

PRELIMINARY STUDY ON THE AGE ESTIMATION OF BLUEFIN TUNA (*Thunnus thynnus*, L.) AROUND THE MALTESE ISLANDS

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ABSTRACT

A preliminary age-length key is presented based on 84 bluefin tuna (*Thunnus thynnus*, L.) samples caught around the Maltese Islands by longline fishing between May and June 1999. The length of the bluefin tuna ranged from 106 cm to 290 cm while the weight ranged from 65 kg to 295 kg. Spine analysis of the sampled tuna revealed that the age ranged from 8 to 14 years. An extension of the age-length key made by Cort (1990) has been prepared to include larger fish. The age of all the other tuna caught in this period of time was calculated using the prepared key.

INTRODUCTION

The bluefin tuna fishing season in Malta starts during the month of May and extends until the month of July. The fishing of bluefin tuna has been undertaken by Maltese fisherman for a very long time. Statistics kept at the Department of Fisheries show that as early as 1920 a substantial amount of tuna was already being landed regularly during the season. The upsurge in bluefin tuna landings came about as a result of the tapping of the Japanese market in 1989 and in fact one will find that from a mere 48,669 kg in 1990, landings shot up to 353,014 kg in 1995 as a result of the diversification of the fishing effort by the larger vessels. The decrease in landings during the last three seasons may be attributed to the large presence of tuna purse seiners off the Maltese Islands. In 1998 150 full-time and part-time fishermen targeted tuna using 52 multi-purpose vessels ranging from 10 to 20 m. The total landings were 244,749 kg of which 108,768 kg (45%) was exported. The surface long-line is the most popular method for tuna fishing in the Maltese Islands. It can vary from 20 km to 120 km in length and the number of hooks used by each fisherman ranges from 1500 to 2500.

A wide variety of ageing techniques have been applied to bluefin tuna, including length-frequency analysis, tagging studies and examination of hardparts (vertebrae, spines, otoliths). Many of these techniques provide good results in ageing younger fish but age estimation of adult bluefin is more complicated. Reading interpretation of bluefin tuna spines in adult fish is rather difficult since most of the first rings would have been reabsorbed. One must then back calculate body size at age based on the relationship that exists between the growth of the spine and the fish.

No previous studies have been made about the age structure of bluefin tuna caught around the Maltese Islands. The objective of this paper is to give a preliminary estimation of the age composition of adult bluefin tuna caught in the Maltese longline fishery.

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MATERIALS AND METHODS

A total of 84 bluefin tuna spines (46 males, 38 females) were collected around the Maltese Islands (Fig. 1) during May and June 1999. The fish length ranged from 106 cm to 290 cm. From the individual weights of the total catch, the individual lengths have been calculated using the length-weight conversion for bluefin tuna for the Mediterranean (Arena; unpubl). The method of extraction, preparation and sectioning of spines used was the one described by Compean-Jimenez & Bard (1980). The samples were cut with a low speed saw (ISOMET) in sections ranged from 0.5 mm to 0.7 mm. The sections were then

mounted on slides covered with a transparent resin (EUKITT) that was useful to fix the samples as well as to clarify the possible bands or annuli. The measuring and reading of the spinal sections was carried out with a profile projector using a zoom of 10. A binocular lens was also used together with a micrometer to determine ring diameter.

Most of the samples belonged to large fish older than 4 years old, which means that it was impossible to find all the rings since normally the nucleus or center of the spine would have been reabsorbed and consequently the first rings have disappeared. For this reason, the table prepared by Cort (1990) which provides the parameters (mean, standard deviation, and confidence interval) of the ring diameters for ages 1 to 7 years old has been used. Based on these parameters, the first visible ring was identified and assigned its respective age according to the table. Then all the successive rings were counted and measures of their respective diameters (mm) taken when possible.

RESULTS AND DISCUSSION

The parameters obtained from measuring the diameter of the corresponding rings are given (Table 1). These values are in good agreement with those obtained by Cort (1990) and Rey *et al.*, (1984) although they only reach up to 8 years old fish. In this paper values obtained from measuring samples up to 15 years old are given.

The study of 72 spines allowed us to build up a preliminary age-length key prepared for large bluefin tuna (Table 2). Bluefin tuna spines were collected between May and June and most of them presented the last visible ring near the border.

The bluefin tuna longline fishery was mostly composed of large fish ranging from 86 to 275 cm (Fig. 2). The demographic composition of the catch in 1999 applying the before mentioned age-length key is presented in Table 3. Individuals from some length classes are missing since it has not been possible to assign an age (due to the low number of spines in some length groups) but in general terms most fish belong to the 8 to 10 years old age group.

