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Reproductive Biology and Histology of Female Brushtooth Lizardfish *Saurida undosquamis* (Richardson), Family: Synodontidae, from the Mediterranean Coast of Egypt

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ABSTRACT

The present study aims at the investigation of reproductive biology and ovarian histology of females Brushtooth lizardfish, *Saurida undosquamis* (Family: Synodontidae), from the Egyptian Mediterranean coast.

The study revealed that female *S. undosquamis* reached the first sexual maturity at 19.5 cm with a range of 16-22 cm total length of the fish. Seven maturity stages were determined according to the maturity of the ovary. The highest value of gonadosomatic index (GSI) was recorded in May and then slightly decreased in the following months. This slight decrease comes in concomitance with the long spawning season and fractional spawning character.

At least eight groups of ova diameter in each specimen were recorded. This number increase up to 15 groups during the complete ripening of the ovary and during the peak of the spawning season. The presence of different egg diameters in the specimens of the ovary and appearance of more than two peaks revealed that three or four batches of eggs are spawned during the annual reproductive cycle of the fish. A strong relation was recorded between the absolute fecundity and both of the total length and gutted weight of the fish. Monthly distribution of the maturity stages, GSI, egg diameter revealed that this species has a long spawning season extending nearly a year round.

INTRODUCTION

Brushtooth lizardfish, *Saurida undosquamis*, family synodontidae, is a well defined species in the eastern Mediterranean waters. It has immigrated from the Red Sea through the Suez Canal by an unidirectional way called Lessespian migration. This species was first recorded by Ben-Tuvia (1953) among 10 new Red Sea immigrated fishes found on the Eastern Coast of the Mediterranean. It is now apparently well established in the Mediterranean and became an economically important species (Ben-Tuvia, 1966, Ben Yami & Glaser, 1974; Shenouda, 1986; Faltas 1993; Saad, 1994; Bakhoum, 2000).

Shenouda (1969) studied the biology of growth and reproduction of *Saurida undosquamis* from the Suez Gulf. Latif and Shenouda (1973), studied the biology of *Saurida undosquamis* from the Gulf of Suez and entails macroscopic peculiarities of the gonads of both males and females through different months. Shenouda and Wadie (1990) studied the egg development of *Saurida undosquamis* from the Egyptian Mediterranean water.

The biology of *Saurida undosquamis* was studied in the Egyptian Mediterranean waters by Faltas (1993). His study also demonstrated the reproductive biology of this species in comparison with another close species *Saurida saurus* in three different regions along the Egyptian Mediterranean water. Golani (1993) studied the biology of this species in the Mediterranean Coast of Israel.

The present study aims at the investigation of the reproductive biology and gonadal histology of female *Saurida undosquamis* in the Egyptian Mediterranean waters of Alexandria. This study is a first contribution for a next one which will be concerned with the reproductive biology and gonadal histology of male *Saurida undosquamis.*

MATERIALS AND METHODS

Samples of female *Saurida undosquamis* were collected from the commercial catch at Anfoushy fish market, Alexandria, Egypt. The sampling was done three times a month throughout the period from January to December 2003. Total length of the fish (in cm) as well as the total weight (in gm) were recorded. Then the fish were dissected and the gonads were removed, weighed to the nearest milligram and thoroughly examined for the determination of sex and maturity stage. The Gonadosomatic index was calculated as a percentage weight of the ovary to the gutted weight of the body.

To estimate fecundity, pieces of 0.1 gram of the middle part of the ovary were preserved in 4% neutral formalin. The number of eggs in these samples were counted, then the total number of eggs in the ovaries were estimated by the following formula:

$$\text{Total no. of eggs} = \frac{\text{weight of ovary}}{\text{weight of sample}} \times \text{no. of eggs in the sample}$$

Estimation of egg diameters: Since there was an obvious difference between the size of eggs found in the anterior part of the ovarian lobe near the genital opening from those found in the middle part of the lobe and those found in the posterior part of the lobe, a sample of 0.1 gram was taken from each part of the lobe separately and preserved in 4% neutral formalin and then the diameters of the eggs were measured to the nearest mm.

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 (m.p 58-62°C). Sections of 6µm thick were stained with Eosin haematoxylin and triple Mallory stain for microscopic examination.

RESULTS

1. Maturity stages

After dissecting the fish, the maturity stages were detected through the morphological examination of the gonads by the naked eyes. A scale of seven stages (Zaki *et al.* 1986) was adopted as follows:

Stage I (Thread stage)

The ovaries are thread like, transparent and occupy less than one fourth of the body cavity. They are colourless or having faint yellowish red colour.

Stage II (Immature stage)

The ovaries are thin, slightly swollen, colourless to faint red and occupy about ⅓ of the body cavity.

Stage III (Maturation stage)

The ovaries increased in size to occupy about half of the body cavity. Their colour becomes red to dark red.

Stage IV (Nearly ripe stage)

This stage is characterized by obvious enlargement in the ovary size with a yellow or opaque orange colour invaded with blood vessels. They occupy about 3/4 to 4/5 of the body cavity.

Stage V (Ripe stage)

The ovaries attain their maximum development and nearly fill the body cavity and they are yellow. The belly looks swollen and ripe ova could be easily extruded upon exerting a slight pressure on the belly.

Stage VI (Spawning stage)

A slight decrease in the volume of the ovary is obvious due to the discharge of ova during the spawning process. Thus the ovaries look slightly flaccid and flabby. They are dark orange or dark red.

Stage VII (Spent stage)

The ovaries are highly reduced in size, shrunken and collapsed. They have deep red colour.

