



SOME ASPECTS OF THE REPRODUCTIVE BIOLOGY OF THE THIN LIP GREY MULLET *LIZA RAMADA* (RISSE, 1826) IN AIN EL-GHAZALA LAGOON–EASTERN LIBYA

Yousef KA Abdalhafid^{1*} and Mohammad El-mor^{1 & 2}¹Zoology Department, Faculty of Science, Omar Al-Mokhtar University, Al-Bayda, Libya²Marine Science Department, Faculty of Science, Suez Canal University, Ismailia, Egypt

Received for publication: February 15, 2014; Accepted: March 21, 2014

Abstract: The reproductive biology of 250 specimens of *Liza ramada* (Family: Mugilidae) collected from catches by gill and trammel nets on Ain El-Ghazala lagoon (Eastern Libya) in the Mediterranean Sea was studied. There were monthly variations in sex ratio between females (159 fish = 63.6%) and males (91 fish = 36.4%). Sex ratio was (1: 1.75) for males to females respectively. The length at 50% maturity was 18.45 cm for females and 16.45 cm for males. The breeding season extends from September to February. Oocyte diameters increase from September ($45 \pm 12.4 \mu\text{m}$), until February ($632 \pm 66.1 \mu\text{m}$). The absolute fecundity ranged was from 61233 to 256677 for fish with the total length ranging from 16.5 to 32.4 cm, whereas relative fecundity ranged from 3479 to 82.1cm⁻¹.

Keywords: Mugilidae, *Liza ramada*, Reproductive biology, Mediterranean Sea, Eastern Libya.

INTRODUCTION

The thin-lipped grey mullet *Liza ramada* (Risso, 1826) is a catadromous pelagic species. *L. ramada* is common in the shallow waters of the eastern Mediterranean and Black sea (El-Mor, 1993). This species lives in brackish and marine waters which corresponds to lagoons, estuaries and rivers deltas (Jardas, 1996). It tolerates salinity extremes as well as important variations of the water quality (Thomson, 1990). Like most Mugilids, this species reproduces at sea, after which fry undertake a trophic migration shoreward to continue their development (El-Mor, 1993; Koutrakis *et al.*, 1994) in food rich lagoons, rivers and even lakes (Thomson, 1966). Few authors have studied the reproductive biology of *L. ramada* (El-Maghrby *et al.*, 1974; Mohammad, 1982; El-Mor, 1993; Bartulović *et al.*, 2007; El-Halfawy *et al.*, 2007). Despite the importance of mugilids, little is known about its biology (Ekwella, 2008). Therefore the aim of the present work is to investigate for the first time the reproductive biology of *L. ramada* in Ain El-Ghazala lagoon, eastern Libya in the south Mediterranean sea.

MATERIALS AND METHODS

A total 250 specimens of *L. ramada* were sampled to study the reproductive biology. Monthly samples of *L. ramada* were collected from September 2013 to February 2014 from trammel and gill nets landings in Ain El-Ghazala lagoon, eastern Libya (Fig. 1). The total length (TL) ranged from 16.5 to 32.4 cm, and total weight (W) from 60.8.5 to 360.5 g. Fishes were dissected to determine sex, then the gonads were weighed to the nearest g (Wg), and the gonad somatic index (GSI) was monthly calculated using the equation: $GSI = Wg/W$ where Wg is weight of the fresh gonad.

Oocytes were separated from the ovarian tissues and put in saline solution (0.9% NaCl) during 24 hours. They were measured under the microscope with the magnification of 40X, then 20 oocytes were taken randomly and their diameters were measured to the nearest 0.01 mm by using one eye-piece micrometer, the average oocyte diameters for mature specimens were calculated. Absolute fecundity was estimated by using a gravimetric method (Bagenal & Tesch, 1978) and the relative fecundity was calculated as related to the fish total length.

RESULTS

Sex Ratio

There were monthly variations in sex ratio between females (159 fish = 63.6%) and males (91 fish = 36.4%). Sex ratio was (1: 1.75) for males to females respectively (Table 1). During all months, the numbers of the females was more important than that of the males. The values of percentage of the females were recorded from September (72.2%), October (64.2%), November (64.0%), December (75.8%), January (54.8%) and February (47.6%).

Table 1: Monthly variations in sex ratio of *Liza ramada* from Ain El- Ghazala, eastern Libya during the spawning season.

Months	No. of fish	Males		Females		Sex ratio
		No.	%	No.	%	
Sep.(2013)	35	12	27.8	23	72.2	1 : 1.92
Oct.	55	20	35.8	35	64.2	1 : 1.75
Nov.	34	12	36.0	22	64.0	1 : 1.83
Dec.	37	17	24.2	20	75.8	1 : 1.18
Jan. (2014)	42	13	45.2	29	54.8	1 : 2.23
Feb.	47	17	52.4	30	47.6	1 : 1.76
Total	250	91	36.4	159	63.6	1 : 1.75

*Corresponding Author:

Dr. Yousef Abdalhafid,
Lecturer in Environmental physiology, Zoology Department,
Faculty of Science, Omar Al-Mokhtar University,
Al-Bayda, Libya.



