

THE SEX RATIO, GONADOSOMATIC INDEX AND STAGES OF GONADAL DEVELOPMENT OF SADDLE GRUNT FISH, *POMADASYS MACULATUM* (BLOCH, 1793) OF KARACHI COAST

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ABSTRACT

The sex ratio, gonadosomatic index, stages of gonadal development and fecundity of saddle grunt fish, *Pomadasys maculatum* (Block, 1793) of the Karachi coast were investigated. *Pomadasys maculatum* had a sex ratio of 1: 1.36 (male to female). The difference in sex ratio was not significantly different ($p > 0.05$) from the expected theoretically 1: 1 distribution except June, September and December. Gonadosomatic index value in males during August – November were 3.109 to 5.630, while in females the high values during August – December were found to be 3.542 to 6.679, which suggested the spawning period. The highest GSI value in males was 5.967 in stage VI and the lowest GSI value was 1.256 recorded during VII stage. GSI values in males increased slowly reaching for maximum in 5.967 in (stage VI), while in females at high value was 6.630 during stage VI and the lowest GSI values were 1.625 and 1.124 during stages I & II respectively. Seven stages of gonadal development were observed in male and female fish. *Pomadasys maculatum* is found in coastal waters over sand near reefs or muddy bottoms. The results will increase our knowledge of reproductive biology of *Pomadasys maculatum* which is relevant for fisheries and aquaculture management as well as breeding programs.

Keywords: *Pomadasys maculatum*, sex ratio, gonadosomatic index, gonadal development.

INTRODUCTION

Commercial quantities of large numbers of finfish and shellfish are present in the coastal waters of Pakistan (Hoda, 1985). The saddle grunt, *Pomadasys maculatum* is an economically important fish, it belongs to the family Haemulidae and can be found at depths between 20 - 110m in soft, sandy and muddy bottoms of the Indo-western Pacific and western Pacific areas. Gonadosomatic index which is an index of gonad size relative to fish size is a good indicator of gonadal development in fish (Dadzie and Wangila, 1980). The percentage of body weight of fish that is used for production of eggs is determined by the gonadosomatic index. Sex ratio studies provide information on the representation of male and female fish present in a population. It states the proportion of male to female fish in a population and indicates the dominance of sex of fish species in a given population. Sex ratio also constitutes basic information necessary for the assessment of the potential of fish reproduction and stock size estimation in fish population (Vicentini and Araujo, 2003). In estimating the reproductive potential of fish, information on sex ratio of fish can be included to determine female spawning biomass.

Information on the reproductive biology of some economically important fish species which include *Pomadasys kaakan*, *Velamugil cunnesius*, *Drepane longimana*, *Pomadasys hasta* and *Euryglossa orientalis* of the Karachi coast has been reported by some authors (Iqbal, 1989; Hoda and Qureshi, 1993; Hoda and Iqbal, 1994; Deshmukh, 1973; Khan and Hoda, 1993). There is a paucity of information on the study of reproductive biology of the grunts in the Karachi coast. The reproductive biology of *Pomadasys maculatum* has not been widely reported in literature. The aim of this study was to investigate the sex ratio, gonadosomatic index and stages of gonadal development which are some aspects of the reproductive biology of *Pomadasys maculatum* of the Karachi coast. It is hoped that the information obtained from this study will contribute to our knowledge of the reproductive biology of *Pomadasys maculatum* and will be useful for fisheries and aquaculture production for the future.

MATERIALS AND METHODS

Study area

The Karachi coast was the study area for this research. The Karachi coastline is between latitude 24°53'N and longitude 67°00'E and lies in the Northern boundary of Arabian Sea.

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Collection of specimens and sampling

Samples of *Pomadasys maculatum* were collected fortnightly (A total of 32 collections) from fish harbors of West Wharf and Korangi Creek of Karachi coast. The specimens were collected from January to December. The fish was identified by using the Bianchi (1985) and Fisher and Bianchi (1984) [FAO Fish Identification Manuals]. The simple random sampling technique was used (Cochran, 2007). A total of 408 samples collected during the study period. The samples were transported to the laboratory and preserved in a deep freezer at -20°C until examination and analysis.