2. Length at first sexual maturity

According to Pitt (1970), the length at which 50% of a fish population reaches sexual maturity (L_{50}) is considered to be the length at first sexual maturity. In the present study, fish of different length groups were classified to either mature or immature individuals. Fish of stages I & II (thread & immature) are considered to be immature. Fish of stages III to IIV (mature to spent) gonads are designated as mature individuals. Figure (1) shows that all female *Saurida undosquamis* fish with total length less than 16 cm are immature, while those longer than 22 cm are mature. By adopting L_{50} value, it was found that female *Saurida undosquamis* fish reach first sexual maturity at 19.5 cm.

3. Monthly distribution of Maturity stages

The percentage distribution of different maturity stages of female *S. undosquamis* in Alexandria Mediterranean water is given in table (1).

The immature and maturing stages are represented throughout the whole year with the highest percentage in March. While the lowest percentage was recorded in September and July, respectively. Nearly ripe stage recorded the highest value in April and the lowest value in December. Ripe stage increased progressively from January until reach the maximum percentage in May. The spawning stage extends nearly a year round with the lowest percentage in April and then increase until reach the maximum percentage during December and January. Spent stage starts to appear in June with a very small percentage and increased progressively until March with the highest value recorded in February.

4. Gonadosomatic Index

Monthly distribution of G.S.I of female *S. undosquamis* as shown in table (2) showed that the mean G.S.I. values ranged between 3.09±1.94 as a minimum value during February and 10.12±4.28 as a maximum value in May.

5. Egg diameter

Four different size groups of ova can be recognized microscopically in ovaries of *S. undosquamis*. The first size group includes the eggs ranging from 0.08 mm to 0.24 mm. This group represents the very small and immature eggs. They are transparent with round shape. The second size group includes the eggs ranging from 0.24 mm to 0.40 mm with a polygonal shape. They have a small amount of yolk. The third size group includes more advanced ova containing a considerably high amount of yolk. Their diameter ranging from 0.40mm to 0.75mm. They are yolky opaque eggs with round shape. The fourth group includes the highly developed ripe ova with diameters more than 0.72mm and reaches sometimes 1.2mm in the anterior portion of the ovary near the genital opening during the spawning time. They are transparent with very faint yellow colour.

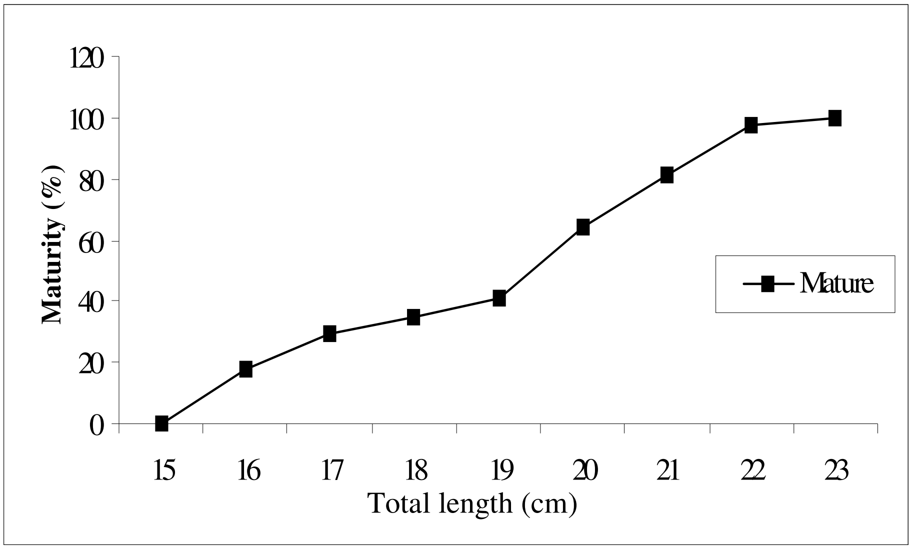

Figure (1): Percentage of mature females of *S. undosquamis* at different length groups.

Table (1): Monthly percent frequency distribution of different maturity stages of female *S. undosquamis* in Alexandria Mediterranean water

Month	No. of fish	Immature		Maturing		Nearly Ripe		Ripe		Spawning		Spent	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Jan.	53	2	3.8	7	13.2	4	7.5	1	1.9	29	54.7	10	18.9
Feb.	38	2	5.3	10	26.3	4	10.5	1	2.6	6	15.8	15	39.5
March	34	3	8.8	12	35.3	12	35.3	2	5.9	4	11.8	1	2.9
April	29	2	6.9	6	20.7	13	44.8	7	24.1	1	3.5	-	-
May	47	2	4.3	4	8.5	17	36.2	21	44.7	3	6.4	-	-
June	53	2	3.8	5	9.4	14	26.4	21	39.6	10	18.9	1	1.9
July	42	1	2.4	3	7.1	9	21.4	15	38.1	12	28.6	1	2.4
Aug.	37	1	2.7	3	8.1	8	21.6	13	35.2	11	29.7	1	2.7
Sept.	56	1	1.9	5	8.9	11	19.6	18	32.1	19	33.9	2	3.6
Oct.	49	1	2.0	5	10.2	6	12.3	14	28.6	20	40.8	3	6.1
Nov.	34	1	2.9	4	11.8	4	11.8	6	17.7	15	44.1	4	11.8
Dec.	30	1	3.3	3	13.3	2	6.7	3	10	16	53.3	5	16.7

Table (2): Monthly distribution of GSI of female *S. undosquamis* in Alexandria Mediterranean water

Month	No. of fish	GSI		
		Min.	Max.	Mean + SD
Jan.	53	1.76	7.28	5.82±2.22
Feb.	38	1.05	4.45	3.09±1.94
March	34	2.84	10.29	5.15±3.21
April	29	4.11	13.66	7.59±3.33
May	47	6.2	16.52	10.12±4.28
June	53	3.16	14.77	9.27±3.07
July	42	3.14	13.12	7.93±3.51
Aug.	37	3.62	11.55	7.19±3.59
Sept.	56	5.17	10.89	7.10±2.93
Oct.	49	3.04	12.51	7.26±3.37
Nov.	34	5.64	9.98	7.30±1.79
Dec.	30	5.12	10.71	7.71±2.14

