

PRELIMINARY RESULTS ON FECUNDITY OF LITTLE TUNNY (*EUTHYNNUS ALLETTERATUS*) IN THE TUNISIAN WATERS

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SUMMARY

The little tunny (*Euthynnus alletteratus*) is one of the most abundant small tuna species in the Tunisian waters. To estimate batch and relative fecundity, samples of little tunny were collected during the spawning period in 2010 (June to September) off Tunisian waters. The microscopic appearance of the oocytes and the oocyte size frequency distribution had been used to define the spawning pattern shown by these species. A total of 34 female LTA ranged between 45.5 and 91.2 cm, average 63.34 ± 3.5 cm were analyzed. Little tunny is a multiple spawner with asynchronous and indeterminate spawning strategy. Batch fecundity was determined using the "hydrated oocytes" method. Average batch fecundity obtained was 451484 and ranged from 73662 to 748062. The relative batch fecundity, a parameter particularly useful to compare female of different size class, ranged from 54 to 223 oocytes g^{-1} , with an average value of 116 ± 35 eggs g^{-1} .

RÉSUMÉ

La thonine commune (*Euthynnus alletteratus*) est l'une des espèces de thonidés mineurs la plus abondante des eaux tunisiennes. Afin d'estimer la fécondité par acte de ponte et la fécondité relative, des échantillons de thonine commune ont été recueillis pendant la période de frai en 2010 (juin à septembre) au large des eaux tunisiennes. L'aspect microscopique des ovocytes et la distribution des fréquences de taille des ovocytes ont été utilisés pour définir le schéma de reproduction que présente cette espèce. Un total de 34 femelles de thonine commune mesurant entre 45,5 et 91,2 cm (moyenne de $63,34 \pm 3,5$ cm) a été analysé. La thonine commune est un reproducteur multiple adoptant une stratégie de reproduction asynchrone et indéterminée. La fécondité par acte de ponte a été déterminée au moyen de la méthode d'« ovocytes hydratés ». La fécondité moyenne par acte de ponte s'est élevée à 451.484 et oscillait entre 73.662 et 748.062. La fécondité relative par acte de ponte, paramètre particulièrement utile pour comparer les femelles de classe de taille différente, variait entre 54 et 223 ovocytes g^{-1} , avec une valeur moyenne de 116 ± 35 œufs g^{-1} .

RESUMEN

La bacoreta (*Euthynnus alletteratus*) es una de las especies de pequeños túnidos más abundante en aguas tunecinas. Para estimar la fecundidad relativa y fecundidad por lote, se recogieron muestras de bacoreta durante el periodo de desove de 2010 (junio a septiembre) en aguas tunecinas. La apariencia microscópica de los oocitos y la distribución de las frecuencias de tallas de los oocitos han sido utilizadas para definir el patrón reproductor de estas especies. Se analizaron un total 34 hembras de LTA, con tallas que oscilaron entre 45,5 y 91,2 cm, con un promedio de $63,34 \pm 3,5$ cm. La bacoreta es un reproductor múltiple con una estrategia reproductora asincrónica e indeterminada. La fecundidad por lotes se determinó utilizando el método de "oocitos hidratados". La fecundidad por lote media fue de 451.484 y oscilaba entre 73.662 y 748.062. La fecundidad por lote relativa, un parámetro especialmente útil para comparar hembras de diferentes clases de talla, oscilaba entre 54 y 223 oocitos g^{-1} , con un valor medio de 116 ± 35 huevos g^{-1} .

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KEYWORDS

Little tunny, Euthynnus alletteratus, Spawning, Fecundity, Tunisian waters

1. Introduction

The Little tuna, *Euthynnus alletteratus* (Rafinesque 1810), has shown a wide distribution in the world's oceans. According to Collette et Nauen (1983), this species can be found in the tropical and subtropical waters of the Atlantic Ocean, including the Caribbean Sea and the Gulf of Mexico. It also occurs in the Mediterranean Sea and in the Black Sea (Collette et Nauen, 1983).

