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REPRODUCTIVE BIOLOGY OF *MUGIL SEHELI* (FAMILY MUGLIDAE) REARED IN FISH FARM

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ABSTRACT

Monthly variations of maturity stages indicate that Mugil seheli has a long spawning period. It extended from November 2002 till the end of farming period in January 2003. Length at first sexual maturity for female and male was 14.2 cm & 12.5 cm, respectively. Gonadosomatic index (GSI) attained high values in July, August and September. The highest peak was 7.68 for females and 4.11 for males in November and December respectively. The ova diameters ranged from 0.1 mm to 0.7 mm. It can be classified into transparent eggs ranging from 0.1 mm to 0.39 mm in diameter and yolked eggs ranging from 0.4 mm to 0.7 mm in diameter. The eggs attained their highest diameters in the spawning period, which extended through November and December. The relationships between absolute fecundity versus total length and weight were highly expressive.

INTRODUCTION

Family Muglidae is widely spread and representing an important species for cultivation in fish farms. Eisawy *et al.*, 1974, carried out the rearing of mullets in Egyptian fish farms. Ham za and Zaki, 1987 who carried out rearing experiments of some marine fishes in brackish water system including grey mullet.

Mugil seheli belongs to family Muglidae and their fry are present in big amounts in Gulf of Suez, especially Suez Bay. They are easily transported to fish farms for rearing. Many authors studies the biology of mullet species such as Chan & Chua (1980); Alvarez-Lajonchere (1982); Salem & Mohamed (1982); Zaki and El-Gharabawy (1991); Zaki *et al*. (1994) and Mahmoud (1997).

In the present study, the reproductive biology of *Mugil seheli* under condition of captivity and fed on natural organic & inorganic fertilizer were studied.

MATERIAL AND METHODS

Mugil seheli is a common fish, reared in captivity at Suez farms. Fingerlings of *Mugil seheli* stocked at a farm located in EL-Shandoura discharge water. The water salinity was 18-30 ‰, with temperature ranged between 20 ^{o}C and 34 ^{o}C and pH was 8.1 in average during the farming period, which extended from April to January. The chemical analysis of water demonstrated oxygen ranged between 7 to 10 mg/L, nitrite was < 0.1 and nitrate was 5.9 in average. The farm was fertilized with chicken manure, urea, superphosphate and potassium hydroxide. The analysis of sediment was found its type was sand.

Samples of *M. seheli* were collected monthly where the total length and total weight were recorded for each fish samples. The gonads were removed, weighed and examined through shape, size and color to determine maturity stage. The gonadosomatic index (GSI) was calculated as follows:-

GSI= gonadal weight /total weight X 100

A piece of mature ovaries (0.1 g) was preserved in 4 % formalin then the contained eggs were counted and measured to 0.1 mm. The eggs were divided into two main groups:

1- Transparent small eggs with ova diameter ranged from 0.1 to 0.39 mm (group I).
2- Yolky eggs of ova diameter between 0.4 to 0.7 mm (group II).

RESULTS

1-Maturity stages:-

The gonads of *M. seheli* are composed of two lobes of almost equal size, lying below the kideny in the perivisceral cavity along the abdominal cavity. They showed a serial change in shape, size and color.

A- Maturity stages of ovaries:-

Stage I (Immature):

Ovaries are thin, thread like, translucent and colorless. Sexes usually cannot be distinguished.

Stage II (Developing):

More rounded translucent and colorless eggs are not evident to the naked eye. The ovaries are extended to the 1/3 of the abdominal cavity.

Stage III (Developed):

Opaque and pale, yellowish small and eggs are seen to the naked eye. The ovaries are extended to 2/3 of the abdominal cavity.

Stage IV (Mature):

Ovaries fill most of the body cavity, become opaque and yellow in color. Eggs are visible to the naked eye.

Stage V (Ripe):

The ovaries fill the abdominal cavity, yellow large eggs are extruded by pressure on the walls of the body.

Stage VI (Spent):

The ovaries fill the abdominal cavity but its wall begins to shrink.

B- Maturity stages of testes: -

Stage I (Immature):

Testes are threads, thin, translucent and colorless.

Stage II (Developing):

Testes are thin, strap-like, translucent, grayish in color and fill about 1/3 of abdominal cavity.

Stage III (Developed):

Testes extend to about 2/3 of the abdominal cavity, grayish white and have smooth texture.

Stage IV (mature):

Testes fill most of the abdominal cavity, opaque, creamy white in color and smooth texture.

Stage V (Ripe):

Testes fill the abdominal cavity, opaque, white in color, smooth texture and milt extrude by pressure on the belly of the fish.

Stage VI (Spent):

Testes still fill the abdominal cavity but their wall shrinking & become dirty white in color.

Monthly distribution of maturity stages:

The maturity stages in female *Mugil seheli* vary monthly throughout the farming period and are shown in figure (1A). From April to June, immature & developing stages (I & II) are highly abundant. They disappeared from November to the end of farming period. In July, the developing stage (stage III) was represented with low value (5 %) and increased gradually till reached to it's highest percentage (57.5 %) in October.