The ovary of *S. undosquamis* has a different shape during the peak of the spawning season (From late May to December) than its shape during other periods of the annual reproductive cycle. So, the ovary was considered as three different parts as follows: The anterior portion, which represents the first part of the ovary near the genital opening of the fish; the middle portion of the ovary and then the posterior portion of the ovary (i.e. from late May to December, the ovary looked as to be divided into three different portions. The eggs were measured separately in each portion. From January to April, the ovary looked homogenous, and thus a sample from the middle of the ovary was measured).

From table (3) and figure (2), it is obvious that the majority of the fish during March are in the Maturing stage. During this month, three size groups of egg diameters could be found. During April, most of the fish are nearly ripe containing all the size groups. During May, the majority of the fish are ripe with a higher percentage of the fourth egg size group in the anterior portion of the ovary (near the genital opening), than the previous two months. The mid-portion of the ovary contains a lower percentage of the fourth egg size group, while the posterior portion contains only the first three egg size groups. From June to December, which represent the spawning season, the anterior portion of the ovary contains the highest percentage of the fourth egg size group. The middle portion of the ovary contains less, but still high portion of the fourth egg size group. The posterior portion lacks the fourth egg size group but has a higher percentage of the third egg size group. During January, the majority of the fish are in a late spawning stage. All the egg size groups are available with a higher percentage of the smallest egg size group.

During February, all the fish are in spent stage and have only the first three egg size groups. The percentage of the smallest egg size group is the highest during this month.

6. Fecundity

In the present study, the fecundity was estimated by adopting fully ripe females with well-developed ovaries. The absolute fecundity of *Saurida undosquamis* has been analyzed statistically in relation to total length and gutted weight of the fish.

6.I. Fecundity-total length relationship

The curvilinear relationship between the fecundity and the total length of the fish is presented as follows: $F= a L^b$

Where F is the fecundity; L is the total length of the fish; a and b are constants.

By adopting the different relations between total length and fecundity, as shown in figure (3a), the highest correlation coefficient (r^2=0.893) was obtained at the equation relating the logarithm of absolute fecundity and the total length. $\text{Log } F_{abs}= 3.7637 + 0.0491 L$

As shown in Table (4), the values of observed fecundity increase with the increase of total length of the fish. Also, a good agreement between the observed and calculated values indicating the fitness of the obtained equation.

Statistical analysis of the obtained results indicated the absence of significant difference ($P<0.01$) between observed and calculated values of absolute fecundity correlated with increase in total length.

6.II. Fecundity-gutted weight relationship

As shown in Table (5) the values of observed and calculated fecundity increase with the increase of gutted weight of the fish. The highest correlation coefficient (r^2= 0.953), was obtained in relation between the logarithm of absolute fecundity and the gutted weight (W), as shown in Figure (3b) is represented by the following equation:

$\text{Log } F_{abs} = 4.6908 + 0.0027 W$

The probability values ($P < 0.01$) showed that there is no significant difference between the observed and calculated values of absolute fecundity correlated with the increase in gutted weight.

Histological characteristics of the eggs during oogenesis:

Oogenesis in the ovary of *S. undosquamis* was demonstrated in the present study through nine stages of oocyte development according to Yamamoto and Yamazaki (1961) for the goldfish, *Carassius auratus*, with some modifications. These nine stages are demonstrated and described as follows:

1. Chromatin nucleolus stage

The oogonia of this stage, as shown in plate (1), are small and spherical with a distinct thin basophilic cytoplasmic zone and a relatively large nucleus. This stage is present in almost throughout the whole year round, but less abundant in the spawning season. The diameter of this oogonia ranged from 15 to 25µm. The nucleus diameter ranged from 7 to 11 µm. it contains a relatively faint chromatin net work and a large centric or eccentric nucleolus.

2. Early perinucleolus stage

The oocytes of this stage has a round, oval or polygonal shape with a relatively large nucleus and highly basophilic cytoplasm (plate 2). The diameters of these oocytes range from 17 to 70µm. The diameter of the nucleus ranges from 12 to 21µm having 1 to 6 nucleoli arranged near the periphery of the nucleus or scattered in the nucleoplasm.

Table (3): Frequency distribution of ova diameters in ovary of *S. undosquamis* at Alexandria through the annual reproductive cycle according to the maturity stage.

Month	Prevailing Maturity Stage	No. of the fish	G.S.I ± SD	Egg diameter (mm)														
				0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64	0.72	0.80	0.88	0.96	1.04	1.12	1.20
March	Maturing	11	7.11±2.88	13	11	20	9	7	4	8	13	9	6					
April	Nearly ripe	13	9.28±3.17	15	13	9	4	7	3	4	10	11	14	10				
May																		
anterior portion				1	2	3	7	4	8	4	10	8	16	26	8	2	1	
middle portion	Ripe	14	11.4±3.89	7	14	20	19	17	2	5	6	3	6	1				
posterior portion				7	10	12	10	12	15	30	4							
June-Dec.																		
anterior portion				0	1	2	3	5	3	1	7	5	4	11	13	25	11	9
middle portion	Spawning	28	10.78±4.31	10	6	9	4	7	4	8	10	14	9	11	8			
posterior portion				10	4	5	3	5	11	21	30	11						
January	Late spawning	12	6.41±2.98	18	11	6	10	7	10	15	6	3	7	5	2			
February	Spent	9	3.78±1.13	24	31	11	4	9	11	7	3							

