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ARTICLE

Gonadal Morphology, Histology and Spermatogenesis of Striped Grunt Fish, *Pomadasys Stridens* (Forsskal, 1775) (Family: Pomadasyidae)

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ABSTRACT

The present study was conducted on some aspects of histology and morphology of gonadal development and spermatogenesis of the striped piggy fish, *Pomadasys stridens* from the Arabian Sea near Karachi coast. A preliminary investigative study was carried on genetic-variability, morpho-histological characters to observe the differences between both gonads of both the sexes along with the size of the associated fat bodies. Both the gonads were investigated and classified in seven different stages of maturity. Testes were found asymmetrical in measurement with the right testis larger than the left one. It was found that meiotic activity and spermatid development showed the opposite relationship. The left testis showed a relatively greater activity than the right one.

1. Introduction

Pomadasys stridens Forsskal, 1775 (Plate 1) is a common grunt "Dhoter" fish and an important sea food species of the Arabian Sea and Persian Gulf. It is small to medium sized, usually inhabiting shallow coastal water, usually occur in coral reef areas as well as in muddy and weedy waters, feeding on bottom invertebrates and small fishes [1-2].

Some workers investigated and reported previously on different biological aspects of some species of family Pomadasyidae (Grunt) from this region previously [3-17].

Practically, no work has been under taken on the gonadal morphology, histology and spermatogenesis of this species from Karachi coast of Pakistan; however some works are available on Gonadal morphology, histology and spermatogenesis of some other important fish species [18-21]. The present study was therefore under taken to study and investigate these aspects.

Genetic variability of *P. stridens* in relationship and differences in morphology were observed between the gonads of both the sexes along with the measurement of the fat body attached with the gonads. It determines the relationship between these morphological differences and the conditions of the reproductive structures from the histological examinations of the gonads of both the sexes. However, an innovative approach may enable the detection of a mechanism for common regulation to all biota components, with benefits for the scientific knowledge, for the productive chain and especially for people in the region [22]. In the current study are reporting some findings on gonadal morpho-histology and spermatogenesis and relationship with some other reproductive biology of this species. Since these information's are little but still im-

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portant for the proper management of the grunt fisheries and for the optimum utilization of the fisheries of this species, it is therefore proposed to carry out research studies like this.

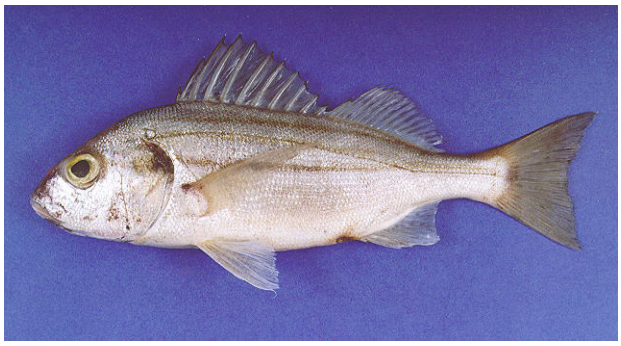

Plate 1. Lateral view of Pomadasys stridens

2. Material and Methods

Fortnightly collections of *P. stridens* (Plate 1) were made from the commercial landings at West Wharf & Korangi Creek of Karachi coast. There were 155 males and 236 females measuring 56-210 mm in total length (TL) were investigated during current studies. Their gonads were dissected out, weighed and preserved in 10% neutral formalin. Sexual stages were marked according to the scale adopted by International council for the Exploration of the sea [23]. Counting the ova in a portion of known weight and then calculating the total number from the total weight of the ovary made fecundity.

The gonads and associated fat body were dissected from each fish just after the fish were collected and the total lengths of fishes were measured to the nearest mm. Both the gonads and both the lobes of each gonad were preserved separately in 10% neutral buffered formalin solution. Washed the tissue in running water for 12 hours and after that the histological preparations were initiated. A processor of Optical T/P tissue was utilized to dehydrate and embed the tissue in para-plast just after the washing of tissues. The sections were sectioned at near to five microns and applied by Harris' hemato-xylin followed by eosin stain counter just like the previous investigators [18 & 20]. Each gonadal (testis) sub-samples was classified according to the relative abundance of spermatocytes, spermatids, and sperm, sperm-duct development and maturity.