Body measurements

The specimens were brought out of the deep freezer and allowed to thaw and the body length and weight were measured. Total and standard lengths were measured using a one-meter measuring board graduated in cm. The

fish was wiped with a dry napkin before weighing and body weight and ovary weight were measured using a weighing balance (Sartorius model).

Sex ratio

Each specimen was dissected and the gonads were removed. The sex of each specimen was identified by examination of the gonads. The proportion of the two sexes relative to one another was used to calculate the sex ratio.

Gonadosomatic index

The Gonadosomatic index was calculated by following formula:

$$GSI = \frac{\text{Weight of gonad}}{\text{Weight of fish}} \times 100$$

Stages of Gonadal Development

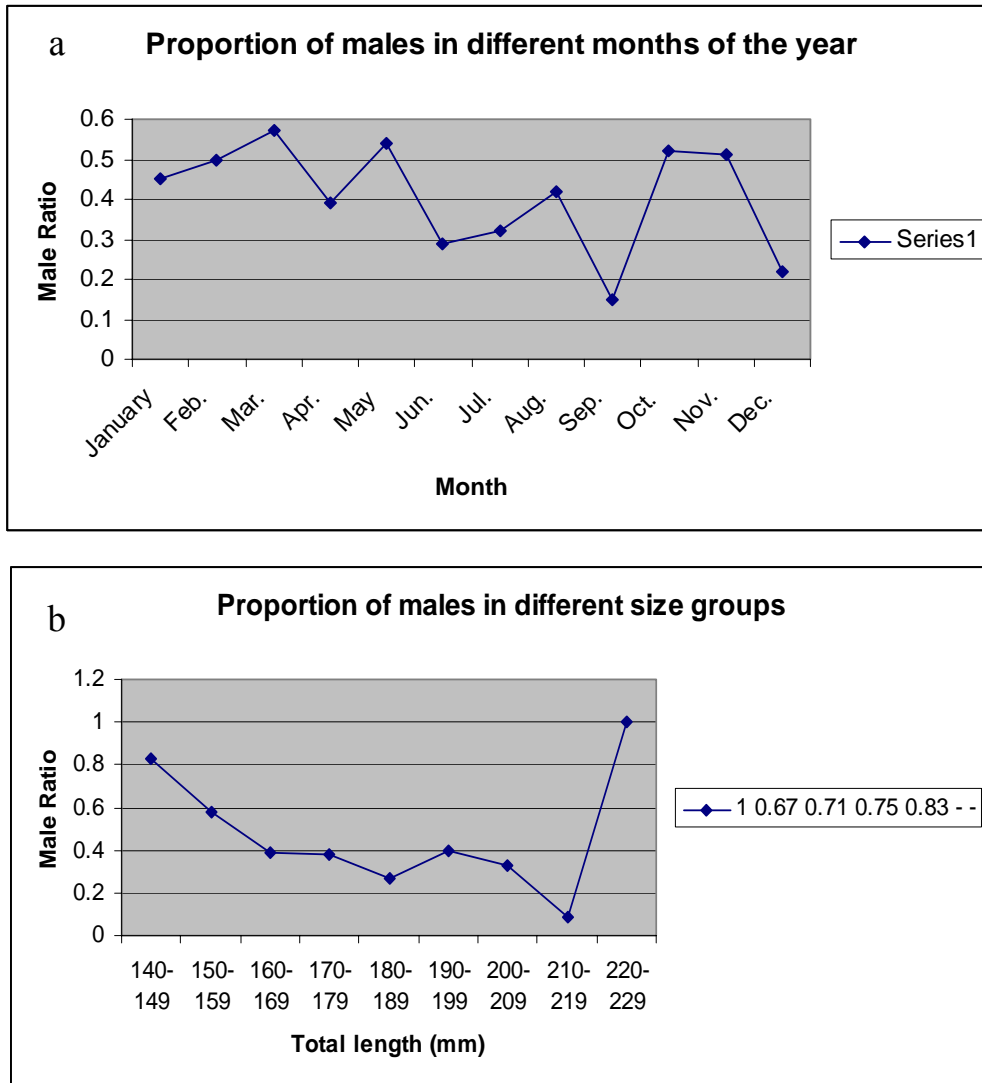


Fig. 1. Proportion of male in different (a) Months and (b) Different size groups.

