

## Reproduction Characteristics of Thinlip Grey Mullet, *Liza ramada* (Risso, 1826) Inhabiting Akgöl-Paradeniz Lagoons (Göksü Delta)

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**Abstract:** In order to determine the reproduction characteristics of *Liza ramada*, a fish of economical importance, the GSI, egg diameter, sex maturity, age and sex ratio were examined in 228 specimens caught periodically, between February 1992 and July 1994 in Akgöl-Paradeniz Lagoon. According to the GSI % and egg diameter, the reproduction period of *Liza ramada* was determined to be November and December. The lowest GSI % obtained for *Liza ramada* was 4.99 % in February and the highest values were 16.67 % in November and 11.67 % in December. The average egg diameter of *Liza ramada* ranged from 0.15 to 0.69 mm. It was determined that both the female and male *Liza ramada* specimens reached sexual maturity at the age of III.

**Key Words:** *Liza ramada*, reproduction, sex maturity age, GSI, Akgöl-Paradeniz Lagoon, Göksü Delta.

### Akgöl-Paradeniz Lagünü (Göksü Deltası)'nda Yaşayan Kefal-Ceran Balığı *Liza ramada* (Risso, 1826)'nin Üzerine Özellikleri

**Özet:** *Liza ramada*'nin üreme özelliklerini ortaya çıkarmak amacıyla ekonomik öneme sahip Akgöl-Paradeniz Lagününe şubat 1992 ile Temmuz 1994 tarihleri arasında periyodik olarak gidilerek yakalanan 228 örnekte %GSI, gonad yumurta çapları ve eşeyssel olgunluğa ulaşma yaşları ile eşey oranları belirlenmiştir. Gonad yumurta çapı ve % GSI oranına göre *Liza ramada*'nin üreme zamanı Kasım ve Aralık ayları olarak belirlenmiştir. *Liza ramada* için elde edilen minimum % GSI değeri şubatta % 4.99 ve maksimum % GSI değerleri Kasım'da % 16,67 ile Aralık'ta % 11,67'dir. *Liza ramada*'nin ortalama yumurta çapları 0,15 mm. ile 0,69 mm. arasında değişmektedir. *Liza ramada*'nin erkek ve dişi bireylerinin III. yaşta eşeyssel olgunluğa eriştiği belirlenmiştir.

**Anahtar Sözcükler:** *Liza ramada*, üreme, eşeyssel olgunlaşma yaşı, GSI, Akgöl Paradeniz Lagünü, Göksü Deltası.

### Introduction

Fish have great nutritious value and are an important alternative to other food sources. Therefore, in order to protect and better appreciate these available living resources, fish reproduction time and condition should be determined. When determining fishing restrictions it should be a principle that fish are allowed to reproduce at least once, and the determination of length restrictions should depend on the age and size of sexual maturity. In water systems used as study areas, knowledge of the terms of reproduction and fishing prohibition regulations have great importance for the protection and the survival of natural stocks. In this study, the reproduction period, age of maturity and egg productivity of *Liza ramada* were determined. In the literature, there are several reports of studies carried out in lagoons on the production of *Liza ramada* (1-10).

### Material and Method

Sampling was carried out monthly at Silifke, Akgöl Paradeniz Lagoon between February 1992 and July 1994. 228 specimens were caught by means of pincer and fishing nets with mesh sizes of 18x18 mm, 25x25 mm and 40x40 mm. Length measurements were taken with a space measurement stick divided into mm., and weight was determined with a balance sensitive to  $\pm 5$  gr. Scales were used for determining age. From each fish, 15-20 scales were taken and preserved in envelopes which were then brought to the laboratory. The scales were prepared according to a commonly used method (11). To determine age, the scale preparations were examined by stereo microscope and checked by micro projection. Bagliniere and Louarn's (12) methods, were used with the scale preparations and in annulus determination was used to determine the age of the fish.

