Using histological ultra-structural characteristic in gonads to study some Reproductive Biology of the Valamugail seheli (Forsskal 1775) from Sudanese Red Sea Coast

Badr Eldinn KH, Adam; Sheikheldin M. Elamin and Salah Eldeen Y.M. Habiballah

Department of Fisheries, Faculty of Marine Sciences and Fisheries, Red Sea University. P.O. Box 24. Port Sudan. Sudan

Received 25 September 2017; Accepted 28 November 2017; Available online 31 December 2017

ABSTRACT
Valamugail seheli (Forsskal 1775), are very widely distributed species of the family Mugilidae in Sudanese Red Sea Coast. Some aspects of the reproductive biology and histology of the gonads of Valamugail seheli were studied between 2008 and 2009. A total of 358 specimen Valamugil seheli were used during the study the total length range from 14 (cm) minimum to 44 (cm) maximum for males and from 12 (cm) to 43 (cm) for females. The present study described six maturity stages for gonad development based on external features and histological study of males/females for Valamugil seheli. The present study described the phases of gonad development and determined the spawning season and length at first maturity from morphological and histological study of the mentioned species. Spawning season is characterized by the presence of different individuals at different levels of maturity during the spawning period. Besides additional amount of sperms are always formed during the spawning period. Results showed that Valamugil seheli attains first sexual maturity at 26 cm (total length) for males and at 27 cm for females at age of one year for both males and females. This study is a considerable need, and is an important matter to manage and regulate this species.

KEYWORDS: (At least 3 and at most 8 keywords)

INTRODUCTION
Scientific work on mullets along the Sudanese Red Sea Coast included the field guide notes for the group given by Reed[1] and Abu Gideiri [2]; some biological and ecological attributes of Mugil cephalus by Ali [3] and Mohammed (4) and its gross chemical composition by Mohammed et al., [5]; Some studies concerning of Valamugail seheli were conducted such as: Some environmental and biological aspects of Valamugail seheli and Valamugail buchanani by Osman [6]. Reproductive biology of the blue spot mullet valamugil seheli in coast of India Venkatesha et al [7], Feedig of fry of V.seheli Yousif [8], Morphometric relationships of V.seheli from Sudan coast Mokhtar et. al. [9], Reproductive biology of V.seheli in Sudan coast Mokhtar et. al. [10].

The study of reproduction and egg production increases our knowledge about the state of a stock and improves standard assessments of many commercially valuable fish species. The present study on some biological and histological on the reproductive system (males and females) of Valamugil seheli.
One of the commercially important fish groups along the Sudanese Red Sea Coast are the mullets. Family Mugilidae are widely distributed in Sudanese Red Sea Coast. The Mugilidae are shallow-water schooling fishes of moderate size. They are silvery except for the back which is dark colored [1]; [11]; Abu Gideiri [2] and FAO [12]. Six species have been recorded in local name such as mullet, Jilani.

The attainment of sexual maturity in fish as in many animals is influenced by a number of factors including; Difference in species; age; size; and physiological conditions Barbieri, [13].

There is no biological studies in detail such as studying reproduction and management of fishing in most fishes of Red Sea especially Sudanese Coast, needed for regulating fishing and exploitation of the resource. Therefore, this study is a considerable need, and is an important matter to be studies.

Methodology:
Collection of specimen:
A total of 358 specimens of Valamugil seheli were collected monthly and randomly from the Fish Commercial Centre at Abu Hashish Fish Central Market-Port Sudan during period from June 2008 to May 2009. The total length (TL), were measured to the nearest 0.1 cm and the total weight (TW,) and gonad weight (GW) were weighed to the nearest 0.01 grams in an electronic balance and age estimates using the scales.

Reproduction:
Stages of maturity:
Fish were dissected, sexed and the gonads removed and weighted to the nearest milligram. After gross examination, the gonads were assigned to a maturity stage based on their external features such as size, colour, shape and texture following the protocols of Ntibata and Jaccarini [14].

Length and age at First Maturity:
The length at first maturity was defined at the length at which fish attain maturity. Stage (IV) was considered as the mature stage in order to enable determination of the minimum size at which fish attain sexual maturity. It was estimated according to Soondron et al. [51].