Gonadal stages were examined microscopically and classified according to Nikolsky (1963) as follows:

Stage I- immature, Stage II- Developing, Stage III- Developing, Stage IV- Maturing, Stage V- mature, Stage VI- Ripe(Running) and Stage VII- spent.

The number of males and females in the different stages of Gonadal development was counted and recorded.

RESULTS

A total of 173 males and 235 females were observed out of 408 samples examined. The sex ratio was 1:1.36 (male to female). The difference in sex ratio was not significant ($p > 0.05$) (Fig. 1). The GSI values in males during August – November were 3.109 to 5.630 after which the values decreased slowly reaching to minimum in July (1.072), while in females the high values during August – December were found to be 3.542 to 6.679. This suggests that male and female gonads mature during August – December, the peak value being in October (Table 1 and Fig. 2).

The highest gonadosomatic index value in males were 5.967 (Stage VI) and the lowest GSI value 1.256 were recorded during stage VII, GSI values increased slowly reaching to maximum in stage VI (5.967) and then suddenly dropped to 1.256 in stage VII, while in females the high value was 6.63 during stage VI and the lowest GSI value were 1.625 and 1.124 stages I and II respectively (Table 2 and Fig. 3).

In this study, seven stages of gonadal development were observed in male and female *P. maculatum*. These stages were:

Ovarian stages

- Stage I-** (immature virgin): Small, transparent, a bit asymmetrical, somewhat cylindrical, ova transparent and devoid of yolk deposition, Occupying less than half the length of the body.
- Stage II-** (Developing virgin): Slightly creamy to pale, a bit asymmetrical, half or a little more than half the length of the body.
- Stage III-** (Developing): Oviduct much reduced, granular appearance, occupying less than 1/3rd of body cavity.
- Stage IV-** (Maturing): Yellow, oviduct further reduced, occupying nearly 2/3rd of body cavities, ova still in the follicle.
- Stage V-** (Mature): Yellow, occupying 2/3rd to 3/4th of the body cavity, blood vessels ramifies over the surface.
- Stage VI-** (Ripe, Running): Occupy almost the whole of the body cavity, deep yellow in colour.
- Stage VII-** (Spent): Ovaries spent, bag like with some residual ova.

Testicular stages

- Stage I-** (Immature): Small, thin, whitish, a bit asymmetrical.
- Stage II-** (Developing): Whitish, elongated, about half of the body cavity.
- Stage III-** (Developing): More elongated, Vas difference widens but reduced.
- Stage IV-** (Maturing): Quite massive, pale whitish, blood capillaries visible.
- Stage V-** (Mature): Pale white, with seldom transverse grooves, viscous fluid oozes out from the cut surface.
- Stage VI-** (Ripe, Running): More elongated, the outer margins slightly wrinkles, milt expression

Table 1. GSI of *P. maculatum* in different months.

Month	No. of males	♂GSI %	No. of females	♀GSI %
Jan.	21	1.877	25	1.950
Feb.	30	1.970	29	2.316
Mar.	28	2.192	21	3.384
Apr.	21	1.854	32	1.597
May	6	1.569	5	1.249
Jun.	8	1.134	20	1.188
Jul.	6	1.072	13	1.401
Aug.	13	3.109	18	4.474
Sep.	3	3.315	17	3.542
Oct.	11	5.630	10	6.679
Nov.	18	4.964	17	5.146
Dec.	8	1.668	28	3.129
Total	173	-	235	-

