Analyses of sex ratio, by length-class and length-weight relationships for several species of Family *Xiphiidae* (*Xiphias gladius,* *Linnaeus 1758*) and *Istiophoridae* (*Istiophorus platypterus,* *Shaw 1792*) and *Tetrapturus angustirostris,* *Tanaka 1915*) caught from experimental cruise on Spanish longliners in the South Western Indian Ocean during 2005

by

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SUMMARY

This paper presents results based on data obtained by observers on board Spanish longliners regarding relationships between body round weight (RND) and lower jaw fork length (LJFL), and sex ratio by length range of some of the main species belonging to Xiphiidae *and* Istiophoridae *families caught during the pilot action (AP) undertaken by these vessels for twelve months in 2005. During this AP, two ships performed 539 sets and worked 531 916 hooks of 5 different kinds, baited with mackerel or squid, or squid-like species. From the total tons of fishes caught (75 species or groups of species), billfishes correspond to 40% of round weight (466t): 9824 individuals (9438 SWO:* Xiphias gladius*, 126 SFA:* Istiophorus platypterus *and 168 SSP:* Tetrapturus angustirostris*; the rest correspond to another species of billfishes). Observers weighed 54% of SWO (5091 individuals) and also obtained length data (LJFL). Analyses of these data have resulted in a length-weight relationship for SWO, described by the equation* $W = 1.83 \times 10^{-6} \times L^{3,3921}$ *if both sexes are taken into account. This is also described for males and females of SWO. The same equations are presented—combined sex—for 81 individuals of* Istiophorus platypterus *(SFA) and 116 individuals of* Tetrapturus angustirostris *(SSP).*

Scientific observers on board have reported the sex and size of 6836 individuals of SWO (73% from total data capture) from direct observation of gonads. Thus, 67% of individuals are females, which points to over 50% in practically all length classes and involves all three-month periods of 2005.

1 Introduction

At the meeting of the Scientific Committee of the IOTC in November 2004, information was provided about the experimental campaign being carried out by the Spanish Oceanographic Institute (IEO) on two surface longliners in the international waters of the Southwestern Indian Ocean (*Ariz et al., 2004*).

Spanish Fisheries Institutions are encouraged to carry out experimental fishing plans or pilot programs (AP), including participation and scientific monitoring by the Instituto Español de Oceanografía (IEO), the purpose of which is to test new fishing gear, manoeuvres, fishing technologies, and so on.

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In 2005, one of these pilot programmes—AP-8/2004—was undertaken on two Spanish longliners in the South Western Indian Ocean. The main purpose of this AP was to put into effect experiments with circular hooks and different kinds of baits, in order to minimize frequent catches of marine turtles resulting from these long line fisheries.

For AP programme development and monitoring, two scientific observers, directed by IEO, were always on board both participating vessels from the onset. For all the sets, observers collected detailed information about ship activities, data capture and biological parameters of all the species caught.

This paper presents biological data of fishes belonging to the following families: *Xiphiidae: Xiphias gladius* (SWO), *Linnaeus 1758* and *Istiophoridae: Istiophorus platypterus* (SFA), *Shaw 1792, and Tetrapturus angustirostris* (SSP), *Tanaka 1915,* caught during this programme, which has now concluded.

Data are taken from within the geographical limits of the AP and, consequently, are representative of different species depending on the stock structure to which they belong.

2 Material and Methods

The pilot action was undertaken by two Spanish surface longliners: *Beata Teresa Jornet* (IOTC000207) and *Zumaya Dous* (IOTC000844). The working area was in international waters of the South Western Indian Ocean, between 25º S and 35º S and 30º E and 50º E (Figure 1).

Activities began on 12 December 2004 and ended on 12 December 2005. 539 sets were undertaken for this period (as shown in Figure 1).