The Percentage of Mature Fish:
The Percentage of Mature Fish (%MF) was determination for the combined sexes of stage (IV and V) using the following equation:

\[ \text{MF}\% = \left( \frac{\text{Number of mature fish}}{\text{Total number of in the sample}} \right) \times 100 \]

Histological processing:
Whole gonads removed from each individual were blotted dry, weighed to the nearest 0.001 g, sexed and staged macroscopically, and immediately fixed in Bouin’s solution for 24 hours for histological processing. Sections of gonads embedded with paraffin wax were mounted on glass slides and stained with Haematoxylin and Eosin Harris, [16]. These sections were viewed under a high powered microscope to confirm macroscopic sexes and stages.

Results:
The gonads of 358 Valamugil seheli individuals were examined. These individuals ranged from 14 (cm) minimum to 44 (cm) maximum for males and from 12 (cm) to 43 (cm) for females.

Maturity stages:
The description of maturity stages of Valamugil seheli are shown in Table 1, while mature ovaries and tests are shown in Fig. 1 and 2.

Table 1: Description of maturity stages of Valamugil seheli were examined to determine and accordingly classified into:

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Testes</th>
<th>Ovary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1 Immature</td>
<td>There is no visible sexual organ in the body cavity</td>
<td>There is no visible sexual organ in the body cavity</td>
</tr>
<tr>
<td></td>
<td>Testes small, paired slender-distinguished microscopically from the ovaries</td>
<td>Ovary short, translucent, paired flesh colored thread-like structures. Eggs irregular shaped, no yolk</td>
</tr>
<tr>
<td>Developing</td>
<td>Gonad are thread-like transparent, testes white, occupying 1/3 of the body cavity</td>
<td>Ovaries thin, extending to slightly more than half the length of body cavity. Ova spherical, opaque. Translucent-nucleus visible.</td>
</tr>
<tr>
<td>Maturing-or Ripening</td>
<td>Gonad begin to swell testes ivory colored occupying about 1/2 the body cavity but still translucent.</td>
<td>Ovary yellowish, elongated Slightly lobulated, ovarian blood vessels visible extending almost the entire length of</td>
</tr>
</tbody>
</table>
Maturing
2
Nearly ripe

The gonads fill almost the body and white in colour.

Ovaries are pale yellow in colour.

Full mature
Ripe

Testes flabby, massive, dull pink or creamy white, occupying whole body

Ovaries yellow white, occupying whole body cavity, enclosing the intestine lateral extensions. The ovarian wall very thin. Eggs opaque, very distinct

Spent

The testes are yellowish white in colour occupying 1/4 of the body cavity.

Ovaries flaccid, reddish in colour, occupying 1/5 of The body cavity, majority of ova were small transparent invisible to naked eye.

Length and age at first sexual maturity:

The age at first sexual maturity is the age at which 50% of all fish all fish at this age are mature. *Valamugil seheli* attains their first sexual maturity at 26 cm for males and 27 for females referring these lengths correspond to age one year for both sexes (Table 2 and Fig. 3).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean length (cm)</th>
<th>Frequency</th>
<th>Cumulative Frequency</th>
<th>% of Mature fish</th>
<th>Age group</th>
<th>Mean length (cm)</th>
<th>Frequency</th>
<th>Cumulative frequency</th>
<th>% of Mature fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>12.8</td>
<td>1</td>
<td>1</td>
<td>0.76</td>
<td>I</td>
<td>15.11</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>II</td>
<td>22.60</td>
<td>12</td>
<td>13</td>
<td>9.85</td>
<td>II</td>
<td>22.38</td>
<td>17</td>
<td>17</td>
<td>12.14</td>
</tr>
<tr>
<td>III</td>
<td>28.22</td>
<td>68</td>
<td>81</td>
<td>61.36</td>
<td>III</td>
<td>27.98</td>
<td>76</td>
<td>93</td>
<td>66.43</td>
</tr>
<tr>
<td>IV</td>
<td>34.29</td>
<td>37</td>
<td>118</td>
<td>89.39</td>
<td>IV</td>
<td>34.21</td>
<td>35</td>
<td>128</td>
<td>91.43</td>
</tr>
<tr>
<td>V</td>
<td>39.94</td>
<td>14</td>
<td>132</td>
<td>100.00</td>
<td>V</td>
<td>40.66</td>
<td>12</td>
<td>140</td>
<td>100.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>132</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Age I = 0 +, Age II = 1 +, etc
Fig. 3: Shows the percentage of mature males and females for *Valamugil seheli* versus total length, arrows shows Length at first sexual maturity.

