SUMMARY

In this paper we present data about the 1983 shortfin mako and porbeagle longline fishery in NW (Galicia) and N (Cantábrico) of Spain. These two species are caught in association with the swordfish, Xiphias gladius. Data about the total catch, catch by size class, fishing effort and CPUE, are given.

The relationships \( \frac{M}{F} \) and \% of male and female for each size class, are given too.

Size-weight relationship curves by sex are shown for shortfin mako and porbeagle.

It was possible to distinguish some modal class in shortfin mako size frequency distribution. Separation of these modal class was done for male, female and male plus female.

RESUME

Ce travail a été entrepris dans le but de rassembler des notes sur le marache et le taupe capturés à la palangre dans le NW (Galice) et à le N (Cantábrico) de l'Espagne.

Ces deux espèces sont capturés associés avec l'espadon, Xiphias gladius. On présente les données sur la capture total, capture par classe de taille, effort de pêche et CPUE. On présente aussi le sex-ratio et les courbes de la relation taille-poids par sexe, pour le marache et le taupe.

Nous avons établi classes modales dans la distribution des fréquences des tailles du marache en séparant ces classes pour les mâles et les femelles, et les mâles plus femelles.
1. - INTRODUCTION

In this paper we present data about the 1983 shortfin mako and porbeagle longline fishery in NW (Galicia) and N (Cantábrico) of Spain. These two species are caught in association with the swordfish, Xiphias gladius, directed surface longline fishery. In the Spanish NW and N area, in 1983, 66.2% of the Spanish Atlantic total yearly catch of swordfish were landed. The last 33.8% were landed in the SW (Andalucia) of Spain. We have no information about the shark fishery associated with swordfish in this area, so we can't present global data about total Spanish catch on shortfin mako and porbeagle. However we belive that NW and N results could be extrapolated to the total Spanish Atlantic swordfish fishery.

This Spanish Atlantic swordfish fishery is done principally throughout the beginning and the end of the year, alternating, in the NW and N, with the albacore, Thunnus alalunga, fishery.

Associated with swordfish, the Spanish Atlantic longline fishery, frequently catches blue shark (Prionace glauca), shortfin mako (Isurus oxyrinchus), and porbeagle (Lamna nasus) (GARCES Y REY, 1984), and less frequently thresers (Alopias vulpinus, and A. superciliosus), smooth hammerhead (Sphyrna zygaena), (GARCES y REY, 1983), and the tunas Thunnus thynnus, T. obesus and T. alalunga.

The NW and N Spanish swordfish fleet is composed of vessels between 50 and 150 GRT, which fish with surface longline (about 18 m deep) thrown into the sea, in 1983, about 1500 hooks by set (the vessels set once a fishing day).

Principal fishing areas to this NW and N fleet could be: one limited by 40°N and 45°N parallels and 8°W and 17°W meridians, other limited by the 35°N and 42°N parallels and 13°W and 20°W meridians, and other limited by 40°N and 45°N parallels and 18°W and 30°W meridians, (figure 1).

In Spain shortfin mako or porbeagle directed fishery does not exist. Swordfish fishery is the only type which catches measurable quantities of these species. Some specimens, more in porbeagle, may be caught sporadicaly by trawl in the Spanish continental shelf.

2. - MATERIALS AND METHODS

The Spanish swordfish fishery began to be studied in 1973 (GARCES y REY, 1984), but only in 1983 associated species, principally shortfin mako and porbeagle, began to be studied.

Number and weigh catch data, fishing areas, days at sea, fishing days, and quantity of hooks by set were registred by surveys in the most important ports of the area, Vigo and La Coruña (total catch of both these ports is 87% of the total area catch). Moreover size and weight samplings were made for both species, resulting that 18.8% of the shortfin mako total catch of the area, and 20.0% of the porbeagle, were sexed, sized and/or weighed.

Catches in La Coruña and Vigo were obtained directly by surveys, and the total catch of the NW and N area, weighting it to the total swordfish catch of this area.

The effort (f) employed was the same as the swordfish effort. The units were:

\[ f = \frac{\text{average of hooks by day} \times \text{number of days fishing}}{1000} \]

In sampling, for each vessel sampled, all shortfin mako and porbeagle landed were sized, weighed or both. The size measured was the fork length rounding
to the inferior cm. The weight was taken in kilos.

Size-weight relationships were done by the minimum square fitting method to the straight line \( \ln W = \ln a + b \ln L \), using weight (W) in kg, and fork length (L) in cm. The straight lines were transformed in power relationships \( W = a L^b \).

Size histograms were made by grouping in 5 cm size classes. With size frequencies, shortfin mako normal components separation were done, following HARDIN (1949) and CASEY (1954) method explained by PEREIRO (1983), for male, female and both together.

3.- RESULTS AND DISCUSSION

During 1983 the NW and N Spanish fleet caught 366 MT of shortfin mako and some 28 MT of porbeagle, by longline fishery (Table 1), with 13539 hooks/1000 effort and, 27.01 and 2.07 kg/1000 hooks CPUE respectively.

In the same table we can see that in both species male percentage is higher than female, both in weight and number of fish caught. The observed shortfin mako male/female relationship (2.23) does not coincide with the proportion shown for this same species in the west Atlantic (1.13) in June (PRATT and CASEY, 1983). This difference could be due to the fact that in Spain (east Atlantic) we had analyzed one whole year where as in the west Atlantic (U.S.A. fishery) only June was studied.

Male-female relationship in the porbeagle Spanish fishery was 1.71.