As noted by other authors in the western stock (Butler *et al.*, 1977, Hurley *et al.*, 1981), differences in age and growth between adult males and females exist. Although sex data has been recorded, analysis of the spinal sections by sex has not been possible to perform due to the wide range of lengths and the low number of samples in each length class. However collection of new data will continue and further studies will be made.

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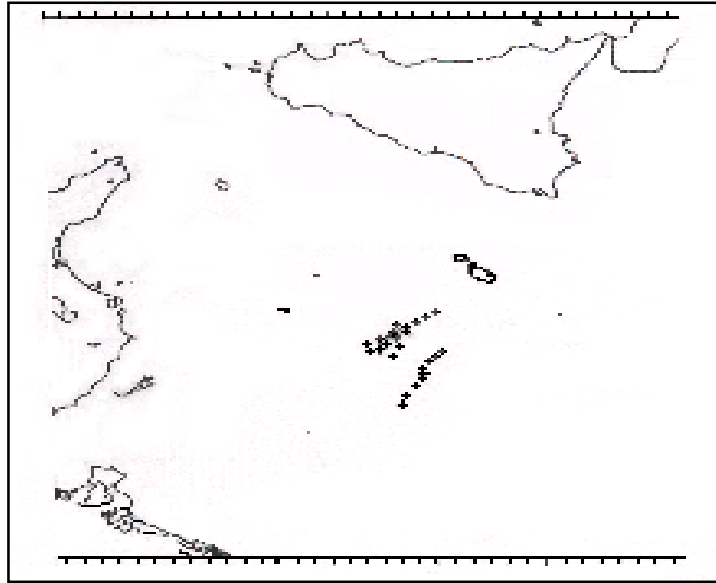


Fig. 1 Map indicating area from where bluefin tuna used in the study was caught

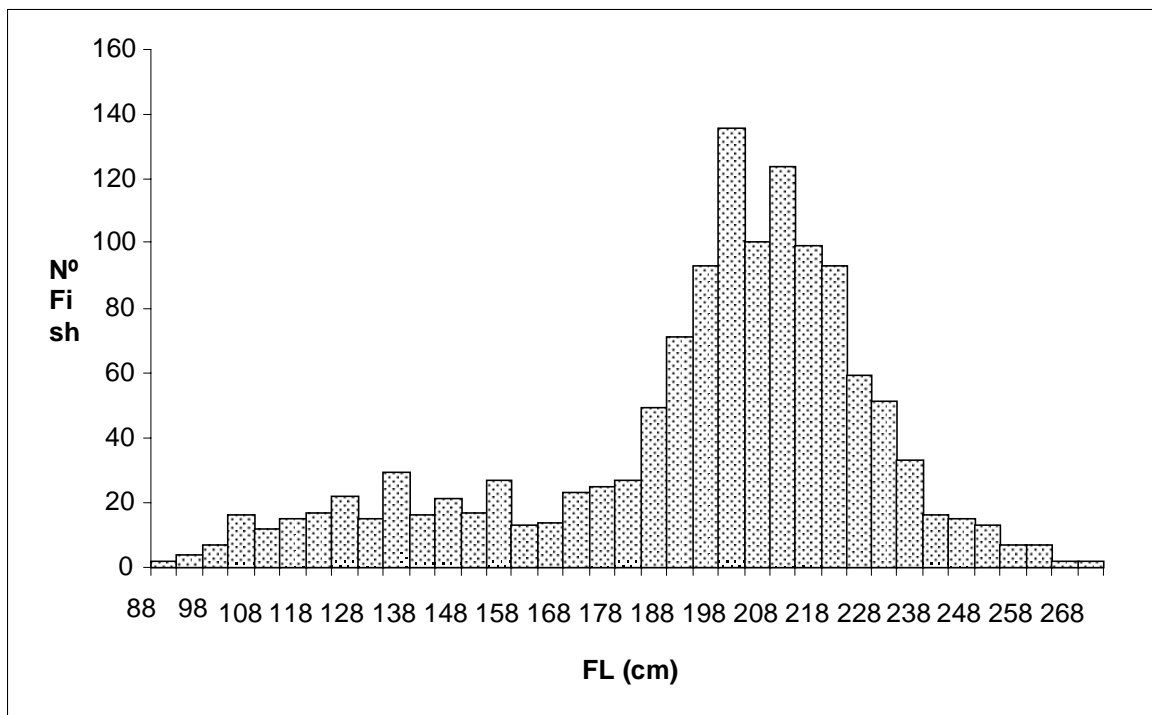


Fig. 2. Length-frequency distribution of bluefin tuna caught by longline fishery around the Maltese Islands in 1999.

| Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| N | 3 | 6 | 14 | 24 | 48 | 50 | 42 | 46 | 43 | 38 | 34 | 18 | 12 | 3 | 1 |
| Mean | 2.23 | 3.43 | 5.14 | 6.30 | 7.48 | 8.59 | 9.58 | 10.44 | 11.26 | 12.09 | 12.68 | 13.58 | 14.36 | 15.10 | 16.41 |
| s.d. | 0.21 | 0.25 | 0.45 | 0.32 | 0.30 | 0.29 | 0.29 | 0.37 | 0.46 | 0.52 | 0.74 | 0.82 | 0.88 | 1.10 | |
| Sy | 2.18 | 3.38 | 5.03 | 6.25 | 7.46 | 8.57 | 9.56 | 10.40 | 11.20 | 12.00 | 12.50 | 13.27 | 13.93 | 13.72 | |
| Sx | 2.28 | 3.48 | 5.24 | 6.34 | 7.51 | 8.62 | 9.61 | 10.48 | 11.33 | 12.18 | 12.86 | 13.89 | 14.80 | 16.48 | |

Table 1. Values and parameters (N= number of samples, Mean, s.d.= standard deviation, Sy = Inferior limit of confidence interval, Sx = superior limit of confidence interval) obtained from measuring the rings diameter of bluefin tuna spinal sections.

| Length/Age | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | N |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|----|
| 106-110 | 1.00 | | | | | | | | | | | | 1 |
| 111-115 | | | | | | | | | | | | | 0 |
| 116-120 | | | 1.00 | | | | | | | | | | 1 |
| 121-125 | | | | | | | | | | | | | 0 |
| 126-130 | | 1.00 | | | | | | | | | | | 1 |
| 131-135 | | | | | | | | | | | | | 0 |
| 136-140 | | 1.00 | | | | | | | | | | | 1 |
| 141-145 | | | | | | | | | | | | | 0 |
| 146-150 | | | | 1.00 | | | | | | | | | 1 |
| 151-155 | | | 1.00 | | | | | | | | | | 1 |
| 156-160 | | | 1.00 | | | | | | | | | | 1 |
| 161-165 | | | | | | | | | | | | | 0 |
| 166-170 | | | 1.00 | | | | | | | | | | 1 |
| 171-175 | | | | | | | | | | | | | 0 |
| 176-180 | | | | | | | | | | | | | 0 |
| 181-185 | | | | | | 1.00 | | | | | | | 1 |
| 186-190 | | | | | 1.00 | | | | | | | | 1 |
| 191-195 | | | | | | 1.00 | | | | | | | 1 |
| 196-200 | | | | | 1.00 | | | | | | | | 3 |
| 201-205 | | | | | | | | 1.00 | | | | | 2 |
| 206-210 | | | | | | | 1.00 | | | | | | 3 |
| 211-215 | | | | | 0.20 | | | 0.60 | | 0.20 | | | 5 |
| 216-220 | | | | | | | 0.50 | | | 0.50 | | | 4 |
| 221-225 | | | | | 0.25 | | 0.38 | | 0.13 | 0.25 | | | 8 |
| 226-230 | | | | | | 0.20 | 0.40 | 0.40 | | | | | 5 |
| 231-235 | | | | | | | | 0.50 | 0.25 | 0.25 | | | 4 |
| 236-240 | | | | | | 0.44 | | 0.33 | 0.11 | 0.11 | | | 9 |
| 241-245 | | | | | | | | 0.67 | | 0.33 | | | 3 |
| 246-250 | | | | | | | | | 1.00 | | | | 2 |
| 251-255 | | | | | | | | 0.25 | | 0.50 | 0.25 | | 4 |
| 256-260 | | | | | | | | 0.33 | 0.33 | | | 0.33 | 3 |
| 261-265 | | | | | | | | | 0.50 | | 0.50 | | 2 |
| 266-270 | | | | | | | | | | 1.00 | | | 1 |
| 271-275 | | | | | | | | 1.00 | | | | | 1 |
| 276-280 | | | | | | | | 1.00 | | | | | 1 |
| 281-285 | | | | | | | | | | | | | 0 |
| 286-290 | | | | | | | | | | | | 1.00 | 1 |
| N | 1 | 2 | 4 | 1 | 7 | 7 | 10 | 18 | 7 | 11 | 2 | 2 | 72 |

Table 2. A preliminary age-length key prepared for large bluefin tuna.

| Age | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---------|-----|-----|-----|-----|------|------|------|------|-----|-----|-----|-----|
| Nº fish | 12 | 31 | 80 | 17 | 242 | 159 | 213 | 216 | 34 | 102 | 3 | 2 |
| % | 1.1 | 2.8 | 7.2 | 1.5 | 21.8 | 14.4 | 19.2 | 19.4 | 3.0 | 9.2 | 0.2 | 0.2 |

Table 3. Demographic composition of bluefin tuna catch for 1999 in Maltese Islands.