**Histological aspect of gonads development:**

The histological aspect of ovary and testes development and their microscopic characteristics was summarized in (Plates 1-14), for females, and (Plates 15-25) for males respectively.

**Plate. 1:** (Whole section, x = 4)
Plate. 2: (Enlarged section, x = 10)

Plate (1) and (2) transverse section through the immature ovary, the first growth phase which includes three stages as following chromatin nucleolus (undifferentiated) stage shows oogonia (O), connective tissue (CT), cavity (CA), the gonad wall (GW) is very thick. In this stage was small spherical cells present either solitary or cluster and founded embedded in the ovigerous lamella (stained with Himatoxline and Eosin).

Plate. 3: (Whole section, x = 4)
Plate. 4: (Enlarged section, x = 10)

Plate (3) and (4) transverse section through the immature ovary several stages of oogenetic development based on specific cytological changes as follows in this stage the ovary is composed of clusters of oogonia (O), oogonia still smallest germ cells with no distinct boundaries, small groups of primary oocytes (PO), and chromatin nucleolus oocytes in the ovary with connective tissue (CT), and cavity (CA). (stained with Himatoxline and Eosin).

Plate. 5: (Whole section, x = 4)
Plate. 6: (Enlarged section, x = 10)

Plate (5) and (6) transverse section through the developing ovary there have much connective tissue (CT), gonad wall (GW) very thick, and containing nest of chromatin nucleolus or primary oocytes (PO), early perinucleolus (EP), around the cavity (CA), in this stage they found solitary or in clusters of lamellae close to the germinal epithelium and they have large light nucleus and weakly basophilic cytoplasm (stained with Himatoxline and Eosin).

Plate. 7: (Whole section, x = 4)
Plate. 8: (Enlarged section, x = 10)

Plate (5) and (8) transverse section through the maturing ovary showing the gonad wall (GW) still is thick, there is large circular nucleus (N) is seen with number of small nucleoli (Nu), oogonia (Og) are small spherical cells with a thin indistinct peripheral zone “primordial follicle” and surrounded with follicular epithelial (FE), at this stage have many different oocytes primary and secondary oocytes (PO)(SO) and late perinculeolus (LP) (stained with Himatoxline and Eosin).

Plate. 9: (Whole section, x = 4)
Plate. 10: (Enlarged section, x = 10)

Plate (9) and (10) transverse section through the second maturing ovary showing small nucleolus (N) near to the nucleus membrane (NM) of vacuoles (V) in the perinucleolus oocytes. In this stage the oocytes increase in diameter and characterized by the presence of yolk vesicles. These vesicles would increase in both size and number to form several irregular rows in outer region of the cytoplasm, secondary oocytes (SO), early perinucleolus (EP), late perinucleolus (LP) around cavity (CA), and connective tissue (CT), with follicular epithelial (FE) (stained with Himatoxline and Eosin).

Plate. 11: (Whole section, x = 10)
Plate (11) transverse section through the near mature ovary (last maturing) the ovary filled with different stage of oocytes, oogonia (O), primary and secondary oocytes (PO) (SO) early perinucleolus (EP), late perinucleolus (LP) with connective tissue (CT), the ripe oocytes (RO) appeared with yolk (Y) deposition, nucleus (N) in central position, oocytes bounded by a distinct follicular epithelial (FE). Oocytes at this stage become oval shape and characterized by further increase in number and size of yolk vesicles and granules which accumulated very rapidly in the inner part of the cytoplasm and also enlarged in their size. This leads to irregularly shaped nucleus, the outer follicular cells increased in width and thecal cells, granuloza and zona radiate start appearing in ripe oocytes (RO) but not clearing (stained with Himatoxline and Eosin).