3. Results and Discussion

The gonads were bi-lobed; the right lobe a little bit larger than the left increasing in size with the size of the fish at different maturity stages (Figure 1 & 4). Vasa differentia was not discernible after maturity stage 3 due to the spreading of gonads into the body cavity. Seven maturity stages, based on color, size and GSI are described.

Asymmetrical differences were observed in the measurements of both the gonads and also in the in the size of the fat body attached to gonads of this fish species (Figure 1 & 4). Determined the histological differences and differences in all the stages of sexual maturity along with describing spermatogenesis.

3.1 Number and Size of Fish Examined

Total numbers of 391 specimens of *P. stridens* were examined during the current study period. Sex ratio for each month and in different length groups was calculated along with gonadal development and classification in all specimens.

3.2 Sex Ratio

In most of the collections, time periods and size groups' females outnumbered the males with a sex ratio of 1.5:1. Chi-square (x^2) test showed significant values at 160 – 169 mm, 190 – 199mm and 200 – 209 mm TL hinting at their 50% maturity in either sex. The same sex ratio was found in different size groups of the fish Based on size groups the males were predominant up 129 mm while the females were predominant from 130 mm to 219 mm. The females grew to a bigger size than the males.

Morphological variations have been used as a basic tool in separating population of fish species [18]. *P. stridens* handled in the course of the investigation belonged to a single homogeneous population or not. Samples were studied statistically as a matter of comparison for males and females and the significant difference between the sexes of this species.

3.3 General Morphology of Gonads

The gonads in both the sexes are located in the dorsal portion of the body cavity, paired, elongated as like in most of teleost fishes. These contain fat bodies closely associated with the dorsal body wall and are suspended by the mesentery. Testes are thinner and longer in immature fish than mature ones; immature fish have white and yellowish in colour of testes which are relatively more solid in maturity. Ovaries in immature specimens were closely resembled with the immature testes. They become progress-ively increased in girth and length; tend to be somewhat pinkish in color as the fish gain the sexual maturity (Figure 1-3).

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Figure 1. Ovarian stages I-VII (From left to right)

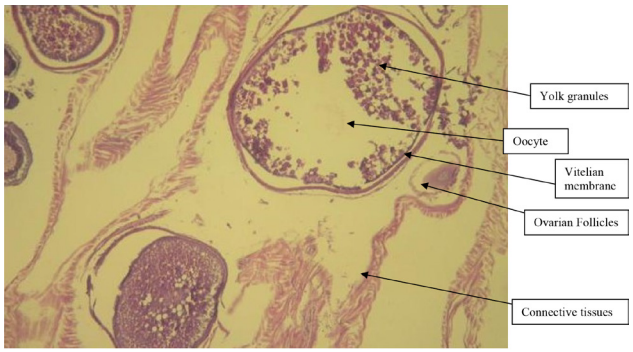

Figure 2. Histological image of Ovary of *P. stridens* under low magnification (X10)

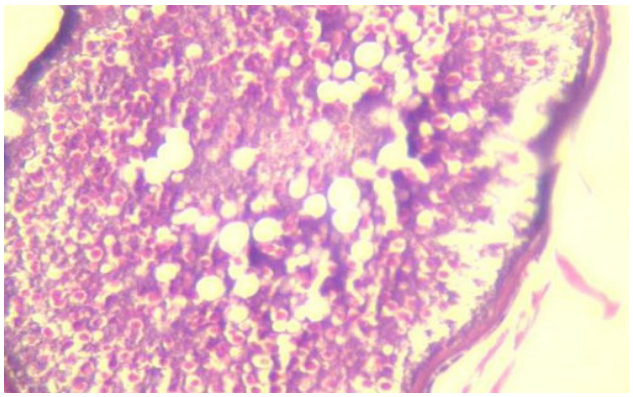

Figure 3. Histological image of Ovary of *P. stridens* under high magnification (X40)

3.4 Size Differences between Left and Right Testes (Figure 4)

Examination of the total length of the fish and the cross-sectional area of both the lobes of the testes showed that the sizes of both gonads gain increase with increasing the total length of the fish respectively. Current examinations showed that the length of the left testis increase at a faster rate than the right one. The right testis is pre-dominantly larger than the left one; however, both of these appear to increase in size at similar rates as the fish gain increase in size.

