

The Sex Ratio, Gonadosomatic Index, Stages of Gonadal Development and Fecundity of Sompat Grunt, *Pomadasys jubelini* (Cuvier, 1830)

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Abstract. The sex ratio, gonadosomatic index, stages of gonadal development and fecundity of sompat grunt *Pomadasys jubelini* off Lagos coast, Nigeria were investigated. *P. jubelini* had sex ratio of 1: 0.85 (male to female). The difference in sex ratio was not significantly different ($p > 0.05$) from the expected 1:1 distribution. Gonadosomatic index ranged from 0.07 to 7.29% with mean of $2.25 \pm 0.08\%$. High gonadosomatic indices were recorded in July to September, which suggested the spawning period. Only three stages (quiescent, maturing and mature) of gonadal development were observed in male and female fish. Fecundity ranged from 10,550 to 65,248 eggs with mean of $35,744 \pm 626$ eggs. This indicated that *P. jubelini* is a low fecund fish. Fecundity and body length and fecundity and body weight were positively correlated. Fecundity-length relationship was $\text{Log } F = 2.1766 + 1.8759 \text{ Log } L$ ($r = 0.2896$) and fecundity-weight relationship was $\text{Log } F = 3.7526 + 0.3719 \text{ Log } W$ ($r = 0.1985$). Fecundity was more related to length than weight. *P. jubelini* is a total spawner which spawns during the rainy season in marine and estuarine environments. As a rainy season marine spawner, large total catch can be done during the spawning period and there is abundance of fish seeds, fry and larvae after this period. This makes it cost effective for fish farmers for production of *P. jubelini* by collection of fish seeds and fry from the wild. The results will increase our knowledge of reproductive biology of *P. jubelini* which is relevant for fisheries and aquaculture management as well as breeding programmes.

Key words: Fecundity, gonadal development, gonadosomatic index, Lagos coast, *Pomadasys jubelini*, reproductive biology, sompat grunt.

INTRODUCTION

Commercial quantities of large numbers of finfish and shellfish are present in the Nigerian coastal waters (Kusemiju *et al.*, 1994). The grunts are among the fish species of great economic importance in the Nigerian coastal waters, off Lagos coast. It is economically important for trawl fishery in Nigeria. It belongs to the family Haemulidae and can be found at depths between 15 and 50m in soft, sandy and muddy bottoms of the coastal waters in the Gulf of Guinea (Mensah and Quatey, 2002).

An important aspect of reproductive biology is fecundity which gives information on the number of eggs in the ovary before the next spawning season (Bagenal, 1978). Studies on fecundity of fish species are pertinent and useful for systematics in racial studies related to total population estimation and productivity.

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. The addition of sex ratio to estimates of reproductive potential can produce some differences in understanding the status of fish stock in relation to a selected point of biological reference (Morgan, 2008).

Information on the reproductive biology of some economically important fish species which include West African Ilisha *Ilisha africana*, the

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croakers *Pseudotolithus typus* and *Pseudotolithus senegalensis* off the Lagos coast Nigeria has been reported by some authors (Marcus and Kusemiju, 1984; Anyanwu, 1990). There is paucity of information on the study of reproductive biology of the grunts in the Lagos coast. The reproductive biology of *P. jubelini* has not been widely reported in literature. The aim of this study was to investigate the sex ratio, gonadosomatic index, stages of gonadal development and fecundity which are some aspects of the reproductive biology of *P. jubelini* off the Lagos coast, Nigeria. It is hoped that the information obtained from this study will contribute to our knowledge of the reproductive biology of *P. jubelini* and will be useful for fisheries and aquaculture production.

MATERIALS AND METHODS

Study area

The Lagos coast was the study area for this research. The Nigerian coastline is between longitude 02° 53¹ to 08° 14¹E and latitude 06° 21¹ to 03° 55¹N, covering a distance of 85km and lies in the Gulf of Guinea. Lagos coast is a narrow coastal shelf and lies between 14, 816km and 27,780km with a total area of 41,000km². It is a marine environment and salinity is a major limiting factor to the growth of some organisms in the Lagos coast (FAO, 1969; Nwankwo and Onyema, 2003).

Collection of specimens and sampling

Specimens of *P. jubelini* were purchased from fish mongers at the landing centre of trawlers fishing off the Lagos coast, at the jetty in Ijora Olopa, Lagos, Nigeria. The specimens were collected from January to September 2005. The fish was identified by using the FAO fish identification manual (FAO, 1981). Simple random sampling technique was used (Cochran, 2007). Fifty samples were randomly selected each month, making a total of 450 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 according to Strum (1978) as follows:

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

Stages of gonadal development

Gonadal stages were examined macroscopically and classified according to Nikolsky (1963) as follows: Stage I, immature; Stage II, quiescent; Stage III, maturing; Stage IV, mature; Stage V, running; Stage VI, spent.