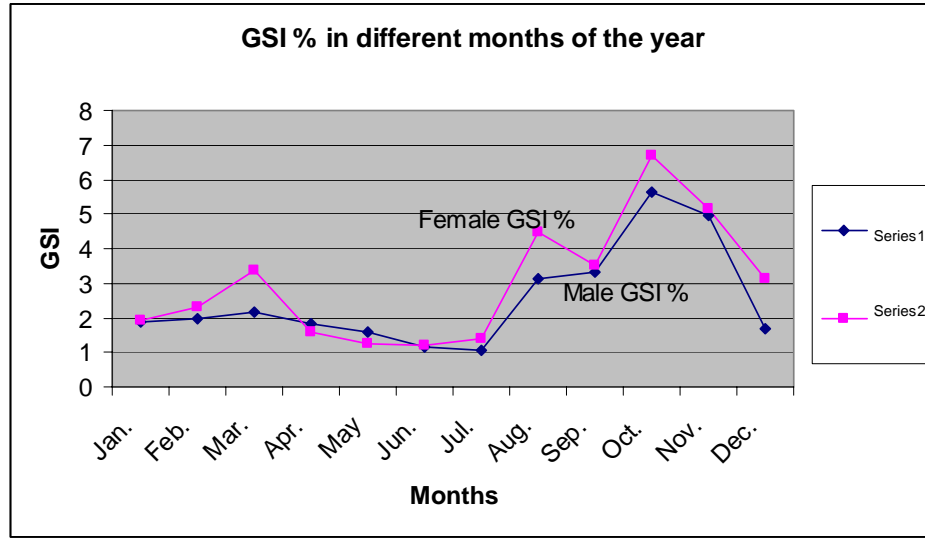


Fig. 2. GSI % of Male and Female in different Months.

Table 2. GSI values of male and female *P. maculatum* in different Gonadal developmental stages.

Male Testicular Stages	No. of males	♂GSI %	Female Ovarian Stages	No. of females	♀GSI %
I	59	2.017	I	39	1.625
II	32	1.483	II	50	1.124
III	26	1.783	III	43	1.943
IV	24	2.852	IV	53	2.819
V	13	4.391	V	18	3.909
VI	15	5.967	VI	23	6.63
VII	4	1.256	VII	9	2.647
Total Male	173		Total Female	235	

by a moderate pressure.

Stage VII- (Spent): Testes shrunken, flaccid, grayish, no milt expression.

DISCUSSION

The females were more than the males. However, the difference in sex ratio was not significantly different ($P > 0.05$) from the expected 1:1 distribution. Adebisi (2013) reported the sex ratio of Sompat Grunt, *Pomadasys jubelini* of Lagos coast, Nigeria, which was in contrast to the result obtained in this study; the males were more than the females. However, the sex ratio of big eye grunt, *Brachydeuterus auritus* of Cape coast Ghana was reported by Asabere-Ameyaw (2001), in which females were more than males. This was similar to the sex ratio of *Pomadasys maculatum* in this study with no significant difference ($P > 0.05$) in the expected 1: 1 distribution. A sex ratio of 1:1.09 (Males to Females) was reported by Al-Ogaily and Hussain (1990) for the trout sweetlip grunt, *Plectorhynchus pictus*. The difference in sex ratio was not

significantly different ($P > 0.05$) from the expected 1:1 distribution, which was similar to the sex ratio of *Pomadasys maculatum* observed in this study. In this study the sex ratio of *Pomadasys maculatum* was in favour of female dominance and there was no significant difference ($P > 0.05$) in the sex ratio. On the West coast of United Arab Emirates, striped piggy grunt, *Pomadasys stridens* had a sex ratio of 1:2.5 (Male to Female) (Al-Ghais, 1995). There were more females than male fish in the population, which was similar to the sex ratio of *Pomadasys maculatum* observed in this study from Karachi coast.