In order to determine sexual maturity and reproduction time, gonads taken from females were brought to the laboratory in 4 % formaldehyde solution. To find the reproduction time, gonadosomatic index values for each month and the average egg diameter were used. In order to determine fecundity, the number of eggs in 1 g ovary taken from each fish was determined.

To determine gonadosomatic index values, the following formula was used:  $GSI \% = \frac{\text{Ovarian weight (g)}}{\text{Body weight (g)}} \times 100$  (9).

The diameters of 10 egg from each of the female upper, middle and lower ovarian parts, 30 eggs in total were measured with 0.001 mm space 1/20 mm sensitive Canon calipers.

## Results

### Sex Ratio

A total of 190 out of 228 *L. ramada*, of which 53.74 % were females and 43.28 % were males, were evaluated by opening the abdomens and examining the gonads. The proportions of males and females according to age are shown in Table I. It may be seen that at every age the number of females was higher.

### Maturity Age

In both females and males of *L. ramada*, the age of sexual maturity was found to be III. Although for both sexes at the age of II, some fish showed gonadal development, these fish did not form the majority, and so it was determined that the age of maturity was III. The males which reached sexual maturity at the age of III had a fork length of 271.04 mm. At this age, the minimum fork length was 240 mm and the maximum was 295 mm. At the age of III, the average fork length of the female *L. ramada* specimens was 267.92 mm (minimum 238 mm and maximum 290 mm).

### Reproduction Period

To determine the reproduction period of *L. ramada*, the gonadosomatic index values of 73 females were evaluated according to month (Table 2). The maximum GSI % obtained for *Liza ramada* was 16.67 % in November. In December, the gonadosomatic index decreased (11.67 %), but in January and February it decreased even more (8.36 %; 4.99 %). On the basis of GSI % values, the reproduction period of *L. ramada* was found to be November through December (Figure 1). In addition, to determine the reproduction period of *L. ramada*, egg diameter changes in 71 females were evaluated according to month (Table 3). The egg

AGE	FEMALE		MALE	
	N	%	N	%
I	25	21.93	23	26.44
II	30	26.31	25	28.73
III	37	32.46	23	26.44
IV	19	16.67	15	17.24
V	3	2.63	1	1.15
TOTAL	114	100	87	100

Table 1. Sex ratio of *Liza ramada* according to age.

Table 2. Female *L. ramada* GSI% values by month.

MONTHS	N	GSI%	
		X	S <sub>D</sub>
SEPTEMBER	2	3.05	0.55
OCTOBER	12	7.87	1.87
NOVEMBER	26	16.67	0.84
DECEMBER	21	11.67	1.53
JANUARY	9	8.36	0.99
FEBRUARY	3	4.99	0.43

Table 3. Female *L. ramada* egg diameter changes by month.

MONTHS	N	Egg Diameter	
		X	S <sub>D</sub>
SEPTEMBER	2	0.41	0.015
OCTOBER	12	0.51	0.024
NOVEMBER	26	0.59	0.014
DECEMBER	21	0.55	0.034
JANUARY	9	0.41	0.029
FEBRUARY	3	0.20	0.017

diameter of *L. ramada* reached 0.59 mm in November and 0.55 mm in December. The egg diameter measurements are in harmony with the GSI % values. The egg diameter changes by month are shown in Figure 2. In addition, to determine the egg diameter, the changes in egg number in 1 g ovary were evaluated according to month (Table 4)

### Fecundity

To determine egg productivity, the total egg number in the ovaries of 70 female *L. ramada* was used. Besides the length and the weight, the egg number also increased with age. At the age of III, the average egg weight was 18.66 g. and the egg number was 234,720, but at the age of V, the average egg weight of *L. ramada* was 41.25 g. and the egg number was 435,265. (Table 5)