Figure 4. Testes stages I-VII (From left to right)

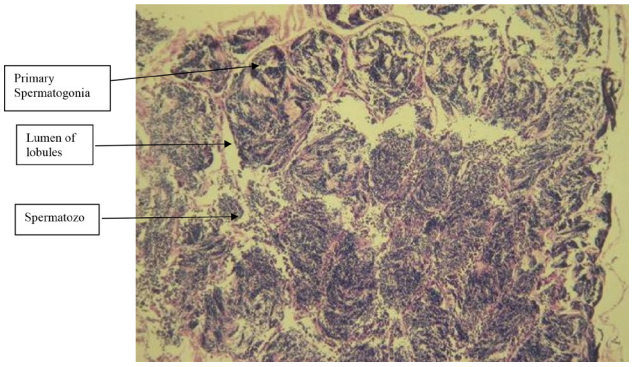

Figure 5. Histological image of Testis of *P. stridens* under low magnification (X10)

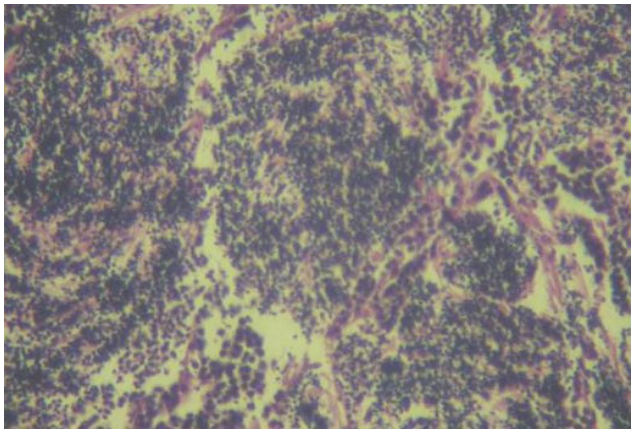

Figure 6. Histological image of Testis of *P. stridens* under high magnification (X40)

3.5 Histology of Testes

P. stridens has same lobular-type of arrangement which is the characteristic of most of the teleost fishes. In present study the germ cells are classified into the following developmental stages:

(1)The primary spermatogonia: Primary spermato-gonia are larger cells with a larger of 12-16 pm (Diameters), have a larger nucleus, basophilic nature, and cystics. The cysts are usually found single near the peripheral region of the testis. Cysts are situated on the lobular walls as shown in Figure 5-6.

(2)Primary spermato-cytes: These are rounded in shape

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with a diameter of 8-12 pm. Most of the nucleus of the cell are occupied by chromatin materials (Figure 5-6).

(3)Secondary spermatocytes: These are very small in size, spherical in shape with a diameter of 4-7 pm. They have chromatin in a clumped condition.

(4)Spermatids: These are strongly basophilic in nature, spherical in shape with a diameter of 2-4 pm. The chromatin material becomes more condensed with maturity.

(5)Spermatozoa: These cells have rounded nucleus and are sub-divided into head, neck, short mid-piece, and tail. They measure up to 2 pm in diameter (excluding the tail).

3.6 Meiotic Activity

During the current study a relative abundance of sperms, spermatids, and spermatocytes were taken as a measure of the meiotic activity. As discussed earlier, the *Pomadasys* texa testes were generally asymmetrical in measurement with the right testis larger than the left one. However, it was found that meiotic activity and spermatid development showed the opposite relationship. The left testis showed a relatively greater activity than the right testis (Figure 5-6).

3.7 Relative Abundance of Sperm, Spermatids, and Spermatocytes

Actual number of spermato-genic cells would be a very difficult task to count. The present results showed that for all the size of fish, the relative abundance of sperm was higher in the left testis than the right testis; we estimated relative abundance of spermatocytes, spermatids, and sperms in number. The results are same for spermatids and spermatocytes, but the differences between testes are not as pronounced as those for sperms. In both the lobes of the testes of fish in all sizes, relative abundance of sperms was highest in the caudal portion and declined towards the rostral end. Relative abundance of both spermatids and spermatocytes was higher in the left than the right testis for all sizes of fish.

