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PRELIMINARY STUDY ON AGE AT FIRST MATURITY OF BLUEFIN TUNA IN THE LIBYAN WATERS

by
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SUMMARY

The objective of this paper is to increase our knowledge about sexual maturity, seasonality and spawning area of BFT in Libyan waters. The histological analysis indicates that all the bluefin females studied were mature independently of their age or FL. The activity stages found in the Libyan tunas indicate us that these tunas are spawning in a near area, possibility in the central Mediterranean, along May and June. In conclusion, our data indicates that all 4-age Libyan tunas are mature and are going to do effective spawning. At present, ICCAT use in the evaluation process the 5-age class like the first maturity one, if our data are confirmed by ulterior studies this age could change.

INTRODUCTION

According to FAO and ICCAT reports, large pelagic fish constitutes a major part of the total world catches, they are not only widely distributed in many parts of the world but also economically valuable species. Catches and landing of those fishes increased from one year to another and new fishing methods have been developed (Miyake, 1968).

As a large pelagic fish species, bluefin tuna (BFT) (*Thunnus thynnus L.*) is considered the most economically valuable species especially in the Atlantic and Mediterranean (CEC. 1995, craves, 2000).

Reports from ICCAT pointed out that BFT is a highly migratory species with two types of migration occurring during its life history: a trophical migration, seeking for food and reproductive migration to spawning (CEC 1995). The hypothesis implies that BFT is one species which return back to the spawning area of its birthplace. Therefore, a massive spawning migration of mature BFT occurs every year in the west Atlantic and east Atlantic. In the west Atlantic, BFT are thought to spawn from Mid-April to June in the Gulf of Mexico and in Florida Strait. In the east, Atlantic BFT migrate to the Mediterranean in large number, generally spawning from late May to July depending on the spawning area and environmental conditions (Court & Liorzou, 1990; ICCAT, 2000; COPEMED, 1999; 2000; De la Serna *et al*., 2000). Accordingly, the Mediterranean sea is very important not only for catching tuna fish (53% of the total BFT catch) but also considered to be a wide spawning area, since it presents optimal environmental factors.

Reports from SCRS assumed that BFT first successfully spawn at age 8 in the west Atlantic compared to ages 4 to 5 in the Mediterranean. However, according to reports from COPEMED, 1999, 2000 it was pointed out that the size of migrated BFT to Mediterranean ranges between 101 to 260 cm and weight from 18 to 450 kilograms therefore the question is: does all the fish entering the Mediterranean mature and what is the age of first maturity? Also, where about are the spawning grounds of those fish? Taking into consideration that identifying the age at maturity and spawning areas of highly exploitable fish species like BFT is critical for effective management (Huppell and Sullivan 2000,

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SCRS 2001), extensive investigations to study the biology and reproduction of BFT in the Libyan waters within the COPEMED program is progressing. The objective of this paper is to increase our knowledge about sexual maturity, seasonality and spawning area of BFT in Libyan waters.

MATERIALS AND METHODS

Bluefin tuna were captured by two different tuna traps in the western part of the Libyan coast (east of Tripoli). The Zrig tuna trap is situated near Musrata, between 32º26´10´´ N and 14º54´20´´ E at a depth of 36 m.. The Gazira tuna trap is situated about 5 Km east of Zrig one between 32º20´N and 15º09´E at a depth of 40 m.

Two sets of collections of bluefin tuna were analysed: a group of 10 females taken in Gazira on 27 June 2000; and a group of 11 females taken in 5 different collections 2 at Zrig trap on 18 and 31 June 2001; and 3 at Gazira tuna trap on 3 May, 9 and 23 June 2001 (Table I).

Soon after the fish were caught, each fish was identified, the fork length was measured to the nearest centimeter and the gonads of each fish were dissected, the sex was noted and the gonad weight in grams was recorded. For histological studies, a small sample of the central portion of the ovarium was preserved in 4% sea water formalin. This portion includes all the thickness of the ovarium. After washing in running water for 2 hours, the gonadal tissue was dehydrated, embedded in paraffin, and serially sectioned at 10 μm. The sections were stained with Mallory´s trichrome stain for a general assesment of the histological components of the ovary.