Little tunny (*Euthynnus alletteratus* Rafinesque, 1810) is the only species belonging to the genus *Euthynnus* that occurs in Tunisia (Hattour 2000). This coastal species primarily occurs in Tunisia throughout the year, with frequent variation in occurrence. Large catches are recorded in May, June and July (Hattour 2000).

Little tunny is a commercially important species of small tuna inhabiting the Tunisian waters. It is mainly harvested by using different fishing gears, such as purse seine, light fishing, gill nets, longlines, pelagic trawl, and beach seine (Hattour 2000). It is among the most important tuna fishing resources in Tunisian waters (Hattour 2000). From 1996 to 2005 this species accounted for 35.23% small tuna landed in Tunisian waters (ICCAT 2009). Moreover, this species was recently described as a priority species by the Scientific Advisory Committee of CGPM (FAO 2009). Due to a continuing lack of biological information on the species, it is highly recommended that research on little tunny biology be conducted in order to provide better information for future stock assessment.

The objective of the current study is to get a preliminary estimate of fecundity of little tunny caught in the Tunisian waters.

2. Material and methods

A total of 34 females of Scombrid fish species *Euthynnus alletteratus* (Rafinesque, 1810) were caught during the spawning season, from June to September 2010 (Hajjej *et al.* 2011) from commercial catches of the coastal areas of Tunisian waters. For each specimen, fork length (FL) to the nearest millimeter and eviscerated weight to the nearest gram (EW) were determined.

For histological examinations, pieces of the ovary were fixed in Bouin's fluid prior to dehydration. They were washed with 70% ethyl alcohol. Then, they were passed through an ascending series of ethyl alcohol, cleared in methyl benzoate and embedded in paraffin wax. Sections of 5µm thick were stained with Eosin haematoxylin and triple Mallory stain for microscopic examination. The slices were analyzed under a microscope to select the hydrated ovaries without evidence of previous spawning (i.e., without postovulatory follicles), in order to avoid an underestimation of fecundity. Sizes of oocytes were obtained by measuring of two diameters of 100 oocytes of each stage using an analysing system of only those oocytes that had been sectioned through the nucleus. The histologic analysis and oocyte diameter distribution in each female was used to assess the spawning sequence (West 1990).

Specimens were classified according to their maturity and activity stages. Only the active pre-spawning females were used to estimate the fecundity. Nine of the studied females meet the above requirement. Data about these exemplars can be found in the **Table 1**. 3 sub-samples of ovarian tissue were removed from the anterior, central and posterior positions of each ovary (Farrugio et Quignard 1973) were preserved in 4% neutral formalin. The numbers of eggs in these samples were counted in a Petri dish. The "hydrated oocyte" method (Hunter *et al.* 1985) was used to calculate batch fecundity (number of oocytes released per spawning event). Batch fecundity was calculated as the weighted mean density of the three subsamples multiplied by the total weight of the ovaries. Relative fecundity (number of hydrated oocytes per gram of body weight) was estimated as the batch fecundity divided by female weight (EW). The relationships of batch fecundity to fork length and eviscerated weight were described using the standard regression.

3. Results

Little tunny ovaries show a continuous distribution of oocyte diameters throughout the stages of mature gonad development. In the ovary of active mature females the oocytes gradually increase in size along with the ovarian development. Oocyte diameters of *E. alletteratus* ranged from 150 to 630 μm . The average diameter of the three main clusters of maturing oocytes showed by the mature females were 320, 490 and 620 μm .

By analyzing the histological sections the ovary appears to be a random mixture of oocytes in all stages of development with no dominant population present. Therefore, *E. alletteratus* is a multiple spawner with asynchronous oocyte development. The oocytes develop from previtellogenic the standing stock of advanced vitellogenic oocytes, passing through different developing stages. After the hydration process a portion of the standing stock of yolked oocytes is spawned in several batches.