### Discussion

In this study, 56.72 % of *L. ramada* were females and 43.28 % were males. At all ages females constituted the majority. El Maghrabi et al. (1973) at Borullus Lake (Egypt) found the ratio of females to be 62 % whereas it was found to be 38 % for males (1). The results of the study of *L. ramada* at Borullus Lake are similar to the results of this study. Brusle (1) at Tunus Lake found the proportion of *L. ramada* females to be 84 %, and the ratio of males to be 16 %. Brusle's (1) findings are totally

different from the values for Akgöl-Paradeniz Lagoon. Salem and Mohammad (2) at Crocodile Lake (Egypt) caught females of *L. ramada* when the reproduction time was greatest in October and in December, and males in July-September. In October- December. January- March, and April-May and the ratios were 36 %, 21 %, 30 % and 24 % respectively. Salem and Mohammad's (2) values are similar to those of this study. Yerli (3) reported that in Köyceğiz Lagoon Systems 41.43 % of *L. ramada* were males and 58.57 % were females. Yerli's (3) results are also similar to those of this study.

The reproduction period of *L. ramada* in Akgöl-Paradeniz Lagoon was found to be November and December on the basis of GSI % values and egg diameter changes. The reproduction period started in September and continued until February. The maximum values determined for GSI % in Akgöl-Paradeniz Lagoon were 16.67 % in November, 11.67 % in December and the minimum values were 3.05 % in September and 9.9 % in February. Abraham et al. (1966) reported that *L. ramada* has maximum GSI % values during the period of migration to the sea in order to reproduce (4). Salem and Mohammed (5) at Crocodile Lake (Egypt) found the GSI % values of *Liza ramada* in October, November and December to be 2.2 %, 4.3 % and 2.2 % respectively. The GSI % values found in Akgöl-Paradeniz Lagoon are higher than the values found in the studies mentioned above.

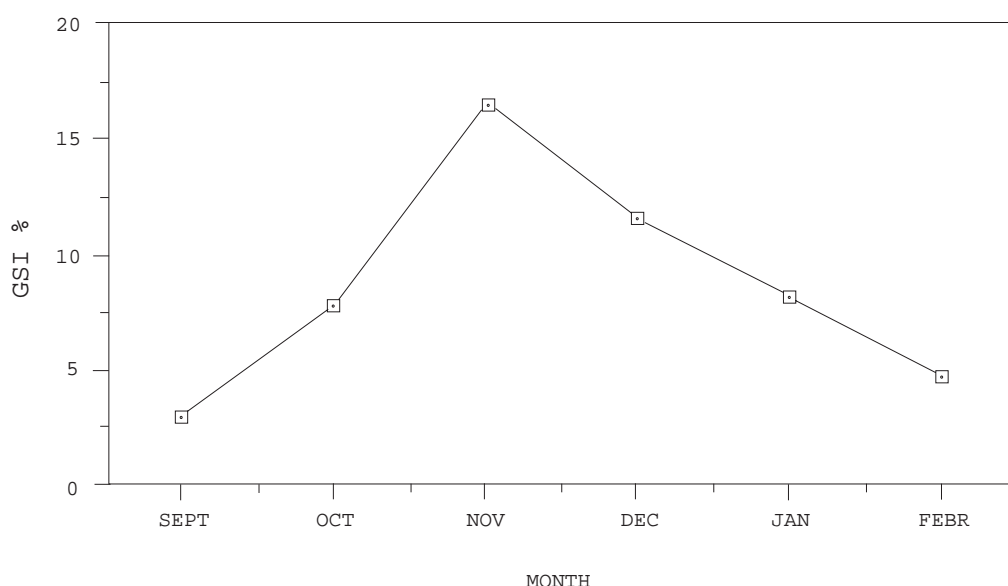


Figure 1. *L. ramada* GSI % values.