Plate (12): (Whole section, x=10)

Plate (12) transverse section through the full mature ovary showing that the ovary filled with ripe oocytes (RO), the yolk granules appear as small spheres in the inner part of cytoplasm around the nucleus, the oocytes membrane in thick ness and composedof three layer outer thecal (Th), middle granulosa (G), inner zona radiate (ZR). In the ripe oocytes yolk (Y) liquefaction and nucleus (N) loses its circularity. This stage is recognized by the nucleus movement which migrates toward the animal pole, nucleoli migrate towards the center of the nucleus away from the nuclear membrane which loses its circularity and stiffness being a winding weak membrane in the way of disintegration completely. The ripe ova appeared in an oval and frequently pearl like shape, as ovulation progresses, the whole oocytes becomes hydrated when this occurred the nucleus of the oocyte cannot be identified (stained with Himatoxline and Eosin).
Plate. 13: (Whole section, x = 10)

Plate. 14: (Enlarged section, x = 25)

Plate (13) and (14) transverse section through the spawning ovary showing filled by oval ripe oocytes (RO), and spherical tertiary yolk (TY), shows the liquefaction of yolk (Y) sphere with large vacuoles (V). The large yolk granules coalesced to form layer drops toward the center of the oocytes until all the yolk spheres undergo liquefaction. With continuation of oocyte development towards the ripeness a release of oocyte into the ovarian lumen begins, zona radiata (ZR) (external & internal), concurrent diminution of thickness, because of their stretching following the size increase of the cell and the outer layer follicular epithelium (FE) become ruptured. The structure of an unfertilized egg chorion (Ch), nucleus (N) oil globules (OG), perivitelline space (PS), theca (Th), granulose (G). The spawning ovaries were observed from September until December for *V. mugil seheli* (stained with Himatoxline and Eosin).
Plate. 15: (Whole section, x = 4)

Plate. 16: (Enlarged section, x = 10)

Plate (15) and (16) transverse sections through the immature testes were bisexual gonad during the reproductive season, (undifferentiated). In this stage many spermatogonia (Sg) around the cavity (CA) and connective tissue (CT), the gonad wall (GW) is thin, it is the first spermatogonial stage in the testes, (stained with Himatoxline and Eosin).
Plate. 17: (Whole section, x = 4)

Plate. 18: (Enlarged section, x = 25)

Plate (17) and (18) transverse section through the immature testes showing preponderance of the spermatogonia (Sg) and nest spermatogonia (Nt Sg), the gonad wall (GW) become thick with connective tissue (CT) and cavity (CA). The seminiferous lobules at immature stage composed of the germ cells which are in active. They designate spermatogonium at different stage. (stained with Himatoxline and Eosin).
Plate. 19: (Whole section, x = 10)

Plate (19) transverse section through the immature testes showing the characteristic of most teleosts, spermatogenic cells observed in testes were spermatogonia (Sg) situated on lobule wall. The chromatin material is arranged on the peripheral part of nuclear membrane, they have a prominent nucleolus are basophilic, and are found in cysts with varying numbers of individual cells, the cysts are usually found singly near the periphery of the testes, acysts situated on the lobule wall. There is another different stages of sperms like primary and secondary spermatocytes (PS) (SS) among cavity (CA) and connective tissue(CT), (stained with Himatoxline and Eosin).

Plate. 20: (Whole section, x = 10)
Plate (20) transverse section through the developing from immature to maturing testes there have much connective tissue (CT), and cavity (CA), testes showing the spermatogonia (Sg) are the largest cells, the primary spermatocytes (PS) and secondary spermatocytes (SS). Tubule wall (TW) is appeared. Are oval or spherical with diameter, they have no visible nuclear membrane and the chromatin material occupies most of the cells. A larger proportion of mature testicular tissue was present, containing seminiferous tubules (STu), in these tubules cells in all the different stages of development were organized in cysts and showed synchronous development, (stained with Himatoxline and Eosin).

Plate. 21: Whole section, x = 10)

Plate (21) transverse section through the maturing testes showing its nucleus (N) and nucleolus (Nu) appearing. The secondary spermatocytes (SS) are very small spherical cells with diameters, unlike primary spermatocytes (PS), the chromatin is found in a clumped condition, similar to the spermatids. The seminiferous tubules (STu) filled with different stage of spermatocytes, we classified the germ cells into the following phases of development spermatogonia (Sg) primary and secondary spermatocytes (SP), (SS), and spermatids (ST). At the beginning of this stage the gonad contains cysts with cells at all the proceeding phases spermatogenesis, (stained with Himatoxline and Eosin).
Plate. 22: (Whole section, x = 10)