The ripe stage (stage V) of female *Mugil seheli* was obvious in November with percentage of 69.3 % and the peak value (90 %) was attained in December, the period of spawning. Slight decrease in abundance & ripe stage (20 %) took place in January. Spent stage (stage VI), was observed in January.

The monthly variations of maturity stages in the male *Mugil seheli* through out the farming period are shown in figure (1B). The immature & developing stages are shown during the beginning of the farming period from April to July. In August, the developed stage (stage III) is appeared at low percentage (16 %) beside the previous stages. The ripening stage started to appear in October (11 %) & increased to reach its maximum percentage 80 % in December. In January spent stage appeared with 23 % percentage.

2- Length at first sexual maturity (L_{50}):

The length of female and male *Mugil seheli* at first sexual maturity was determined by the percentage distribution of mature and immature fishes for each length group. The females of 12 cm length are immature. The mature females appeared with percentage abundance 28.6 % at 13 cm length. The percentage of mature females *Mugil seheli* increased to reach L_{50} at length 14.2 cm. All females at length 16 cm were mature (Fig 2A).

The males of less than 12 cm length are immature. At length 12 cm the mature male appeared with a percentage of 33.3 % and increased gradually to reach percentage 50 % at length of 12.5 cm. At length 15 cm all male became sexually mature (Figure 2B).

3- Gonadosomatic index (GSI):-

A- Female:-

The monthly variations of the GSI values are shown in figure 3. There were very small (0.09 on the average) at the beginning of farming period that represented the pre-spawning period. It increased gradually to reach very high value 7.68 in December (spawning period). At the end of the farming period, GSI decreased to reach 6.24.

B- Male:-

The monthly fluctuations of GSI values are shown in figure (3). At the beginning of the farming period The GSI values was very small and their average was 0.03. At the pre-spawning period increase in GSI was observed. It was elevated to record 1.12 in October. The spawning period demonstrated the highest peak for GSI in November 4.11. From December, GSI started to decrease in value till reached average value 2.95 in January at the end of rearing period.

4- Egg diameter and spawning:

In July the fish with GSI 0.39 & 0.59 had the ovaries with transparent ova (0.1-0.3 mm) (Figure 4). In August, the ova diameter increased to reach 0.4 mm. The ova diameter ranged from 0.1 to 0.5 mm demonstrated with percentage 22 % of total eggs in September. In October, the fish (GSI 1.78) had ova diameter extend to new group of yolky eggs (0.6 mm in diameter) with small percentage 6 %. In November and December, fishes of GSI values 5.86 & 7.68, had transparent and yolky ova with diameter extend to 0.7 mm but varying in percentages between 9 % and 22 %, respectively. At the end of farming period in January, the fish with GSI 5.08, ova diameter returned to 0.6 with percentage of 25 % for yolky eggs and the transparent ova appeared with 59 % percentage. This means that yolky ova appeared from August with diameter 0.4 mm and extends in diameter till they reach its maximum diameter 0.7 mm in December (the period of maturation of gonads).

5- Fecundity:

A-Fecundity versus length

The relationships between absolute fecundity and length was estimated from the following equation

$$Fa = -567987.71 + 585768.92 \text{ Log } L$$

Where Fa is absolute fecundity and L is the total fish length

By applying this equation, the fecundity of individuals were obtained for each length group in table (1). The absolute fecundity increases with the length increase.

The relative fecundity versus total length was estimated for different length groups and expressed as follows

Fr = -20671.79 + 23916.34 log L

Where Fr is the relative fecundity and L is the total fish length

The absolute and relative fecundity increase with the increasing of fish length.

B-Fecundity versus weight

The average absolute fecundity related to weight is shown in table (2). The equation expressive this relationship as the following:-

Fa= -134269.721 +137631.34 Log W

Where Fa is the absolute fecundity and W is the fish total weight

Satisfactory agreement of both observed and calculated fecundity for weight could be showier.

The equation represented the relation ship between relative fecundity and weight was found to be expressed by the following equation

Fr = 4.998 + 0.0235 Log W

Where Fr is the relative fecundity and W is the fish total weight

The relative fecundity increases as weight increasing (Table 2).

Table 1: Mean absolute and relative fecundity of *Mugil seheli* per length group.

Total length	Number of fish	Mean absolute fecundity		Mean relative fecundity	
		Observed	Calculated	Observed	Calculated
13	9	42312 ± 2513.4	42213 ± 2141.2	2752 ± 198.2	2792 ± 0.241.6
14	8	49576 ± 2641.3	48176 ± 2384.6	2893 ± 254.6	2715 ± .274.2
15	10	52137 ± 2474.0	53216 ± 2633.4	3382 ± 342.8	3392 ± 365.2
16	13	69815 ± 2511.3	67651 ± 3242.3	4872 ± 257.3	4754 ± 412.1
17	15	87682 ± 384.4	79391 ± 3512.2	5492 ± 354.5	5261 ± 425.1
18	7	95419 ± 3414.3	96524 ± 3976.3	6624 ± 368.1	6781 ± 463.4

Table 2: Mean absolute and relative fecundity *Mugil seheli* as related to weight.