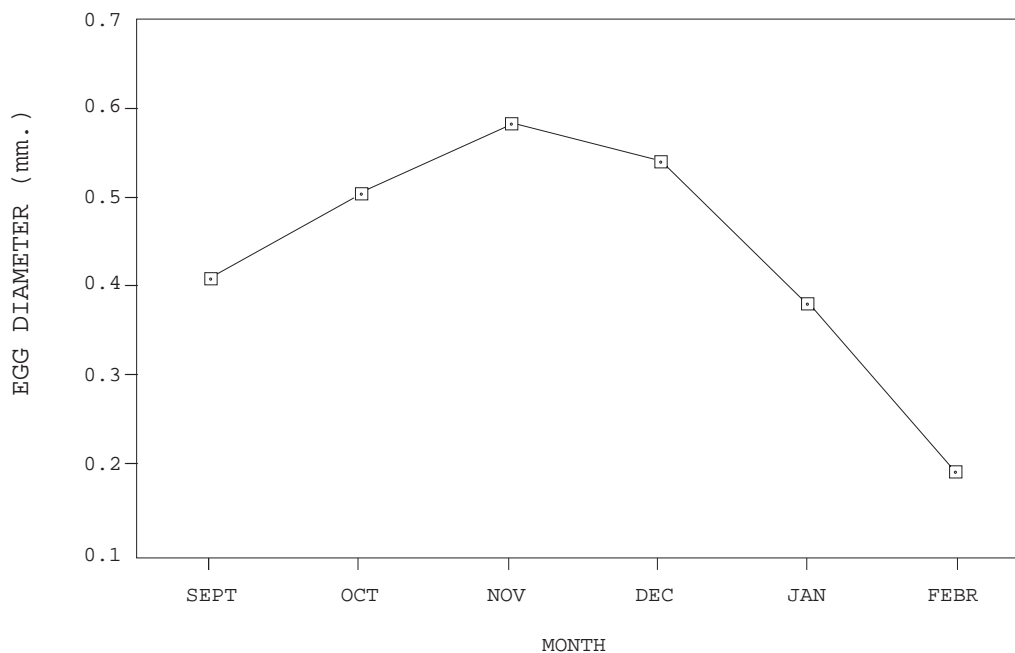


Figure 2. *L. ramada* egg diameter changes.

Slastenenko (6) mentioned that *L. ramada* reproduction continues in the Black Sea during July and September. Heldt (1948) stated that the *Liza ramada* reproduction period in Tunisia was October through December. These results are similar to the results obtained from Akgöl-Paradeniz Lagoon. Yerli (3) stated that reproduction of *L. ramada* in the Köyceğiz Lagoon system is intense during November and December, and in January egg activity continues. Yerli (3) found the values of GSI % to be 18.96 % for November and 16,17 % for December. These result are similar to Yerli's (3) results. Katavic (8), by evaluating the time of emergence of fingerling *L. ramada*, suggested that spawning occurs between late December, January and February. The reproduction periods reported by Salem and Mohammad (2), Slastenenko (6), Katavic (8) and Yerli (3) are all in agreement with each other.

The egg diameter in *L. ramada* varies between 0.20 mm. and 0.59 mm. The reproduction period was intense during November and the egg diameter was 0.59 mm, but in December it was 0.55 mm. GSI % values and egg diameter changes are harmonious with each other, and these results show that the reproduction period is November and December. Slastenenko, (5) stated that *L. ramada* in the Black Sea also reproduces in July and September.

Table 4. Egg number changes by month in 1g in *L. ramada* ovary.

MONTHS	N	GSI% X	S <sub>D</sub>
OCTOBER	12	6.117	152.33
NOVEMBER	26	5.054	309.32
DECEMBER	21	5.102	89.46
JANUARY	9	5.388	94.66
FEBRUARY	3	5.532	65.79

Yashouv (1969) reported that the laying egg diameters of *L. ramada* vary between 0.78 mm. and 1.03 mm. in production pools (9). Wimpany (1936) reported that the laying egg diameters of *L. ramada* in Quaren Lake (Egypt) vary between 0.66 mm. and 0.88 mm. (9). Yashouv's (1969) and Wimpenny's (1936) values are higher than the values found in this study (9). Salem and Mohammed (5) at Crocodile Lake (Egypt) found that the egg diameter of *L. ramada* in November was 0.41 mm. and in December 0.29 mm. The values found in this study are higher. Salem and Mohammed (5) mentioned that the the reproduction period is from October to January and that egg-laying is intense during November and December.