Note: From late May to December, the ovary was not homogenous, and thus it was divided into three portions

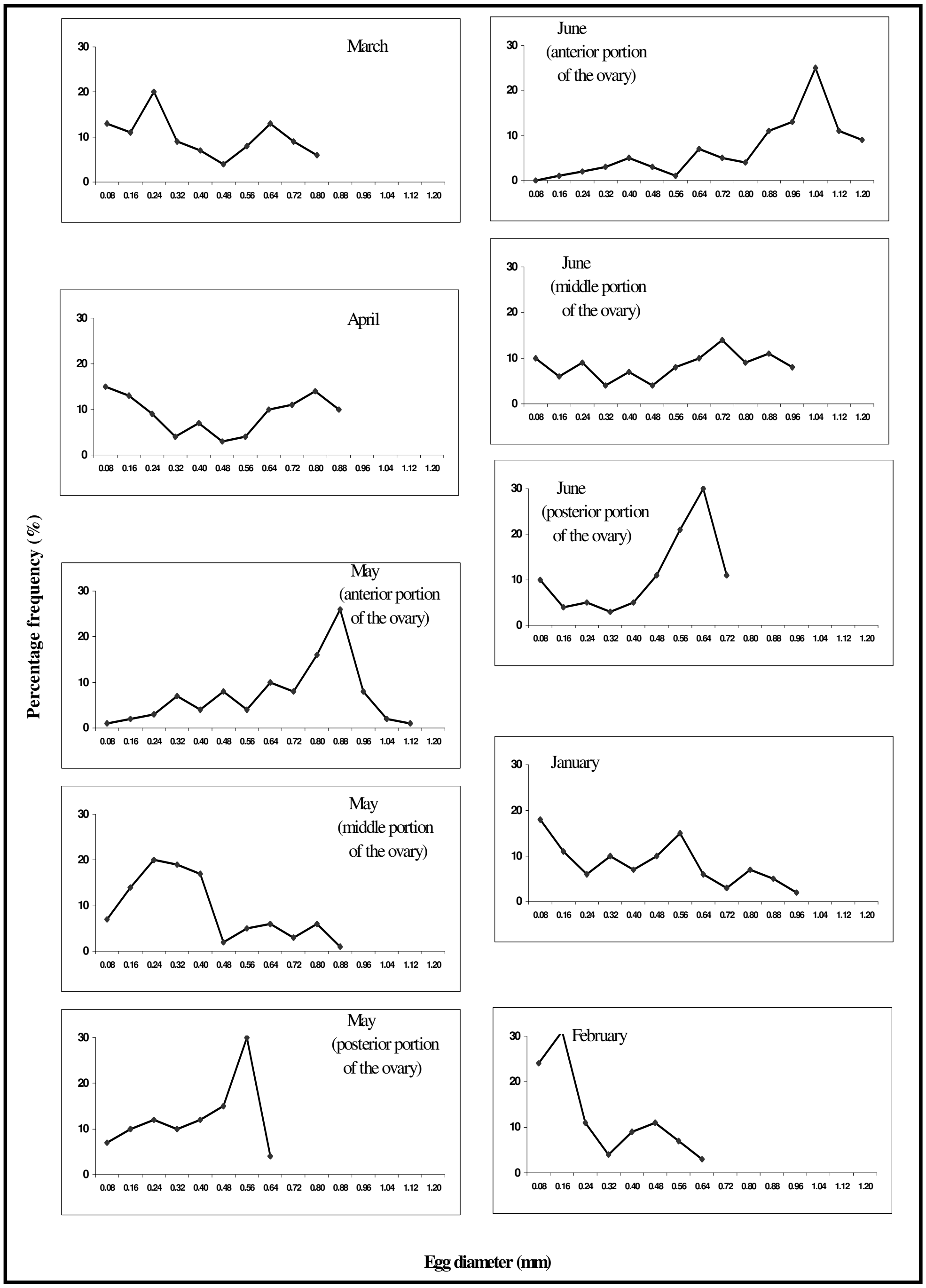

Figure (2): Frequency distribution of egg diameters in ovary of *S. undosquamis* at Alexandria through the annual reproductive cycle according to maturity stage.

Table (4): Total length–fecundity relationship of *Saurida undosquamis* collected from Alexandria.

Total length intervals (cm)	Mean total length (cm)	No of fish	Absolute fecundity	
			Observed	Calculated
19.5-20.4	20.0	5	54168	55680
20.5-21.4	20.8	3	67917	60951
21.5-22.4	22.0	3	75600	69807
22.5-23.4	23.2	4	86306	79950
23.5-24.4	24.1	4	91492	88514
24.5-25.4	24.9	3	97592	96892
25.5-26.4	26.0	4	104166	109724
26.5-27.4	27.1	5	115148	124254
27.5-28.4	27.9	3	120932	136016
28.5-29.4	29.2	6	128537	157551
29.5-30.4	30.1	4	140160	174426
30.5-31.4	30.9	3	155492	190937
31.5-32.4	32.0	4	278144	216222
32.5-33.4	33.1	3	340133	244856

Table (5): Gutted weight-fecundity relationship of *Saurida undosquamis* collected from Alexandria.