3.8 Development of Sperm Duct

Spermatic ducts are formed by some somatic cells developed from the somatic wall during testicular morphogenesis in teleost fishes [24]. No sperm ducts are found in immature testes of the specimens of *P. stridens*, while these ducts were clearly observed in mature specimens, these ducts were observed near the middle of the testis (Figure 4-6). Tabulated branching system was observed radiating toward the end at the testis. These observations differ from those reported by many other researchers on many teleost fishes previously, where the main duct is located along the dorsal surface of the testis and may not be present in immature stages of the testis [25]. The morpholo-gical changes occur in the main spermatic duct with the increase of release of sperms. The main duct in the mature testis, when filled with sperms has much thicker walls and is less convoluted and more circular while in the immature testis the main sperm duct is thin walled and highly convoluted than the mature one. The productions of sperms are also associated with increased of blood vessels of the testis, first in the caudal portion followed by the medal and rostral portions latterly. Observations on characterizing immature and mature stages of spermatic duct development showed a higher proportionality of mature spermatic ducts in the left testis than the right one. The results also reveal that sperm-duct development is greatest in the caudal region, intermediate in the medial, and least in the rostral portions of both the lobes of the testes. There was an increasing trend in sperm-duct development with increasing total length of the fish as expected result of this species.

3.9 Sexual Maturity

This fish samples were classified into seven stages of sexual maturity which were based on sperm observed and relative abundance in the studied testes. These stages are:

Stage 1: Smaller and thinner testes have no evidence of sperms in any side of the testis.

Stage 2: No sperms was present in any portion of either side of testis of this stage.

Stage 3: This stage showing immature condition but few sperms in one or more portions of either or both lobes of the testes were observed.

Stage 4: This stage is a mature one, sperms observed in more portions of both lobes of the testes and the sizes of testes are larger.

Stage 5: This stage is fully developed one, plenty of sperms observed in most portions of both lobes of testes and also observed in the sperm duct.

Stage 6: This is fully mature stage, many sperms were observed in all portions of both testes and the sperm duct.

Stage 7: This is spent stage of the testes. “Milt could be squeezed from the testes of more mature males. Slightly more than 50% of fish were immature, including 28% with no sperm present in any portion of either lobes of the testis. Over 42% were in the inter-mediate level of sexual-maturity and 7% were observed as sexually mature.

3.10 Fat Body

A small lobulated mass of fat bodies were usually observed in both the testes and ovaries attached with mes-

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entery. It was generally larger and well-developed in some samples but quite small and rudimentary in other cases. It was creamy or white in color and always developed in lobulated segmented forms. The presence of the fat body mass was usually co-incident with that of the gonadal length, but usually it extends up to anteriorly beyond the gonadal region. It was generally co-related with the size of the gonad. The left lobes of both the testis and ovary of the *P. stridens* were generally observed smaller than the right one, and had a smaller fat body associated as compared to the right ones (Figure 4). In addition, it has observed in current study that the fat body pro-portionately smaller in mature fish that were meiotically active than in sexually immature one.

4. Conclusions

The developmental stages of the gonads are usually the same on both lobes of the fish, according to the previous related literatures pertaining to the general structure and function of gonads of most of the teleost fishes. However, asymmetrical conditions in gonadal size have been recorded in many species, commonly near the time of maturity and breeding [18-19]. Asymmetrical measurement (size) of gonads appears to be common for most of *Pomadasys* species, at least in pre-spawning stages. The present work has the same result of asymmetrical gonadal samples, with the gonad at the right side is larger than the left side in 85% of the cases in the current investigation. The measurement in size increased with increasing the total length of the fish. The data collected during current study reveal active spawning is starting during stage 3 and 4 which has a co-relationship with some previous study at that stage. [21] Some researchers investigated that the left ovary was usually slightly smaller than the right in some species from the central North Pacific Ocean, but they did not clarify the differences clearly. The observations on the meiotic activity is higher in the smallest of a pair of testes is somewhat confusing and puzzling and current observations have no clear cut description for it. It would be possible for this relationship true only for pre-spawning individuals and possibly during other periods when grunts are not spawning periodically. There may be a functional co-relationship between the quantity and size of fat tissues in the mesentery and meiotic activity. The present study may presume that the fat body provides a source of energy for ongoing spermatogenesis and other reproductive activities, But as there is no such proper information/investigation from the present study which clearly says about *P. stridens*. [26] The fat bodies and its quantity acts as an energy reserve for female fish which is requiring during the spawning period. Some workers based their supposition on the absence of the fat body in three recently spawned albacore fishes inhabiting in the different Islands of Hawaii. Some researchers observed that spawning period in the *Euthynnus lineatus*, is probably regulated by energy reserve available in fat bodies. When the fat body stores fall down a minimum level, ovarian fat body probably occurs over a short period of time during maturity [27]. This study will contribute valuable knowledge needed for fisheries management and aquaculture of *P. stridens* by increasing the knowledge of reproductive biology and gonadal activities related to *P. stridens*.

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