Only nine of the total number of organisms collected had the necessary characteristics to estimate fecundity (hydrated oocytes and no postovulatory follicles). Female weight ranged from 1515 to 11580 g EW (mean = 4375 ± 735 g SE) and size ranged from 45.5 to 91.2 cm FL (mean = 63.34 ± 3.5 cm SE). The mean diameter of the hydrated oocytes was 620 μm .

The batch fecundity (BF) estimated for females caught in Tunisian waters ranged between 73662 and 748062 hydrated oocytes and the mean value was 451484 (± 38780) hydrated oocytes. In this study, the best fit in the relation of EW or FL to batch fecundity was obtained with the linear model (Figures 1, 2).

Relative fecundity of *E. alletteratus* ranged from 54 to 223 hydrated oocytes per gram of female (EW), with a mean of 116 ± 35 eggs per gram.

4. Discussion

Based on the histological sections and the oocyte size frequency distribution, we describe the ovarian development organization of the little tunny as asynchronous and we consider the fecundity of little tunny indeterminate. The Little tunny ovary is considered asynchronous because oocytes at different levels of development were present at the same time in the ovary. Developmental characteristics of oocyte maturation of little tunny are similar to those described for other tuna species with asynchronous development (Matsumoto *et al.* 1984; Schaefer 1987; Megalofonou 2000; Niiya 2001; Macias *et al.* 2005).

Among fishes, great variability exists in the values of fecundity between individuals of a population (Oda *et al.* 1993; Ruiz *et al.* 1999; Marin et Dodson 2000). In this study, batch fecundity (i.e., the number of oocytes about to be liberated by a spawning female) was found to be highly variable among the fish analyzed. This high variability appears to be related to the size (weight and length) of the female, as indicated by the positive and significant correlations between EW or FL with batch fecundity. The study of fecundity showed a proportional increase in the batch fecundity in relation to the increase in length and weight of the fish.

Only ripe, pre-spawning females, with hydrated oocytes in their ovaries, can be used to estimate batch fecundity in multispawner species with indeterminate fecundity (Hunter *et al.* 1985; Murua *et al.* 2003). When the oocytes start to enter the final maturation stage and reach a size of around 510-640 μm a batch of oocytes gets isolated to be ovulated.

The estimates of annual fecundity for this species in the Senegal used volumetric methods ranged from 220000 to 1500000 oocytes (Diouf 1980). The use of histological and stereological approach in this study avoids the bias due to the inclusion of atretic and yolked follicles in the batch of hydrated oocytes (Macias *et al.* 2005). According to our results, batch fecundity estimated for females caught in Tunisian waters ranged between 73662 and 748062 hydrated oocytes and the mean value was 451484 (± 38780) hydrated oocytes. These values are significantly lower than the fecundity of 931611 oocytes, found by Saber *et al.* (2011), for the Mediterranean albacore *Thunnus alalunga* and very higher than value obtained by Macias *et al.* (2006) for *Bullet tuna Auxis rochei* in the Spanish Mediterranean (233941 oocytes).

In this study the estimated relative fecundity was 116 oocytes per gram of body mass. Relative fecundity values were higher than those obtained for other tuna species, *Katsuwonus pelamis* in the western Atlantic, 82 eggs g^{-1} (Goldberg et Au 1986), *Thunnus albacares* in the eastern Pacific, 67 eggs g^{-1} (Schaefer 1998), *Thunnus thynnus* in the Mediterranean, 59 eggs g^{-1} (Medina *et al.* 2007) and *Thunnus obesus* in western Pacific, 31 eggs g^{-1} (Nikaido *et al.* 1991).

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Table 1. Biological characteristics of little tunny used in this study.