Gutted weight intervals (gm)	Mean gutted weight (gm)	No. of fish	Absolute fecundity	
			Observed	Calculated
<50	45.4	9	54098	65070
50-99.9	71.7	11	87456	76628
100-149-9	119.4	8	125932	103081
150-199.9	169.1	7	140682	140401
200-249.9	224.8	8	188674	198500
250-299.9	269.9	6	240532	262742
300-349.9	326.2	5	430689	372855

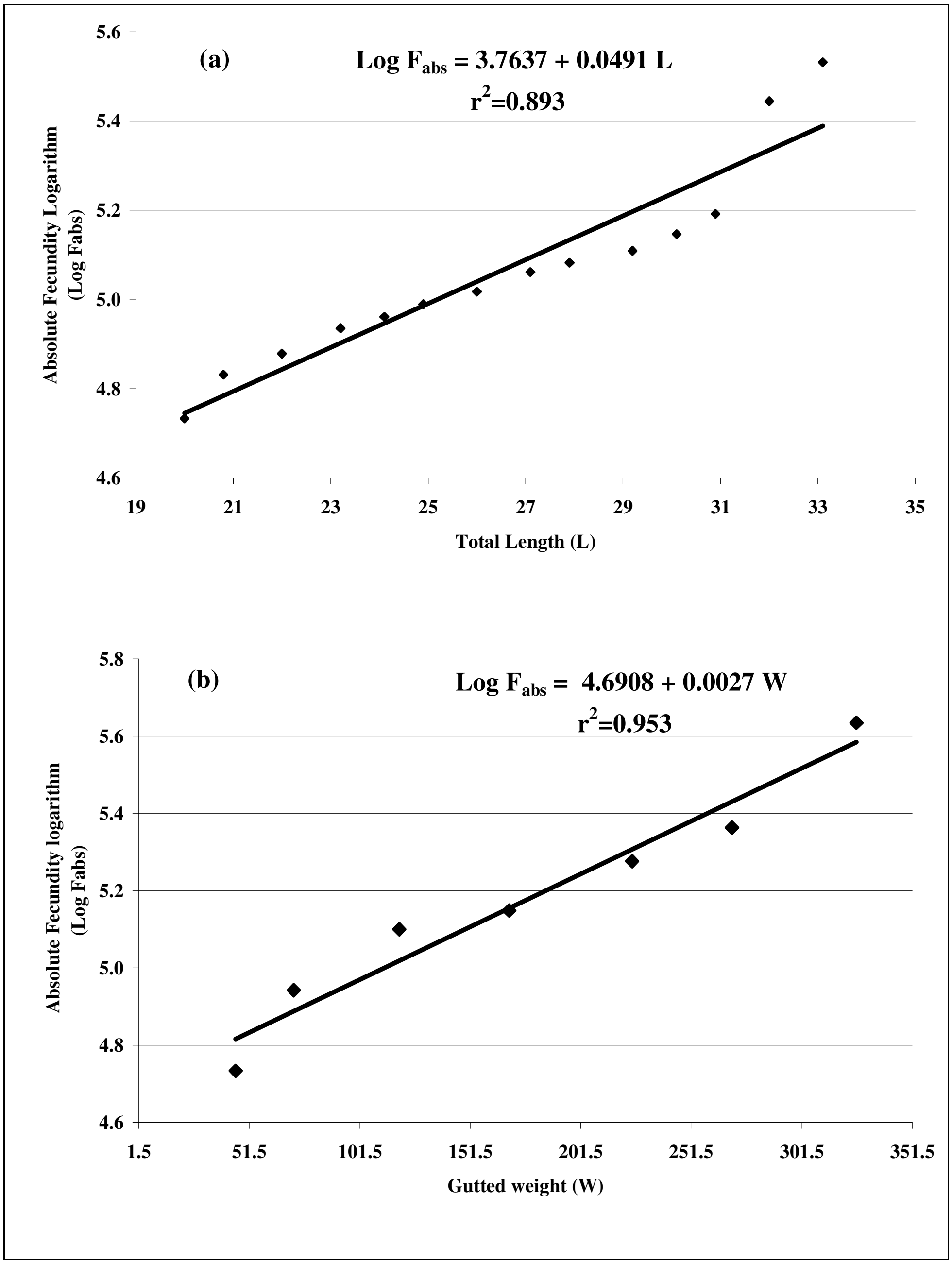

Fig (3): Relation of logarithm of absolute fecundity (Log F_{abs}) with (a) total length (L); and (b) gutted weight (W) of *S. undosquamis* in Alexandria.

3. Late perinucleolus stage

A considerable increase in the size of the oocyte was observed at this stage (plate 3). The oocyte diameter ranged from 60 to 90 µm with a nucleus diameter ranging from 27 to 40µm. The nucleoli started to arrange near the nuclear membrane. Their number ranged from 13 to 22. The oocytes at this stage are still having a strong basophilic, homogenous cytoplasm and surrounded by a thin flattened follicular epithelium.

4. Lipid-Yolk vesicles stage

This stage is characterized by the appearance of lipid and yolk vesicles in the cytoplasm. The yolk vesicles appear first around the nucleus and near to the middle part of the cytoplasm. Soon after this, the oil vesicles appear as a row around the nucleus. Then, another row appear near the periphery of the cytoplasm. Both rows increase and develop towards the middle of the cytoplasm. At the beginning of this stage, as shown in plate 4, the cytoplasm appears as two layers. The inner layer is dark and more basophilic, while the outer layer is lighter and comparatively less basophilic. The oocyte diameter of this stage varied between 180 and 300 µm. The nucleus diameter ranged between 30 and 75µm. The nucleoli were arranged on the nuclear boundary. The oocyte wall become more differentiated, specially at the end of this stage as shown in plate 5.

5. Primary yolk deposition stage

This stage is characterized by the appearance of yolk globules in the cytoplasm (plate 6). It appears first near the nucleus during this stage. The oocyte diameter at this stage ranged from 280µm to 390µm. The nucleus diameter varied between 80 and 100µm. Oil droplets appear first around the nucleus and near the periphery of the cytoplasm. Zona radiata measures about 6µm with follicular epithelium about 3µm.