Figure 2-a shows that the catch of the two species studied is done principally in the last 4 months of the year, apparently independent of the effort (Figure 2-b) since, although during the first 3 months of the year effort was high, the catch was low. Consequently, CPUE was low in the beginning of the year and increased through the year. In the last 4 months it was 3 or 4 times higher then the February or March CPUE, although the effort was on a similar level (Figure 2-c).

It can be seen that, both in catch as well as CPUE, trends through the year are similar in both species (note that in each case porbeagle values are about 10 times less than shortfin mako).

Figure 3 shows male (♂), female (♀), and male plus female (♂+♀) shortfin mako size histograms in percentage. In this figure it is possible to appreciate that there is a different size distribution between males and females, males being distributed in an important way from 175 cm, while females are distributed principally before 175 cm, even though size range in both sexes is approximatively the same. This different male and female size distribution does not appear in the west Atlantic (PRATT and CASEY, 1983).

Figure 4 shows male (♂), female (♀), and male plus female (♂+♀) porbeagle size histograms in percentage.

Shortfin mako and porbeagle male percentage by 5 cm length class is presented in Figure 5. Male percentage in shortfin mako species seems to vary around 50 % without trends up to 150 cm size. After this size, male percentage increases when size increases, reaching 100 % starting from 250 cm, with the exception of the 265 cm size class of the 2 specimens examined one was male and the other female. Porbeagle percentage of males present no apparent trends and show erratic variations. This could be due to the small number of individuals studied.
Size-weight relationship curves by sex are shown for shortfin mako (Figure 6) and porbeagle (Figure 7). Equation parameters, fitting degree, number of pairs of values used, and their ranges, are given in Table 2.

Since it is possible to distinguish some modal classes in shortfin mako size frequency distribution, separation of these modal classes was done for male, female and male plus female. Results of these separations are presented in Table 3, showing mean sizes, standard deviation, and number of fishes in each normal distribution obtained from each modal class.

Normal components denominated as 0 and 1, were calculated with only a few individuals, so their values could be not very significant. Values of those denominated 2, 3 and 4 for male, and 2, 3, 4 and 5 for female can be considered more suitable, and have some similarity with those calculated using the same method as PRATT and CASEY (1983). It must be considered that these authors analyzed samples from June and in the present paper we analyze global year data, where catches from October, November and December are predominant. So provided that normal components represent age classes, the difference between means in each class in both papers could be due to growth of individuals between June and the fall, which is the period (northern Summer) probably with a higher growth rate than in the rest of the year.

LITERATURE CITED


Table 1.- Catch in number, catch in weight, percentage of male and female, CPUE and average weight of shortfin mako (*I. oxyrinchus*) and porbeagle (*L. nasus*). Year 1983, NW and N of Spain.

<table>
<thead>
<tr>
<th></th>
<th>CATCH</th>
<th>SAMPLE</th>
<th>$\bar{x}$</th>
<th>$\sigma$</th>
<th>$\bar{y}$</th>
<th>$\sigma$</th>
<th>CPUE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>I. oxyrinchus</em></td>
<td>5525</td>
<td>1041</td>
<td>69.1</td>
<td>30.9</td>
<td>365726</td>
<td>71642</td>
<td>76.6</td>
<td>23.4</td>
</tr>
<tr>
<td><em>L. nasus</em></td>
<td>400</td>
<td>80</td>
<td>63.1</td>
<td>36.3</td>
<td>28066</td>
<td>5670</td>
<td>61.8</td>
<td>38.2</td>
</tr>
</tbody>
</table>

Table 2.- Size-weight parameters for shortfin mako (*I. oxyrinchus*) and porbeagle (*L. nasus*). $b$ and $a$, constants of the equations $W = a L^b$. $n$ = number of pairs of values, $r$ = correlation coefficient. Intervals: $L$ = length range, $W$ = weight range.

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$a$</th>
<th>$r$</th>
<th>$n$</th>
<th>Interval</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>I. oxyrinchus</em></td>
<td>3.004706</td>
<td>0.0000101</td>
<td>0.98574</td>
<td>597</td>
<td>(82 \leq L \leq 262)</td>
<td>(6 \leq W \leq 213)</td>
</tr>
<tr>
<td><em>L. nasus</em></td>
<td>3.033177</td>
<td>0.0000088</td>
<td>0.98536</td>
<td>283</td>
<td>(75 \leq L \leq 267)</td>
<td>(5 \leq W \leq 215)</td>
</tr>
</tbody>
</table>

Table 3.- Shortfin mako. Mean, standard desviation and number of fishes of each modal class determined from size distribution. ($\delta'$) males, ($\Omega$) females, ($\delta' + \Omega$) males plus
2: N (Cantabrico)

3: SW (Andalucía)

Figure 1.— Spanish NW and N shortfin mako and porbeagle fishing areas. A, B and C, fishing areas. 1, 2 and 3, landing areas.
Figure 2. - Catch (A), effort (B) and CPUE (C) of the shortfin mako and porbeagle fishery in the NW and N Spain. Scales for shortfin and porbeagle are different.
1. oxyrinchus

Figure 3.- Shortfin mako (Isurus oxyrinchus) 1983 male (♂), female (♀) and male plus female (♂ + ♀) size distribution in percentage. (n= number of fishes caught in 1983).

L. nasus

Figure 4.- Porbeagle (Lamna nasus) 1983 male (♂), female (♀), and male plus female (♂ + ♀) size distribution in percentage. (n= number of fishes caught in 1983).
Figure 5. - Shortfin mako (I. oxyrinchus) and porbeagle (L. nasus), male percentage by size. n = number of fishes sampled.
**I. oxyrinchus**

Figure 6. - Shortfin mako (*I. oxyrinchus*) size-weight relationship by sex.

**L. nasus**

Figure 7. - Porbeagle (*L. nasus*) size-weight relationship by sex.