High gonadosomatic indices were recorded for both male and female *Pomadasys maculatum* in this study from August to December, which suggested that the spawning period of *Pomadasys maculatum* was August to December, the peak value being in October. The gonadosomatic index of *Pomadasys commersonnii* ranged from 0.4 – 5.5 % for both sexes and was high in July to November (Al-Nahdi *et al.*, 2010). This was about similar

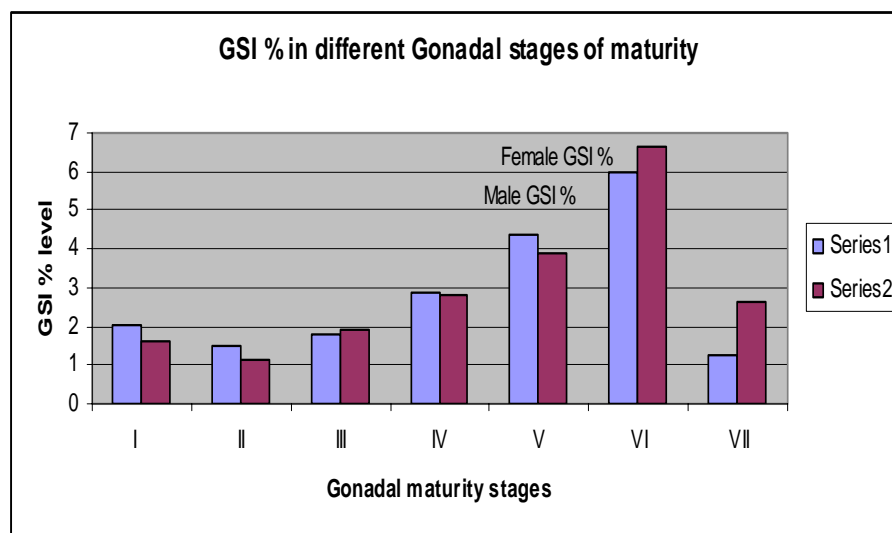


Fig. 3. GSI % of Male and Female in different Gonadal developmental stages.

to the results of the gonadosomatic index of *P. maculatum* observed in this study. Whereas in this study, the gonadosomatic index of *P. maculatum* was higher than that of *Pomadasys commersonnii*. High gonadosomatic indices were recorded for *P. jubelini* in July to September (Adebiyi, 2013). Bastard grunt *Pomadasys incisus* had a gonadosomatic index range of 0.159 - 7.880 and high gonadosomatic indices were observed in July to September (Fehri-Bedoui and Gharbi, 2008). According to Al-Ogaily and Hussain (1990) high GSI was recorded for trout sweet lip grunt, *Plectorhynchus pictus* from March to May. This was in contrast to the results obtained in this study. GSI of silver grunt, *Pomadasys argenteus* was highest in March and an additional small peak was observed in October in the females. High GSI values were observed in February to May in the males. The spawning periods of *Pomadasys argenteus* were February, April and October (Abu-Hakima, 1984). This was in contrast with the results of this study. Spawning occurred throughout the year in bastard grunt, *Pomadasys incisus* (Pajuelo *et al.*, 2003). This was unlike the spawning period of *Pomadasys maculatum* observed in this study which was from August to December.

The stages of gonadal development observed in both male and female *Pomadasys maculatum* in this study were according to Nikolsky (1963) as stage I- immature, stage II- Developing, stage III- Developing, stage IV- Maturing, Stage V- mature, Stage VI- Ripe(Running) and stage VII- spent. In *Pomadasys jubelini* only three stages (Quiescent, Maturing and Mature stages) were observed (Adebiyi, 2013). This was unlike the stages of gonadal development observed in *Pomadasys maculatum* in this study. In *Pomadasys commersonnii* all the stages gonadal developments were observed in both male and female fish except the ripe running stage which was not encountered

(Al-Nahadi *et al.*, 2010). Fehri-Bedoui and Gharbi (2008) observed immature, resting, maturing, mature, spawning and spent stages of gonadal development in bastard grunt, *Pomadasys incisus*. Eight stages of gonadal development were observed in silver grunt, *Pomadasys argenteus* (Abu-Hakima, 1984). This study will be contribute valuable knowledge needed for fisheries management and aquaculture of *Pomadasys maculatum* by increasing the knowledge of reproductive biology of *Pomadasys maculatum*.

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