The Gonado-Somatic Index (G.S.I.)

The monthly changes in G.S.I. are represented in Figures (2&3). *L. ramada* have a long spawning season, which extends from September to February. GSI of the males was lower than that of females. GSI of the males increased rapidly from September to February. The average values of GSI of the females increased from September (10.4%) to December (19.08%) then decreased to the lowest value in February (3.99%). The males recorded the highest value in December (15.08%) and the lowest value in February (0.8%).

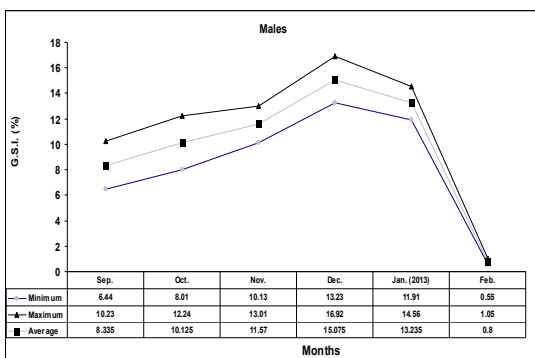


Fig.2: Monthly variations in the average gonado-somatic index in males *Liza ramada* from Ain El-Ghazala lagoon, eastern Libya during the spawning season.

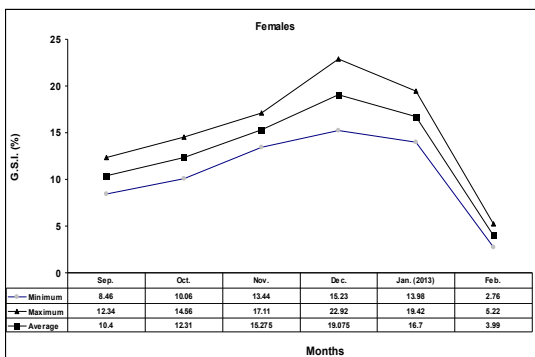


Fig.3: Monthly variations in the average gonado-somatic index in females *Liza ramada* from Ain El-Ghazala lagoon, eastern Libya during the spawning season.

The length at first sexual maturity

The distribution of immature and mature fish for each length group was analyze to determine the size at 50% sexual maturity (TL₅₀) (Table 2). All males with a total length higher than 14.4 cm are mature. First maturation size was determined for males as L₅₀ = 16.45 cm. All females with a total length higher than 16.4 cm are mature. First maturation size was determined for females (L₅₀ = 18.45 cm) (Fig. 4).

Table 2: The percentage of mature and immature fishes for different length groups of *Liza ramada* from Ain El-Ghazala lagoon, eastern Libya during the spawning season

Total length (cm)	Average	Males		Females	
		Immature	Mature	Immature	Mature
12.5-14.4	13.7	100	—	100	—
14.5-16.4	15.4	68.3	31.7	100	—
16.5-18.4	17.6	41.9	58.1	57.3	42.7
18.5-20.4	19.7	25.6	74.4	42.1	57.9
20.5-22.4	21.5	11.5	88.5	20.4	69.6
22.5-24.4	23.6	—	100	17.4	82.6
24.5-26.4	25.5	—	100	12.2	87.8
26.5-28.4	27.6	—	100	6.5	93.5
28.5-30.4	29.4	—	100	—	100
30.5-32.4	31.3	—	100	—	100

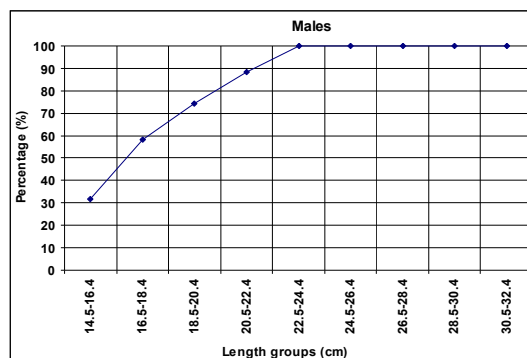
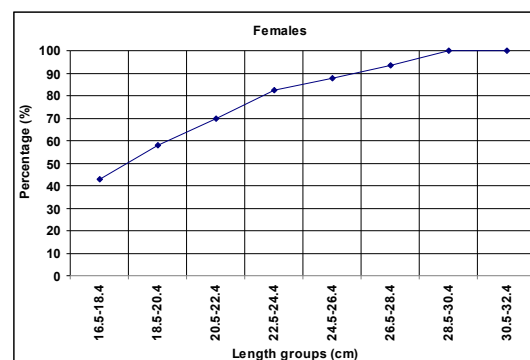


Fig.4: Length at first maturity of *Liza ramada* from Ain El-Ghazala lagoon, eastern Libya during spawning season



Oocyte diameter

The recorded average oocyte diameters of *L. ramada* over the period of the study are presented in Table (3). The minimum average oocyte diameter was recorded in September (45 ± 12.1µm). The average oocyte diameter increase strongly in November (365 ± 34.2µm), then the increase continued in the following months to reach the maximum values in February (632 ± 66.1µm).