The number of males and females in the different stages of gonadal development were counted and recorded.

Fecundity estimation

Fecundity which is the number of ripe eggs in the female prior to the next spawning season was estimated according to Bagenal (1978). Only ovarian developmental stages III and IV were used for fecundity estimation. Fecundity was estimated through sub-sampling by gravimetric method. The gonad weight of the fish was measured before preservation in Gilson fluid. Preserved gonads, were later washed with water before counting.

The eggs were placed in a Petri dish and a subsample of 1g of eggs was measured. Then the number of eggs in the subsample was counted. Five subsamples were taken and the mean value of eggs was used to calculate the total number of eggs in the gonads. Thirty mature ovaries were used for

fecundity study of *P. jubelini*.

Regression analysis was carried out relating fecundity to size of fish. The relationship between fecundity and size of fish was determined by using the formula

$$F = aX^b$$

Where F = Fecundity, X = Standard length of fish (cm) or weight of fish (g), a= Regression constant and b= Regression coefficient.

The relationship was transformed into a straight line using logarithm, as

$$\text{Log } Y = a + b \text{ Log } X.$$

Statistical analyses

Data were analysed using statistical analysis software (SAS 9.2) and Microsoft Excel 2003 software. Data were expressed as mean \pm standard error of mean. The sex ratio was tested for any deviation from the expected 1:1 ratio by using chi-square analysis. Fecundity-length and fecundity-weight relationships were analysed by using regression analysis. The relationship of fecundity with body length and body weight of fish was also analysed by using Pearson's correlation analysis. Level of significance was selected as $p < 0.05$.

RESULTS

A total of 243 males and 207 females were observed out of 450 samples examined. The sex ratio was 1: 0.85 (male to female). The difference in sex ratio was not significant ($p > 0.05$).

The gonadosomatic index of *P. jubelini* ranged from 0.07% (in a fish of standard length 18.9cm and body weight 133.7g) to 7.29% (in a fish of standard length 12.5cm and body weight 34.3g). The mean gonadosomatic index was 2.25%. High gonadosomatic indices were observed in July, August and September (Table I).

In this study, only three stages of gonadal development were observed in male and female *P. jubelini*. These were stage II- quiescent, stage III- maturing and stage IV- mature. Table II shows the macroscopic features of the stages of testes and ovarian development of *P. jubelini*.

Table I.- Gonadosomatic indices of *Pomadasys jubelini*.

Months	Gonadosomatic index (%)
January	0.07
February	1.50
March	0.40
April	0.15
May	0.20
June	1.00
July	4.64
August	5.00
September	7.29

Table II.- Stages of gonadal developments of *Pomadasys jubelini*.

Stages of gonadal development	Macroscopic characteristics	
	Testes	Ovaries
I	Not encountered	Not encountered
II	Testes were tiny, threadlike and translucent.	Ovaries were tiny, translucent and creamy white in colour. Oocytes were not visible.
III	Testes were large, opaque and creamy white in colour.	Ovaries were large, opaque and light yellow in colour. Blood vessels were seen on the surface
IV	Testes were enlarged and whitish in colour. Milt could be released if the testes were under pressure.	Ovaries were enlarged, yellowish in colour and the eggs were clearly visible.
V	Not encountered	Not encountered
VI	Not encountered	Not encountered

The number of eggs in each mature ovary ranged from 10,550 eggs (in a fish of standard length 16.1cm and body weight 84.9g) to 65,248 eggs (in a fish of standard length 17.1cm and body weight 80.2g). A mean fecundity of $35,744 \pm 626$ eggs per female was obtained. Fecundity was positively correlated with length and body weight. The correlation coefficient r was 0.2896 and 0.1985 for fecundity-length and fecundity-weight relationship, respectively. The fecundity – length relationship is illustrated in Figure 1. The regression equation was $\text{Log } F = 2.1766 + 1.8759 \text{ Log } L$ ($r = 0.2896$).

The fecundity - weight relationship is illustrated in Figure 2. The regression equation was $\text{Log F} = 3.7526 + 0.3719 \text{ Log W}$ ($r = 0.1985$).

DISCUSSION

The males were more than the females. However, the difference in sex ratio was not significantly different

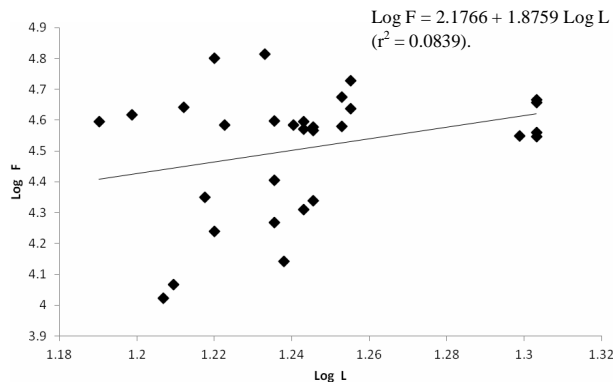


Fig. 1. Fecundity-length relationship of *Pomadasys jubelini* off Lagos coast.