Plate (22) transverse section through the near mature testes (last maturing) the testes filled with spermatids (ST), and spermatozoa (SZ), and a few of secondary spermatocytes (SS), the gonad wall (GW) become very thin, and found many connective tissue (CT) and small cavity. Membrances (thick arrow) and tubular structures (thin arrow) with translucent cytoplasm and discarded cytoplasmic structures appearing in the spermatids (ST) in the maturation to spermatozoa (SZ) stage of the reproductive season. Spermatids are strongly basophilic spherical cells with diameters, as they mature they become smaller and the chromatin becomes uniformly condensed, in this stage shows that after detaching from the lobule wall, the spermatids remain in dense clusters. Up on completion of spermiogenesis, the cells transform into spermatozoa, the most advanced cysts show the first spermatozoa to appear. (stained with Hematoxyline and Eosin).
Plate. 23: (Whole section, x = 4)

Plate. 24: (Enlarged section, x = 10)

Plate (23) and (24) transverse section through full mature testes showing the lumen of all the lobules is filled with free spermatozoa (SZ), and spermatids (ST) at the end of spermiogenesis are visible next to the lobule walls. And all Spermatid developed to spermatoza (SZ) in this stage and have many inter lobular connective tissue (CT) and gonad wall become very thin. (stained with Hematoxyline and Eosin).
Plate 25: (Whole section, x = 10)

Plate (25) transverse section though the spawning testes (oozing) all the testes filled with full mature spermatozoa (SZ), with connective tissue (CT), the spermatozoa have around nucleus and are morphologically subdivided into head, neck piece, short midpiece, and tail; as in other teleosts, there is no acrosome, they measure in diameter, excluding the tail. As the number of spermatozoa in the lobule lumen increases, spermatozoa are moved into the efferent duct. New batches of cysts-enclosed cells mature grandually, at that time gonad section show the cysts to disappear, the lobule boundary wall at that time is considerably and thick. The cysts containing spermatagonia disappear first, followed by those with the primary and secondary spermatocytes and spermatids until all the cells in gonad will have finished spermatogenesis. The spawning testes were observed from September until December for *V. seheli* (stained with Hematoxyline and Eosin).

Discussion:

The occurrence of high percentages of individual fishes with running gonads (stage 5) in the samples in, at least, in *Valamugil seheli*, four consecutive months from September to December it was peak through all this period. This result were closer to the finding of El-Maghraby et al., [1] who studied sexual maturity of *M. capito* in lake Borollus reported that that the fish spawning during October to December which are winter months.

While *Valamugil seheli* were found to be immature at lengths smaller than 19 cm for males and 17.1 cm for females. Fish of *Valamugil seheli* attains their first sexual maturity at 23 cm for both sexes these lengths correspond to age one year for both sexes like most other species of mulles [18,19,20]. According to Ali[3] all specimens of *M. cephalus* and *P. gaterinus* up to 25 and 22 cm standard length corresponding to 1+ age group respectively were immature. The majority of fishes attain sexual maturity at 27 and 25cm for both species at age 2+, and also observed that *M. cephalus* spawn once a year over a prolonged period from September to February. The chromatin nucleolus stage (oogonia) in the present study of *V. seheli* was found in immature ovaries at the beginning of oocyte formatting, when the division of oogonia were recorded. This phenomenon started from the ovigorous lamellae as it was filled with germ cells, oocytes are expanding towards the lumen of the ovary. In immature fishes, the formation of oocytes comes from the division of oogonia. This results is in accordance with that of Raina [21].

In fully ripe ova of *V. seheli*, small opening the ovarian wall is place of entrance of the head and trunk of sperm for fertilization. The egg membrane in other teleosts is contained a small opening which is the micropyle through the sperm gain access to enclosed egg Laale, [22].
After the oocytes reached their final maturation they are spawned. Those which do not succeed to be spawned are reabsorbed and become atretic. The oocyte became amoeboid in shape, in which granulosa layer hypertrophied and yolk granules disintegrated into small granules. Finally, the thecal cells attacked the yolk granules and the follicles appear as sieve and can be easily removed. In this respect, Khoo [23] gave detailed description of histological changes of follicular atresia of gold fish and found that after complete reabsorption of all remnant oocytes by hypertrophied granulosa cells, it collapse into atrium to form cellular mass. Various authors attributed the follicular atresia to environmental stress, [24] and Kamel, [25].