To estimate reproductive condition of bluefin tuna, two different histological classification systems were used: one for estimating the sexual maturity and the other for assesing the activity stage of mature females. Each ovary was histologically classified according to both systems (Hunter and Goldberg, 1980; Hunter and Macewicz, 1980, 1985a, b; Hunter, Macevicz and Sibert, 1986).

Sexual maturity

It is considered that a female is a mature one when has the capability of reproduce in a determinate spawning season. Histological signs of maturity are the presence in the ovary of yolked oocytes, hidrated oocytes or postovulatory follicles. The inmature females have not reached the sexual maturity and are unable to reproduce in a determinate season.

Sexual activity

Four different stages of activity have been taken into consideration:

Inactive females: the histological analysis indicates that the ovary contain no yolked oocytes and no atretic structures.

Prespawning females: Those females showing signs of an imminent spawning like hidrated or in nuclear migration phase oocytes but not postovulatory follicles or extended atresia. High oocyte density in the ovary.

Spawning females: The histological analysis shows signs of past spawning (postovulatory follicles) and enough vitellogenic oocytes to complete more spawning.

Postspawning females: Those females showing signs of past spawning (postovulatory follicles) but have not enough vitellogenic oocytes to complete more spawning. Extended atresia in vitellogenic oocytes. Low oocytes density in the ovary.

The gonadosomatic index was calculated according to Kume and Joseph (1969)

The age of the tunas was calculated according to Sella (1929).

RESULTS

All the IGS by size class were over 10 (see figure 1E) and a similar case shows the GSI by age class. The highest GSI was shown by the 4 years old age class (figure 1 F).

The histological analysis indicates that all the bluefin females studied were mature independently of their age or FL. Hundred per cent of the 4 years old females (n = 8) were mature. These females showed a lot of yolked oocytes, nuclear migration stage oocytes or postovulatory follicles that suggest an imminent or recent spawning periods.

Regarding to the activity stages, the studied bluefin tuna ovary could be classified into three different stages (see table II):

- Stage 1 (prespawning): 20% of the females showed an mature ovary with many flly yolked and nuclear migration stage oocytes, few partially yolked and unyolked oocytes, high oocyte density and only incidental atresia. Any postovulatory follicles could be observed. All these signs indicates imminent spawning (figure 1. A).
- Stage 2 (spawning): 66% of the females ovaries contained few totally yolked oocytes, some partially yolked or unyolked oocytes, some atresia of vitellogenic oocytes and some postovulatory follicles. These females were in the spawning period and had enough vitelogenic oocytes to complete several more spawning in the same season (figure 1 B).
- Stage 3. (postspawning): the remaining 14% females showed completely spent ovaries with low oocytes density, few vitelogenic oocytes, many atresia and some postovulatory follicles (Figures 1 C and 1 D).

The activity stages found in the Libyan tunas indicate us that these tunas are spawning in a near area, possibly in the central Mediterranean, along May and June.

DISCUSSION

According to literature, bluefin tuna in the eastern Atlantic and Mediterranean has their first maturity at ages classes 2-4 (Frade and Manacas, 1933; Arena, 1964; Sará, 1973; Rodriguez-Roda, 1969; Frade and Vilela, 1962). Sella (1929) noted that the bluefin usually spawned first at age-3 although few 2-age tunas might also spawn and Scaccini et al. (1975) reported the smallest mature bluefin tuna observed at 4-age class. Our data agree with the previous literature. We have not data on 3-age tunas so we cannot discuss the age at first maturity (age at 50%) but it is possible that some 3-age tunas could be mature because the 100 % of 4-age bluefin tuna caught in Libyan waters were mature. Mather *et al*. (1995) conclude that “the first spawning in the eastern Atlantic and Mediterranean occurs at age 3, in exceptional cases, and more frequently at age 4. By age 6 all, or nearly all, of the fish are spawners”. Unlike, our data indicates that in Libyan waters all the 4-age tunas are spawners.