Both vessels had a setline carrying 960 hooks (480 baited with mackerel and 480 baited with squid or squid-like species), as equipment for the fixed part of the long line. Specifically, 240 units of each type of hook were used, alternately varying sequences of 60 hooks of each type baited, with different kinds of bait. The variable part of the long line, whose use depended on the criteria of the ship's skipper, had a maximum of 240 and a minimum of 60 hooks. These hooks had the same sequence as the fixed part—60 hooks of each type with only one kind of bait per sequence. The variable part was required to be exactly the same for both boats when undertaking joint sets (to measure and standardise the fishing efficiency of each vessel).

Longline configuration and hook distribution for fixed and variable parts was as follows:

- Hooks between buoys: 5
- Distance between hooks: 87 m
- Hooks between radio beacons: 60 hooks of each kind.
- No. of hooks per section: 240 (4 types of hooks) with the same kind of bait.
- Each snood drops to 18 metres to the meeting point with the setline. From here 14.6 m of line extends to where the electrical or chemical light is positioned and a further 3.6 m to the hook (approximately 10 cm, including anchoring).
- Approximate distance between radio beacons: 5220 m, reaching the fixed part of the gear at a distance of 84 km from the head to the end of the longline.

In the experiment, five types of hooks and two types of bait were used for the "basic or fixed long line" and for the variable or "optional" part of the long line.

A scientific observer was on board each ship from programme onset. Their work was to collect information about environmental parameters (including depth and temperature data using depth registers located on the longline), information about fishing boats, biological (sex, etc) and morphological (size and weight) and predation data, pop-up tagging and catches per type and hook.

Given that numerous samples were gutted on board, scientific observers took the individual weight of each specimen, the size, sex and the degree of gonadal development wherever possible.

Round weight (RND) was calculated directly from spring balances (100 Kg, 200 gr precision) placed on board, and length was taken by utilizing 1.5 m-long callipers, always considering the lowest centimetre. The final measurement taken was LJFL (lower jaw fork length) for *Xiphiidae* and *Istiophoridae.*

For the adjustment of the size-weight ratio, weights were allocated to the size corresponding to the average point of the interval: 0.5 cm. For the sex ratio, sizes were grouped into 5 cm intervals for results presentation.

By direct observation of gonads, scientific observers reported sex, determining males, females or undetermined individuals. No criteria were used to select individuals to determine sex, so the entire process was made at random.

Although there is a space-time stratification for sampling in the prospection area, it was not taken into consideration for this document. Joint analysis has been made of all the specimens sampled since activities began (539 sets) for the entire area.

3 Results

Figure 1 shows the geographical distribution of the 539 fisheries performed for both vessels during this AP.

28106 specimens of several species and taxonomic groups were identified in the sets. In the case of the billfishes, 9824 fish were caught: 9438 SWO, 168 SSP, 126 SFA and 92 of other species.

3.1. Length-weight relationships

This paper presents data related to three of the main billfish species caught by these fisheries. Specifically, length and weight data were collected from 5091 samples of both sexes of swordfish (SWO), 81 Indo-Pacific sailfish individuals (SFA) and 116 specimens of short-billed spearfish (SSP).

Table 1 shows the results of length-weight adjustment to a $W = a \times L^b$ type equation, as well as characteristics of the data used in each adjustment (number of data pairs, range of weights and sizes) for the three most frequently caught species of swordfish. These data are presented for all the sampled specimens (both sexes and undetermined) and by sex.

Figure 2 gives the graph and data pairs used in the adjustment of length-weight relationships, taking into account both sexes, or only males or only females of SWO. The low graph of this figure shows that three equations were obtained in addition to those from IOTC analyses for SWO—combined sex—in the South Pacific area (*Anonymous, 2005*).

Correlation coefficients are high in the three equations obtained (combined sex, male and female) for SWO—the species with the most specimens sampled. This equation (both sexes) is very similar to that used by the IOTC for the SWO in the South Pacific (SPC) for sizes below 175 cm. From here on, the equation presented in this document predicts weights above the aforementioned size (see lower graph in Figure 3).