6. Secondary yolk deposition stage

More accumulation of yolk in the cytoplasm is observed. Thus, an obvious increase in oocyte diameter is clear ranging from 300 to 430µm. A considerable increase in the number of oil droplets was clear (plate 7). The nucleus diameter ranged from 90 to 120µm and the nucleoplasm appeared granulated. The nucleoli are still arranged in the periphery of the nucleus. Zona radiata measured about 8µm with a well differentiated follicular epithelium measured about 3 to 4µm.

7. Tertiary yolk deposition stage

Furthermore accumulation of yolk is continued. The oocyte became oval with a diameter increased greatly with a short and long axis of about 450 and 560µm respectively (plate 8). the nucleus is still round or oval with a diameter ranged from 100 to 140µm. Increase in numbers of both yolk globules and oil droplets is clear. Thickness of zona radiata increased greatly to 15µm and the follicular epithelium reached 5µm.

8. Migratory nucleus stage

This stage is characterized by the migration of the nucleus to the animal pole where the micropyle is located. Plate 9 demonstrates a cell at the beginning of the migration of the nucleus. The oocyte is oval with a diameter ranged between 450 to 510 and 580 to 630µm for short and long axes respectively. The nucleus has an amoeboid shape with an irregular boundary. The nucleoli were arranged in the boundary.

9. Mature egg stage

Many yolk globules are fused together due to yolk liquefaction at the beginning of this stage as well as many oil droplets fuse together (plate 10). The diameter of the oocyte varied between (500 to 590µm) and (560 to 700µm) for short and long axes respectively. Zona radiata measured about 19µm. It consisted of two layers. The follicular epithelium reached 8µm. At the end of this stage, the oocyte became ready for ovulation as shown in plate 11. The diameter at this period reached 1200µm just before ovulation. Zona radiata at this stage reached 27µm and became differentiated into two distinct layers (Plat 12). The follicular epithelium reached 10μm.

Histological characteristics of the eggs during oogenesis of this species during the present study were demonstrated according to Yamaoto and Yamazaki (1961). Oogonia of the chromatin nucleolus stage represent almost all the cells found in the ovary of the thread stage. It was found less frequent in maturating stage, but still in a high percent. Early perinucleolus stage was recorded in a high frequency in the maturating stage and less frequent in thread stage, but lower percent was recorded in nearly ripe stage. Lipid-yolk vesicles stage, primary and secondary yolk deposition stages were more frequent in the ovaries of nearly ripe stage. Also, they are present in the ripe stage but in a lower frequency. Tertiary yolk deposition stage, migratory nucleus stage, and mature egg stage are most abundant in the ripe, spawning and spent stages. However, the ovary of the spawning stage contains nearly all the stages of egg development since the ovary is nearly divided into three parts. The first outer part, which is near the genital opening, contains the highly developed eggs. The middle part contains a mixture of the less developed and the immature eggs. The third inner part contains the eggs of low development stages.

DISCUSSION

The study of the reproductive biology of fish is a very important step for proper planning of fishery management. In the present study, important reproductive parameters were studied for females of *S. undosquamis* throughout the whole annual reproductive cycle. These parameters are: maturity stages, length at first sexual maturity, monthly distribution of maturity stages, gonadosomatic index, egg diameter, fecundity and ovarian histology.

Seven maturity stages for the ovaries of *S. undosquamis* were determined morphologically by the naked eyes in the present study as follows: stage I (thread); stage II (immature stage); stage III (mature stage); stage IV (nearly ripe stage); stage V (Ripe stage); stage VI (spawning stage); stage VII (spent stage).

By studying the length at first sexual maturity, it was observed that female *S. undosquamis* fish of Alexandria start maturation at a total length of 16 cm with a small percentage of 17.6%. This percentage increase with the increase of total length of the fish until reaching 100% at a total length of 23 cm. Faltas (1993) recorded a range of (16-22 cm) for the same species in Alexandria and a range of (16-21 cm) in Damietta. Latif and Shenouda (1973) recorded (16-18 cm) in the Gulf of Suez, but Sanders and Kedidi (1984) recorded 16.6 cm. Out of Egyptian waters, Budnichenko & Dimitrova, 1979 recorded (17-18 cm) in the Arabian sea. Rao (1983) recorded (14-26 cm) total length in the Indian waters. These different data from different regions means that the length at first sexual maturity can differ from region to another for the same species. This difference could be referred to the difference in environmental conditions. Length at first sexual maturity is important to determine the minimal legal size that must be avoided in fishing to protect an adequate spawning stock and ensure at least one spawning for the mature individual.

Monthly distribution of maturity stages of *S. undosquamis* indicated that this species exhibits nearly a year round spawning with maximum activity from late May to December. Most of the stages are present throughout the whole year with different percentage from month to another. Immature and maturing stages are high during January to March, then the nearly ripe stage increases during March, April and May. Spawning stage extends throughout the year with minimal value at April and May. The percent spawning increase progressively from June to reach maximum percentage at December (53.3) and January (54.7).

Quick and good idea about a species spawning season could be demonstrated by the establishment of its gonadosomatic index throughout the whole annual reproductive cycle. In the present study, the monthly distribution of GSI revealed that the mean maximum GSI values were recorded in May. Then it decreased gradually due to the spawning process. However, the values from July to December were not greatly different from each other indicating that this species has a long spawning season.