In conclusion, our data indicates that all 4-age Libyan tunas are mature and are going to do effective spawning. At present, ICCAT use in the evaluation process the 5-age class like the first maturity one, if our data are confirmed by ulterior studies this age could change.

Another question is if the fraction of tuna sampled is representative of the whole age class. Does all the 4-age tuna the reproductive migration? Or, only mature tunas do it? More extensive studies are needed to answer these questions.

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Table I. Summary of information on *Thunnus thynnus* specimens used in the study (FL = Fork length; GW = Gonadal weight).

ID code	Date	Local area	Gear	FL (cm)	Age (years)	Sex	GW (gr)
LBFT-394	27/06/00	Gazira	trap	115	4	F	2600
LBFT-395	27/06/00	Gazira	trap	138	5	F	3000
LBFT-380	27/06/00	Gazira	trap	147	6	F	8000
LBFT-388	27/06/00	Gazira	trap	147	6	F	5500
LBFT-397	27/06/00	Gazira	trap	151	6	F	4250
LBFT-390	27/06/00	Gazira	trap	151	6	F	5600
LBFT-387	27/06/00	Gazira	trap	155	6	F	6000
LBFT-389	27/06/00	Gazira	trap	159	6	F	4000
LBFT-384	27/06/00	Gazira	trap	171	7	F	5000
LBFT-406	27/06/00	Gazira	trap	172	7	F	5000
LT-10	09/06/01	Gazira	trap	118	4	F	3000
LT-6	18/06/01	Zrig	trap	118	4	F	1500
LT-4	09/06/01	Gazira	trap	119	4	F	5000
LT-3	23/06/01	Gazira	trap	120	4	F	3500
LT-7	23/06/01	Gazira	trap	120	4	F	4200
LT-9	23/06/01	Gazira	trap	120	4	F	3500
LT-1	23/06/01	Gazira	trap	127	4	F	3500
LT-8	23/06/01	Gazira	trap	130	5	F	3000
LT-5	31/06/01	Zrig	trap	145	5	F	4000
LT-11	23/06/01	Gazira	trap	155	6	F	4000
LT-2	03/05/01	Gazira	trap	162	7	F	6000

Table II. Maturity and activity results of the bluefin sample.

ID code	Age (years)	GSI	Maturity	Activity
LBFT-394	4	17,1	Mature	spawning
LBFT-395	5	11,4	Mature	spawning
LBFT-380	6	25,2	Mature	prespawning
LBFT-388	6	17,3	Mature	spawning
LBFT-397	6	12,3	Mature	spawning
LBFT-390	6	16,3	Mature	postspawning
LBFT-387	6	16,1	Mature	spawning
LBFT-389	6	10,0	Mature	spawning
LBFT-384	7	10,0	Mature	spawning
LBFT-406	7	9,8	Mature	postspawning
LT-10	4	18,3	Mature	postspawning
LT-6	4	9,1	Mature	prespawning
LT-4	4	29,7	Mature	spawning
LT-3	4	20,3	Mature	spawning
LT-7	4	24,3	Mature	spawning
LT-9	4	20,3	Mature	spawning
LT-1	4	17,1	Mature	spawning
LT-8	5	13,7	Mature	prespawning
LT-5	5	13,1	Mature	prespawning
LT-11	6	10,7	Mature	spawning
LT-2	7	14,1	Mature	spawning