Figure 3 shows the same adjustments but only for both sexes of SFA and SSP, respectively. No graphical representation was based on each sex, given the small number of samples available, although regression adjustments, as shown in Table 1, show the same for the total and by sex.

3.2. Sex ratio

The sex of 6983 billfish individuals was recorded (72% of number of billfishes caught): 6836 SWO, 64 SFA and 83 SSP, so as to establish the sex ratio by length class in the prospected area.

Tables 2, 3 and 4 give the sex ratio per size interval, as well as the percentage of females obtained for SWO, SFA and SSP. A general predominance of females was observed for the three species studied, since they were present in practically all size intervals, with the following overall proportion: 67% for SWO, 80% for SFA and 64% for SSP.

Figure 4 gives the bar charts of size per sex for the three species studied.

Figure 5 shows the graph of the percentage of females per size interval for the three species studied. Thus, 67% of SWO individuals are females. In general, the percentage of females increases with size to around 80% in sizes over 175 cm. It is emphasized, anyway, presence of males with lengths larger than 210 cm, mainly if it is taken into account low representation of individuals with this size in Atlantic Ocean.

This preponderance of females coincides with that indicated by *Anonymous 2004* for the Programme Palangre Réunionnais, La Reunion, which shows percentages of females higher than 50% practically throughout the entire year for the sizes indicated.

The percentage of female swordfish per quarter was calculated (65-71% for all quarters), in order to corroborate this finding (Figure 6).

It is difficult to draw more conclusions for the other species, owing to the small number of specimens sampled.

References

Anonymous, 2004. Report of the 4th session of the IOTC working party on billfishes. IOTC-2004-WPB-R[EN].

Anonymous, 2005. Biological data on tuna and tuna-like species gathered at the IOTC Secretariat: Status Report. IOTC-2005-WPTT-05.

García-Cortés, B., J. Mejuto, J.M. de la Serna, A. Ramos-Cartelle. 2005. Activity of the Spanish surface longline fleet catching swordfish (*Xiphias gladius*) during the year 2003, in the Atlantic Ocean. SCRS/2005/073.

J. Ariz, Delgado de Molina, A. & P. Pallarés. Spanish long line experimental fishing cruise in international waters of the Western Indian Ocean in 2004 and 2005. IOTC-SC-04-INF05.

Matsumoto T., H. Saito & N. Miyabe. 2004. Report of observer program for Japanese tuna logline fishery in the Atlantic Ocean from august 2003 to January 2004. SCRS/2004/113.

Matsumoto, T. 2005. Report of observer program for Japanese tuna longline fishery in the Atlantic Ocean from August 2004 to January 2005. SCRS/2005/095.

Mejuto J. & B. García-Cortés. 2005. Documentación sobre la preparación de datos científicos de la pesquería española de pez espada (*Xiphias gladius*) en las regiones del pacífico, con especial referencia a los años más recientes 2002 y 2003.

Mejuto, J., B. García-Cortés, J.M. de la Serna & A. Ramos-Cartelle. 2003. An overview of the activity of the Spanish targeting swordfish (*Xiphias gladius*) during the year 2001, with special reference to the Atlantic Ocean. SCRS/2003/084.

Mejuto, J., B. García-Cortés, J.M. de la Serna, & A. Ramos-Cartelle. 2004. An overview of the activity of the Spanish surface long line fleet catching swordfish (*Xiphias gladius*) during the year 2002, with special reference to the Atlantic Ocean. SCRS/2004/151.

Mejuto, J., B. García-Cortés, J.M. de la Serna & A. Ramos-Cartelle. 2005. Scientific estimations of bycatch landed by the Spanish surface long line fleet targeting swordfish (*Xiphias gladius*) in the Atlantic Ocean: 2000-2004 period. SCRS/2005/074.

Smith, C. & L.A. Janson. 2005. Revision of South Africa's longline catch record (1997-2003). SCRS/2005/068.