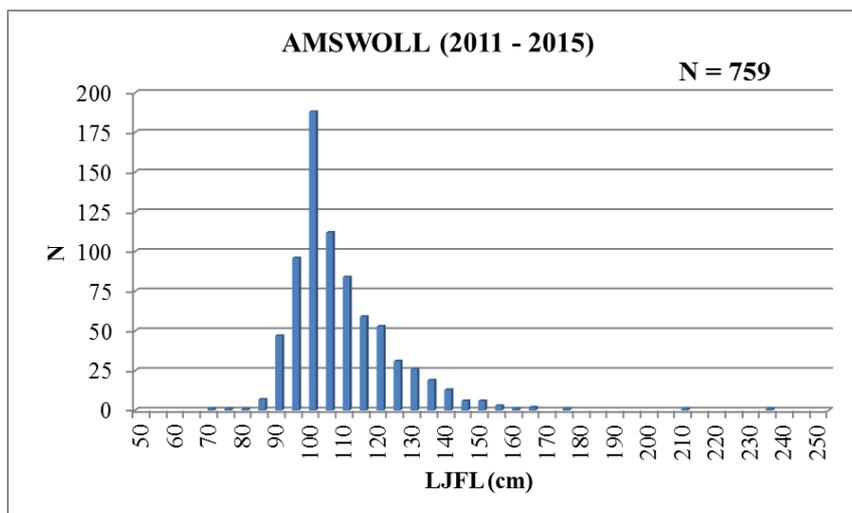
Figure 2. CPUE time series for the three different type of longlines. A) CPUE in weight B) CPUE in numbers.



**Figure 3.** Size distribution of swordfish caught by MESOLLSWO.



**A**



**B**

**Figure 4.** Size distribution of swordfish caught by two different surface longlines. A) traditional surface SWOLL b) American Type SWOLL.

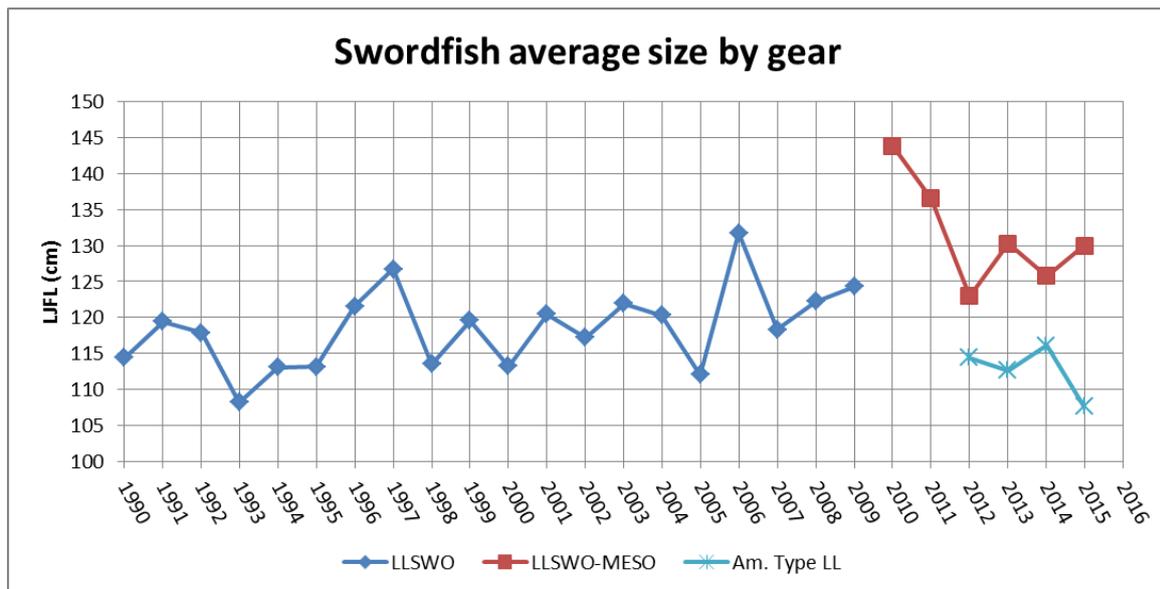


Figure 5. Evolution of the mean size of the swordfish caught with the three types of longline.