The present result indicate that perinucleolus oocyte of two species under the study are inclosed in a single layer of follicular epithelial cells with progressive development of oocyte the boundary envelope is composed of two layer; an inner granulosa cell layer and an outer theca cell layer. It seems that both theca and granulosa cells are the major cellular sites of steroid synthesis in the ovaries as described in oncorhynchus rhodurus Kagawa, [26]; Oreochromic mossabes Smith and Haley, [27] and pagrus major Matsuyma et al., [28].

This boundary envelope have exhibited both quantitative and qualitative variation concomitant with the successive maturity stages of oogonenes. These feature were taken as an indication in the process of steroidoidoogeneses accompanying the development of the ovaries and formation of ripe oocyte, these results conform with those presented by Matsuyma et al. [28] in Pagrus major.

The histological and morphological characters of ovaries V. seheli have indicated that the oocyte pass through six successive stages of sexual maturation stage 1, immature oocyte (resting stage); stage 11, Vacuolization of the cytoplasm (preparatory stage); stage 111, beginning of yolk deposition (maturing stage); stage iv, nearly mature (last maturing); stage v, the maturation of oocytes (spawning stage) and stage vi, egg resorption (postspawning stage). this findings agreement with Similar stages were described by Zaki et al. [29] and Ashour et al.[30] in manyof other fish species. The present ultrastuctural study during spermatogenesis in V. seheli show that the arrangement of mitochondria is similar to that described in other species, were these organelles surround the base of nucleus plateichys fleus, Jones and Butler, [31] and a number of species of bleunidae Lahnsteiner and Patzner,[32]. In addition Fishelson et al., [33] reported that in several species of Gobies, the mitochondria present around the spermatids disappeared to be replaced by two large mitochondria.

Also in the present study on V. seheli as reported in several teleost species, the condensation of chromatin in the nuclei of secondary spermatocytes and spermatids as they reach maturation occurs in specific pattern that is often in the region adjacent to the developing flagellum [34; 35].

As the chromatin condenses there is obviously a great decrease in the size of the nucleus. This result is agreement with that described in several teleost species [36;37] and [38]. From the histological characteristics of immature testes in which the lobules containing only the spermatogonial cells in different size and the interlobular connective tissue thick relatively as represented by Latif and Sandy [39]. The maturing testes of V. seheli display active spermatogenesis and the cells of all stages can be seen, spermatogonia, spermatocytes (Primary and Secondary) and spermatids. This results are in agreement with Zaki et al., [29] for clarias lazera; Mousa et al., [36] for Mugil cephalus; El-ghamdy [40] for Acanthopagrus bifasciatus.

The spent stage in which the seminiferous lobules disintegrated and no milt are left in it. The function of the seminal vesicle in teleosten fishes varies with type of fish. According to Zaki et al., [29] reported that with the exact function of the seminal vesicle in Clarias gariepinus was not determined but a change in its size was observed during the annual reproductive cycle of sexually mature fish. The change may be due to storage and discharge of sperm cells, which is turn may be an adaptation of the long and continuous spawning period of Clarias gariepinus. Spawning season is characterized by the presence of different individuals at different levels of maturity during the spawning period. Besides additional amount of sperms are always formed during the spawning period. This results support the finding of Zaki et al., [41] in Mugil seheli.

Conclusion:
First length and age of maturity for the V. seheli was extremely at the 23 cm for both sexes these lengths correspond to age one year for both sexes. There seems to be one long spawning seasons for V. seheli from September to December. The results of histological development study in gonads of V. seheli accorded six stages (immature, maturing, nearly mature, mature, spawning and spent) for both sexes.

ACKNOWLEDGEMENT
Authors acknowledge Sayed Yosif from Khartoum University for photo the slides and the Faculty of Marine Sciences and Fisheries, Red Sea University.

REFERENCES


8. Youssif, M.O., 2012. The Potential of Dehydrated Enteromorpha, Prosopis cineraria Linn.(Leguminosae) Pods Meal and Date Pits in Formulated Feed for Bluespot Grey Mullet Fry, Valamugil seheli (Forsskal)


19. Luther, G., 1963. Some observations on the biology of Liza macrolepis (Smith) and Mugil cephalus Linn. (Mugilidae) with notes on the fishery of grey mullets near Mandapam, Indian J.Fish., 10: 642-665.