Total weight	Number of fish	Mean absolute fecundity		Mean relative fecundity	
		Observed	Calculated	Observed	Calculated
26.6	7	40172 ± 1876.4	41852 ± 1972.2	1395 ± 197.3	1345 ± 178.2
30.9	6	41260 ± 1897.2	42612 ± 1997.6	1406 ± 232.2	1367 ± 198.5
41.8	8	53493 ± 2347.8	53671 ± 2541.2	1632 ± 259.1	1585 ± 235.0
48.6	10	75721 ± 3544.2	73536 ± 2845.3	1853 ± 314.2	1747 ± 352.1
52.6	10	87805 ± 3874.4	86733 ± 3412.8	1993 ± 325.7	1962 ± 387.4
57.1	7	92351 ± 4232.1	93216 ± 3652.1	2108 ± 453.2	2074 ± 389.9

DISCUSSION

The present study demonstrates the behavior of reproductive mode of *Mugil seheli* under captivity by using natural feeding. This mode of reproduction discussed through the study of reproductive items such as maturity stages, length at first sexual maturity, gonadosomatic index, egg diameter and fecundity (Allam, 1996; Abdallah & Faltas, 1998 & Ibrahim, 1999).

The maturation of gonad for *Mugil seheli* in the present study was classified according to Mahmoud (1997) with some modification into six stages; immature, developing, developed, mature, ripe and spent. Monthly variations of maturity stages insure that *Mugil seheli* has spawning period extending from November to December where stage V was represented with percentage 69.3 % & 90 % respectively. In January, spent stage started to appear, this may be due to ovarian regreesion, which related to mullet species during captivity. This result coincides with Salem and Mohamed (1982), EL-Boray (1993) and Mahmoud (1997).

The females of 12 cm length were all immature but the mature females appeared with length 16 cm. The males of *Mugil seheli* reached to maturity at length of 15 cm but all fishes with 11 cm were immature. The size at which female and male *Mugil seheli* attains 50 % maturity was 14.2 cm and 12.5 cm, respectively. El-Boray (1993) demonstrated that L_{50} of male *Mugil seheli* were of 12.95 cm. But Salem & Mohamed (1982) showed that L_{50} of females were of 14 cm but that of males were of 13 cm for the same species. So, the male *Mugil seheli* reach its maturity at smaller size than the female.

Gonadosomatic index in the present study fluctuated with maturation of gonads. So, the GSI increased progressively with the increased percentage of ripe fishes. Values of GSI increased gradually to reach the highest peak (7.68) in December for female and (4.11) for male in November. Values of GSI showed sharp increase in November where the spawning season begins. At the end of rearing period GSI gradually decreased, this referred that the ripe eggs infaced atritic

condition due to captivity (Mahmoud 1997). This result agree with Mahmoud 1997 who indicated that GSI peak of *Mugil seheli* reared in farms was sharp in November and December for male and female, respectively. While spawning season for this fish in Suez Bay extend from November to March (EL-Boray, 1993). Salem & Mohamed (1982) showed that the maximum value of GSI in *Mugil seheli* at Lake Timsah occurred in December for both sexes. The variance of GSI peaks from farm to open sea may be attributed to natural feeding and temperature.

The analysis of the ova diameter in this study revealed that the eggs could be divided into two main groups: 1- Transparent small eggs with ova diameter ranging from 0.1 mm to 0.3 mm. 2- Yolky eggs varying between 0.4 mm & 0.7 mm in diameter. This indicates that *M. seheli* has a long spawning season with fractional spawning character. Also, the decreasing in GSI values for both male and female which coincides with shifting in egg diameter in January, may be due to reabsorption of ripe ova, which failed to the ovulated in captivity (Zaki and EL-Gharabawy, 1991; EL-Boray, 1993, Mahmoud, 1997; Assem, 2000; EL-greisy, 2000 and Ramadan, 2003).

From the aforementioned results, the ova-diameters showed the presence of several modes. The biggest ova diameter (0.7 mm) appeared in December, this decreased to 0.6 mm by the end of the rearing period in January. These results coincide with those obtained from the study of monthly variation in maturity stages and goadosomatic index.

Study of the absolute and relative fecundity in *Mugil seheli* illustrate a wide range variation for a varying length or weight. The absolute fecundity has a linear relation ship with length group and weight. In the present study absolute fecundity of *Mugil seheli* ranged from 42312 to 95419 for length and from 40172 to 92351 for weight. Relative fecundity ranged from 2752 to 6624 for length and from 1395 to 2108 for weight. These results coincide with these given by Salem and Mohamed (1982); EL-Boray (1993) and Mohamoud (1997).

According to the reproductive items, we can conclude that the spawning season of *Mugil seheli* extend from November to January. So, it can be recommended that *Mugil seheli* in captivity must harvest in the end November or December where the the fishes reached to its maximum weight and highest economic income.

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