Demonstration of the monthly distribution of egg diameters revealed that there is an obvious difference between the egg diameters of different portions within the same ovarian lobe. The ova of the anterior portion (near the genital opening) are much larger than those found in the middle part and in the posterior part. The eggs of the anterior portion of the lobe which have the turn to be discharged are very large and colourless or transparent having faint yellow colour. These eggs could be easily discharged out of the body by a gentle press on the belly. Percentage of these large eggs has a maximum value during the period from June to December. In the same time, the next smaller egg groups are prepared to replace after the discharge of the current group. Three or four batches of ova diameter were recorded for *S. undosquamis*. This observation indicates that this species has a long spawning season and is a fractional spawning species (Yoshida, 1966; Latif and Shenouda, 1973; Budnichenko & Dimitrova 1979 and Faltas 1993) and nearly year round spawning (BenYami & Glasser, 1974 and Al-Kholy & El-Wakeel, 1975). When the spawning period is long and indefinite, withdrawal of eggs from the egg stock to undergo maturation will be a continuous process, and there will be no sharp separation between the general egg stock and maturing egg (Hickling & Rutenberg, 1936 and Faltas, 1993).

The present study recorded that *S. undosquamis* in the Egyptian Mediterranean water showed nearly year round spawning period. This result is in a good agreement with BenYami & Glasser, 1974 and Al-Kholy & El-Wakeel, 1975. However, Shenouda (1976) claimed that the spawning season of this species was from January to October in the same area. Latif and Shenouda (1973) and Sanders & Kedidi (1984) recorded that it probably occur during nine months beginning in about April in Suez Gulf.

Rao (1983) and Rao *et al.* (1988) mentioned that it occurred in October-March in east west coasts of India; while in Vizhinjan at south west Coast of India, it was reported by Nair *et al.* 1988, that it takes place in August-September. In south west coast of India, spawning takes place in November and January-February (Abdul Nizar *et al.,* 1988). Golani (1993) reported that the spawning season extends from March to December in the Mediterranean coast of Israel.

The present study indicates that the spawning activity of *S. undosquamis* in Egyptian Mediterranean water extends nearly year round with the peak of spawning extending from June (18.9%) to December and January (53.3 & 54.7%). On the other hand, the spawning activity was smallest during April & May.

The range of egg diameter values of *S. undosquamis* in the present study was found to be from 0.08 to 1.2 mm. According to Faltas 1993, it was found to be from 0.1 to 1.0 mm in the same area. Latif and Shenouda (1973) reported a range of 0.13 to 1.01 in the Suez Gulf.

The study of fecundity showed a proportional increase in the absolute fecundity in relation to the increase in length and weight of the fish. The values of fecundity of *S. undosquamis* ranged from 54168 to 340133 for fish length ranging from 20 to 33 cm and weight ranging from 45 to 350 grams. These values varied from those in other regions and/or other time (ex: Budnichenko & Dimitrova 1979 and Rao 1983).

Histologically, the ovaries of *S. undosquamis* contain generally most of the egg development stages. The less development stages (chromatin nucleolus, early and late perinucleolus stages) are more frequent in the immature ovaries. During early maturation of the ovaries, the previously mentioned stages are recorded beside the lipid-yolk vesicles and primary yolk deposition stages. Towards the completion of the maturation, the remaining more developed stages represents the majority of the cells found in the ovary.

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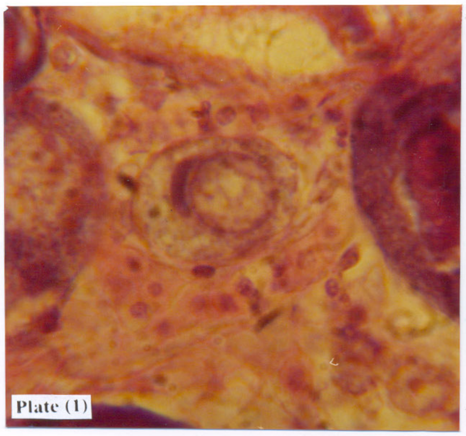
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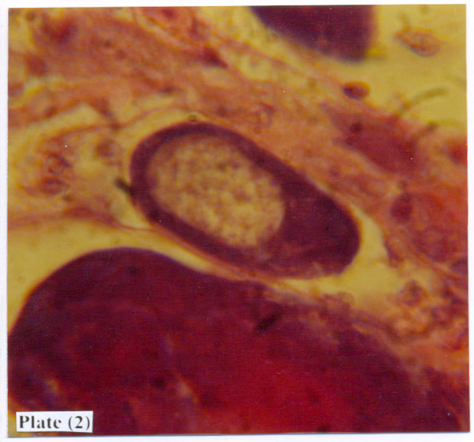


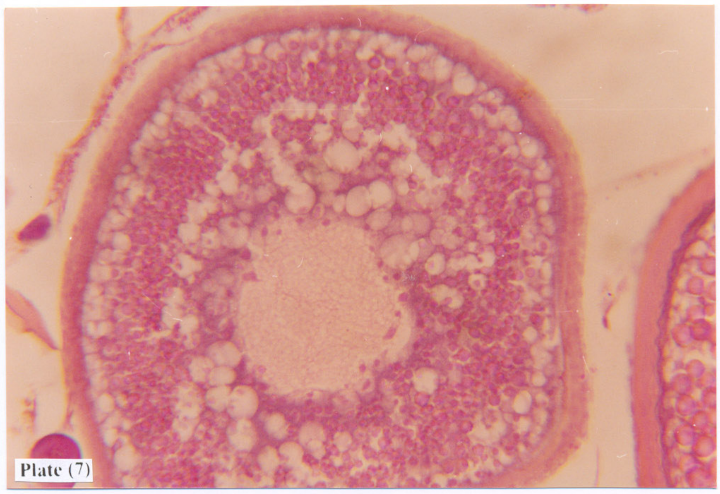
Plate (2)


Plate (3)


Plate (4)


Plate (5)


Plate (6)