Table 5. Changes with age in 1g *L. ramada* ovary total egg number and weight.

Age	N	Fork length		Weight		Egg		Egg	
		(mm) X	S <sub>D</sub>	(g) X	S <sub>D</sub>	Weight (g) X	S <sub>D</sub>	Number X	S <sub>D</sub>
II	37	225.08	7.05	101.25	10.82	12.08	5.15	126668.41	52477.7
III	19	269.23	12.63	188.07	25.76	18.66	4.14	234720.2	299142.5
IV	2	306.74	2.36	276.58	7.67	32.55	4.63	335373.38	41767.31
V		345	5	385	35	41.250	2.19	435265	18415

Sagi and Abraham. (4) showed experimentally that temperature, photoperiod, salinity and short day photoperiod increase the reproduction activities of *L. ramada*. Besides these factors, the fact that the results mentioned above are obtained from water systems located in different regions also has an effect.

In this study, III was the age of sexual maturity in both males and females. Fauzi, (1938) stated that in the waters of Egypt, the length of *L. ramada* males was 130 mm. and of *L. ramada* females was 190 mm. while they reached sexual maturity at the same age. El Maghraby et al. (1974) said that at Borullus Lake (Egypt) females are 170 mm. long and males are 130 mm. long, reaching sexual maturity at the age of I. Ezzat (1965) stated that at Berre Lake (Mediterranean) males of *L. ramada* were 330 mm. in total length and they reached sexual maturity at the age of V, while *L. ramada* females were 370 mm. in length at the age of six when they reached sexual maturity. The values of Fauzi (1938) and El Maghraby et al. (1974) are less than the values found in this study. Ezzat's (1965) values are quite high (10).

Farrugio and Guignard, (1973) and Farrugio (1979) determined that males of *L. ramada* were 230 mm. and females 255 mm. standard length and they reached sexual maturity at the age of III. Cassifour (1975) reported that they reached sexual maturity at the age of III at Biscay Gulf (Spain) (1). The values above are similar to the values obtained from Akgöl-Paradeniz. Females of *L. ramada* at the age of III were 269,12 mm. and males 271,04 mm. in terms of fork length in Akgöl-Paradeniz

Lagoon. Yerli (3) reported that *L. ramada* males at the age of III and females at the age of IV reached sexual maturity at Köyceğiz Lagoon System and males at the age of III reached 276.06 mm. and females at the age of IV reached 316.51 mm. in total length. These results are parallel with the results for Akgöl-Paradeniz Lagoon, but females reached sexual maturity at the age of 4 in Köyceğiz Lagoon.

The egg number in November and in December in 1 gr. ovary decreased when the egg reached total maturity. The egg weight and total egg number increased with age. The egg weight was 18.66 g at the age of III but it was 41.25 g at the age of V. Total egg productivity varied between 126668 and 439265. Since both egg weight and egg diameter increased with age, the number of eggs is supposed to decrease. Because in this study only the ovarian of individuals up to age V was investigated, such a result was not obtained. We could have observed such a decrease if we had evaluated individuals above V years of age.

In accordance with the findings obtained, it was determined that fish bigger than 267.92 mm. in terms of fork length ( as of the IIIrd year of age ) should be caught in order to maintain the maximum benefit from the *L. ramada* population in the Lagoon. It was furthermore established that a prohibition on fishing should be put into effect during October and November since these months were observed to constitute the reproduction period of *L. ramada*.

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