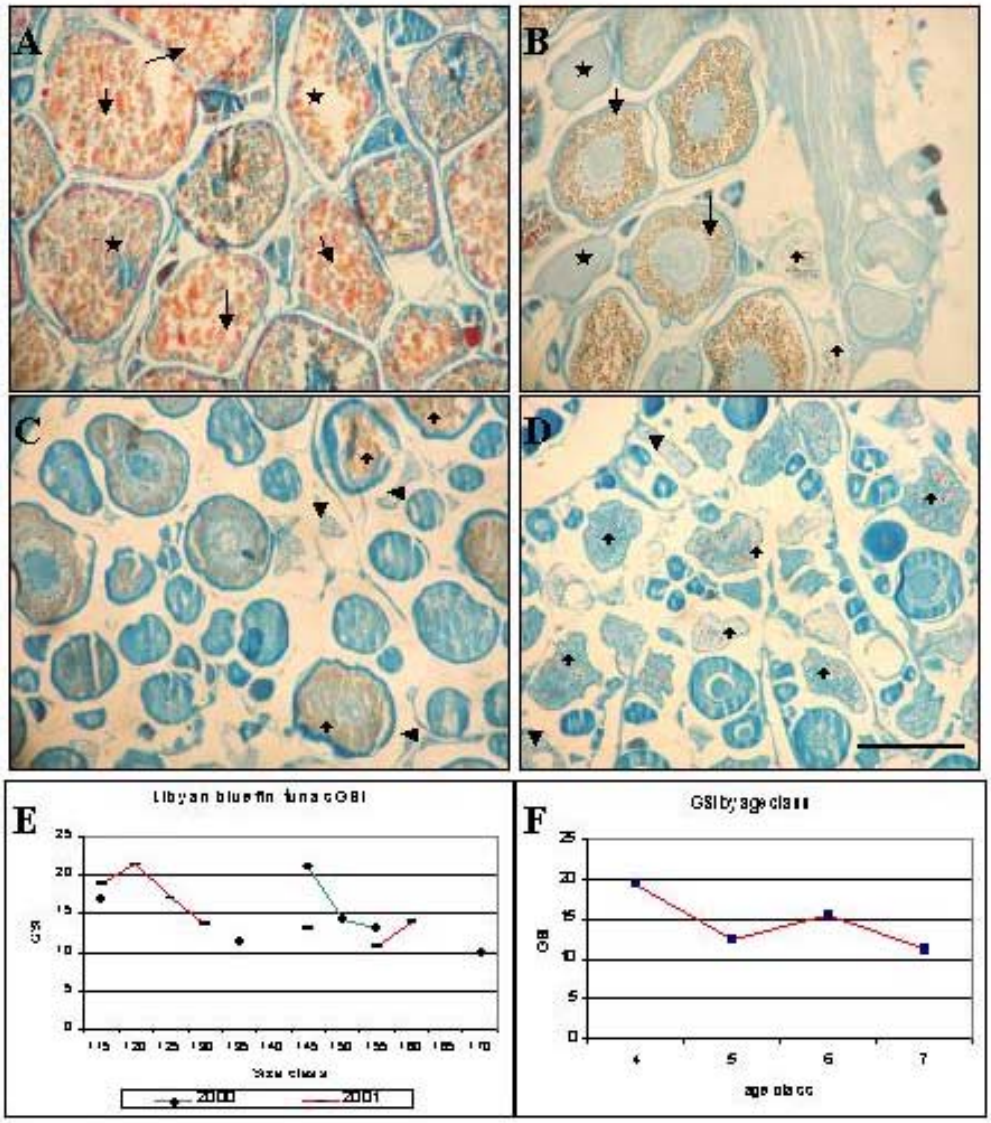

Figure 1. Maturity stages in the libyan tunas (bar= 440 µm)

A. Type one mature ovary (5 years old tuna) that shows many totally yolked oocytes (arrows) and nuclear migration stage oocytes (stars).

B. Type two mature ovary (4 years old tuna) that shows some atresia (cross), unyolked oocytes (stars), partially and totally yolked oocytes (arrows).

C and **D** images show two different postspawning stages (6-7 years old tunas) with different proportion of follicular atresia (cross) and postovulatory follicles (arrowheads).

E. The graphic shows the gonadosomatic idex by size class of the tunas used in this study.

F. Gonadosomatic index by age class.