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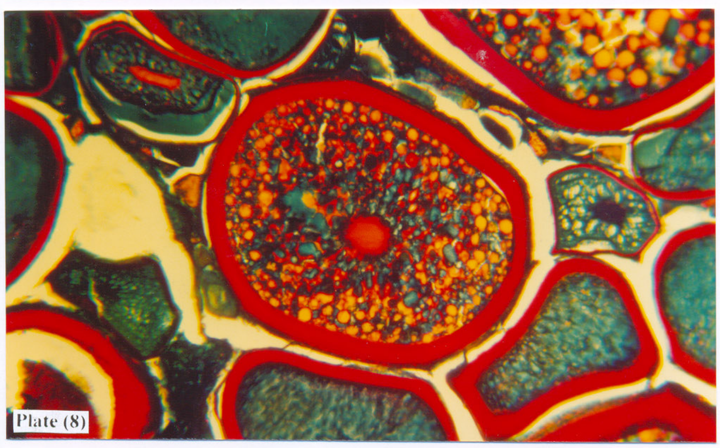

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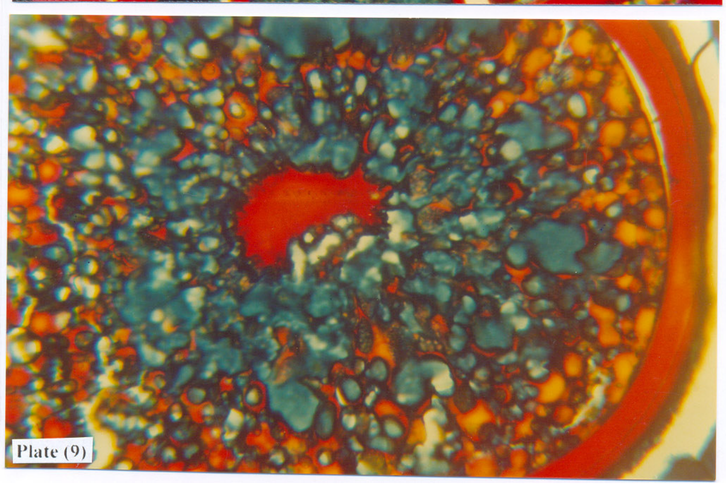

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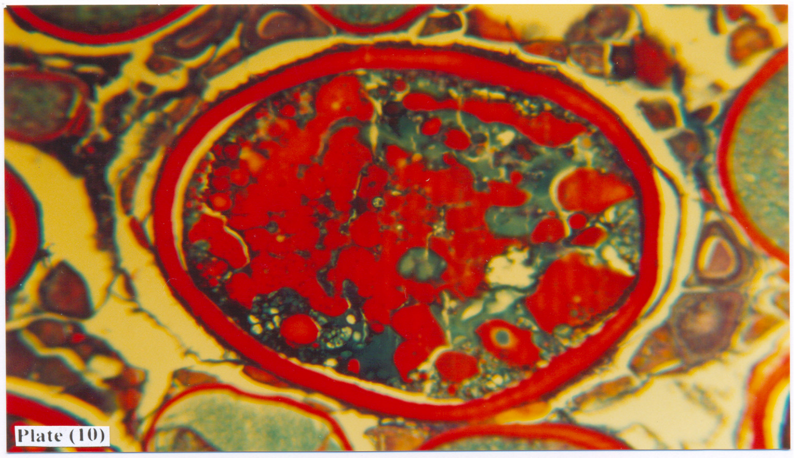

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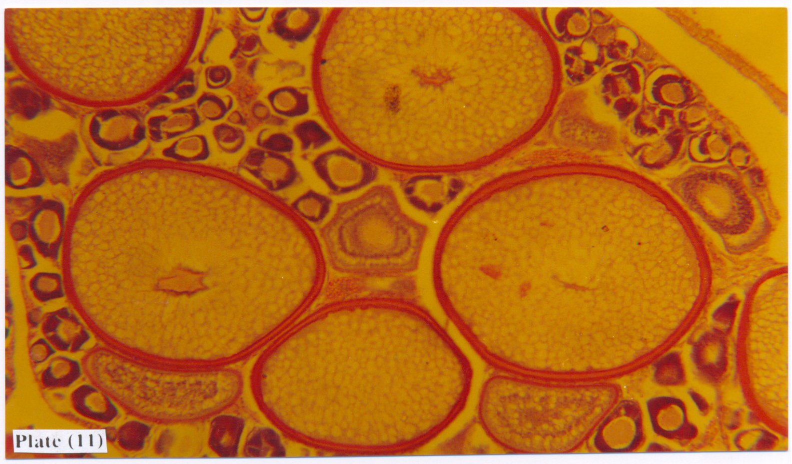

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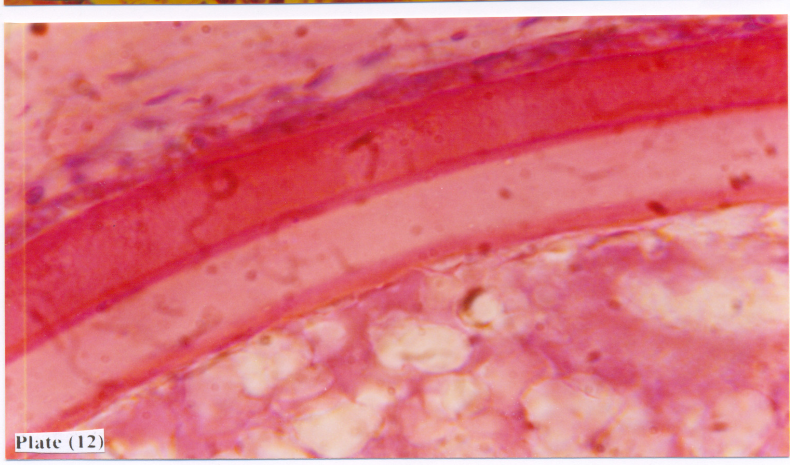

Plate (12)

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