Code	Catch date	Fork length (cm)	Eviscerated weight (g)	Gonad Weight (g)
LTA TN 012	03/07/2010	48.7	1800	89.15
LTA TN 019	05/07/2010	47.6	1535	77.97
LTA TN 022	07/07/2010	69.5	4205	303.4
LTA TN 024	08/07/2010	81.5	10945	330.26
LTA TN 026	11/06/2010	47.5	1725	61
LTA TN 028	13/07/2010	46.2	1515	77.8
LTA TN 029	13/07/2010	91.2	11580	625
LTA TN 031	14/07/2010	76.5	7260	322.87
LTA TN 033	16/07/2010	85.7	7135	256.71

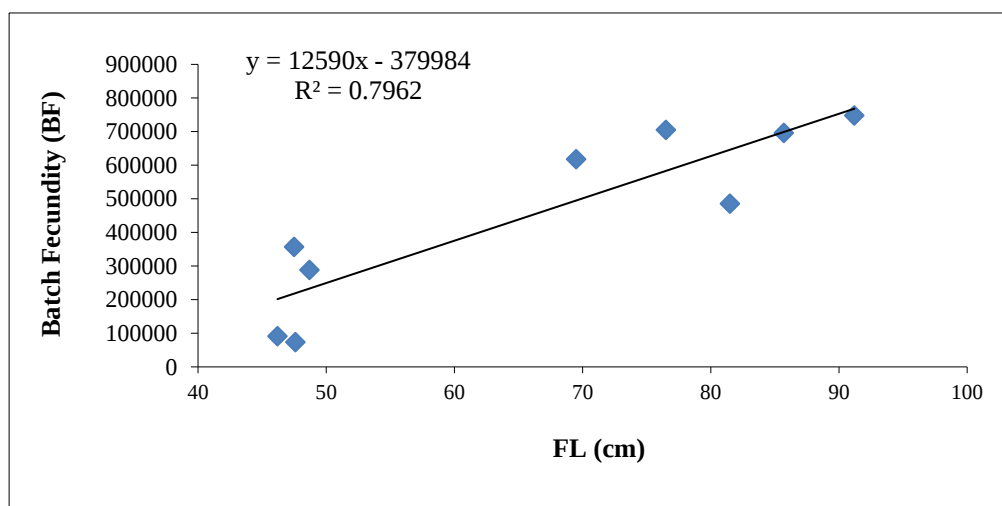


Figure 1. Batch fecundity as a linear function of fork length (FL) in *Euthynnus alletteratus* of Tunisian waters

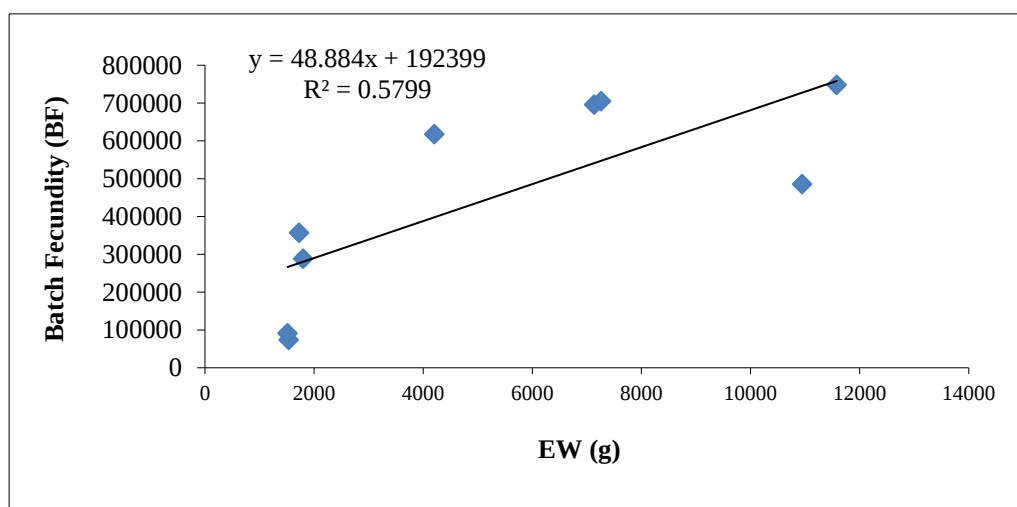


Figure 2. Batch fecundity as a linear function of eviscerated weight (EW) in *Euthynnus alletteratus* of Tunisian waters