Table 3: Monthly variations of oocyte diameters of *Liza ramada* from Ain El-Ghazala lagoon, eastern Libya during the spawning season.

Months	Number of fish	Egg-Diameters (μ)		
		Minimum	Maximum	Average
Sep.(2013)	13	30	58	45 \pm 12.1
Oct.	17	75	99	86 \pm 16.7
Nov.	12	321	411	365 \pm 34.2
Dec.	16	412	501	454 \pm 49.3
Jan. (2014)	21	524	644	576 \pm 55.8
Feb.	14	611	654	632 \pm 66.1
Average	93			359.7 \pm 39.1

Fecundity

The ovaries of 93 *L. ramada* were examined (Table 4). The smallest mature female had a total length of 16.5cm and weight of 54.5g. Its ovary weighed 4.70 g (8.64% of the body weight) with minimum absolute fecundity of 61233 ripe eggs. The largest female had a total length of 32.4 cm and weight of 245.5g. Its ovary weighed 15.9g. (22.92% of the body weight) with maximum absolute fecundity of 256557 ripe eggs. The average absolute fecundity ranged from 61233 to 256677 for fish with the total length ranging from 16.5 to 32.4cm, whereas relative fecundity ranged from 3479 to 82.1cm⁻¹.

Table 4: Relation between fecundity and total body length (cm) of females *Liza ramada* from Ain El-Ghazala lagoon during the spawning season

Total length (cm)		Absolute Fecundity			Relative Fecundity	
Range	Average	No.	Minimum	Maximum	Average	F/T.L. (cm)
16.5-18.4	17.6	13	51231	71231	61233 \pm 3121	3479
18.5-20.4	19.7	11	62473	82473	72479 \pm 3453	3679
20.5-22.4	21.5	12	73329	93329	83322 \pm 5254	3875
22.5-24.4	23.6	14	92799	112799	102809 \pm 10312	4356
24.5-26.4	25.5	11	102337	122337	112323 \pm 11456	4405
26.5-28.4	27.6	12	143411	163411	163428 \pm 12321	5921
28.5-30.4	29.4	11	176587	196587	191572 \pm 14123	6516
30.5-32.4	31.3	9	236557	256557	256677 \pm 16896	8201
Average					130480 \pm 9617	5054 \pm 1667

DISCUSSION

In the present work the overall sex ratio was 1:1.75 for males and females of *L. ramada*, and these results are in agreement with those results of *L. ramada* in Suez Canal, Egypt (Mohammad, 1982), in Egyptian Mediterranean Sea (El-Maghrby et al., 1974 and El-Mor, 1993). The sex ratio was not constant throughout the year, particularly during the breeding season of this species (Oren, 1975). Females are the dominant sex in mullet populations (Peterson & Shehadeh, 1971). It is possible that the females are heavier and caught in the gear in larger numbers than the males, resulting in an unbalanced sex ratio (Broadhead, 1953). In the present work, the maturation size was determined for females $L_{50} = 18.45$ cm and for males $L_{50} = 16.45$ cm. These values are larger than those recorded by El-Mor (1993) in Egyptian Mediterranean sea (14.5 cm for males and 17.0 cm for females). These variations in the beginning of maturity may depend on water temperatures (Fimucane et al., 1978). In the present study, from the average gonado-somatic indices (GSI), males and females of *L. ramada* have a definite spawning season, which extends from September to February. This result corroborated those observed in the Egyptian waters (Mohammad, 1982; El-Mor, 1993).

The spawning season was according to geographical location. In Porto-Lagos lagoon (Northern Greece) juveniles of *L. ramada* began to reproduce in early March at the total length of 14.6 cm (Koutrakis et

al., 1994). Juveniles along the coast of Israel began to reproduce at the end of February or the begin of March (Zismann & Ben-Tuvia, 1975), while in the estuary of the Magra River (Italy) the juveniles had already matured in February (Gandolfi et al., 1981) as along the coast of Tunis (Vidy & France, 1992) and on the eastern Libyan coast (Ekwella, 2008). Finally, El-Mor (2002) noted that *L. ramada* juveniles in the Egyptian waters began to reproduce in February.

In this work, the increase in the oocyte diameters of *L. ramada* was evident from September to February. The increase in egg diameters was mainly due to the deposition of large amounts of proteins and lipids in the developing eggs. A part of these materials comes directly from ingested food but major proportion comes from reserve of food deposits, during the active season in organs such as liver, muscles and fat bodies (Larson, 1974). The egg diameters were comparable with those obtained by El-Mor (1993), who observed that the egg diameters reached 604 μ m in January. The number of eggs produced by females varied greatly according to species, size, age, region, period and used techniques, thus a considerable variability has been shown in different populations of mullets (Oren, 1975). El-Mor (1993) found that the absolute fecundity ranged from 51343 to 267676 for female ranging from 15 to 33 cm total length. Such data also are close to those found in

the present study. This study may prove useful to fishery management from described maturity stages and provide information on spawning season.

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Source of support: Nil

Conflict of interest: None Declared