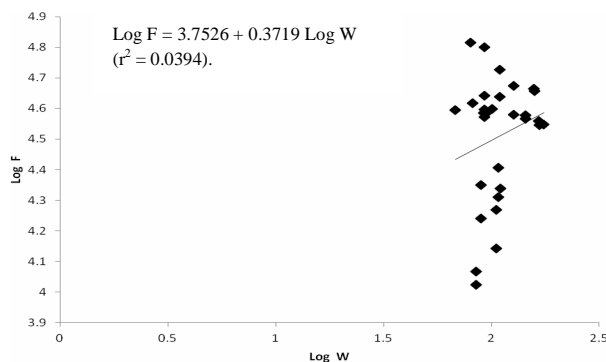


Fig. 2. Fecundity-weight relationship of *Pomadasys jubelini* off Lagos coast.

($p > 0.05$) from the expected 1:1 distribution. Asabere-Ameyaw (2001) reported the sex ratio of big eye grunt *Brachydeuterus auritus* off Cape coast Ghana, which was in contrast to the result obtained in this study, the females were more than the males. The sex ratio of small spotted grunt *Pomadasys commersonnii* indicated homogenous distribution of males and females in the population (Al-Nahdi *et al.*, 2010). This was similar to the sex ratio of

sompat grunt *P. jubelini* in this study with no significant difference ($p > 0.05$) in the expected 1: 1 distribution. Bastard grunt *Pomadasys incisus* had a sex ratio that did not differ significantly ($p > 0.05$) from 1:1 distribution, which was similar to the sex ratio of *P. jubelini* observed in this study (Fehri-Bedoui and Gharbi, 2008). A sex ratio of 1: 1.09 (male to female) was reported by Al-Ogaily and Hussain (1990) for the trout sweetlip grunt *Plectorhynchus pictus*. The difference in sex ratio was not significantly different ($p > 0.05$). However, in classes 215.5cm, 265.5cm and 315.5cm, significant differences ($p < 0.05$) were observed in the sex ratio. In this study sex ratio of *P. jubelini* was in favour of male dominance and there was no significant difference ($p > 0.05$) in the sex ratio. In 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 female than male fish in the population. This was in contrast to the results of sex ratio of *P. jubelini* in Lagos coast, Nigeria. According to Pajuelo *et al.* (2003), the sex ratio of bastard grunt *Pomadasys incisus* in Canarian archipelago was not significantly different ($p > 0.05$) from the expected 1:1 distribution. This was similar to the sex ratio of *P. jubelini* in this study which was not significantly different ($p > 0.05$) from 1: 1 distribution.

High gonadosomatic indices were recorded for both male and female *P. jubelini* in this study in July, August and September, which suggested that the spawning period of *P. jubelini* was July to September and this coincides with the wet season. 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). Whereas in this study, the gonadosomatic index of *P. jubelini* was higher than that of *Pomadasys commersonnii*. High gonadosomatic indices were also recorded for *P. jubelini* in July to September. 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). This was similar to the results of gonadosomatic index of *P. jubelini* observed in this study. According to Al-Ogaily and Hussain (1990) high gonadosomatic

indices were recorded for trout sweetlip grunt *Plectorhynchus pictus* in March, April and May. This was in contrast to the results obtained in this study for gonadosomatic index of *P. jubelini* which were high in July, August and September. Gonadosomatic index of silver grunt *Pomadasys argenteus* was highest in March and an additional small peak was observed in October in the females. High gonadosomatic indices 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 results of this study. High gonadosomatic indices for male and female *P. jubelini* were observed in July - September, which indicated the spawning period. Spawning occurred throughout the year in bastard grunt *Pomadasys incisus* (Pajuelo *et al.*, 2003). This was unlike the spawning period of *P. jubelini* observed in this study which was July to September.

The stages of gonadal development observed in both male and female *P. jubelini* in this study were quiescent, maturing and mature stages. Other stages of gonadal development were not encountered in the samples used for this study. This indicated that the samples used were quiescent, maturing and matured fish. Since no immature gonads were encountered in the samples examined, it indicated that immature *P. jubelini* will be smaller than 13.9cm (total length) and weigh less than 26.8g. In *Pomadasys commersonnii* all the stages of gonadal developments were observed in both male and female fish except the ripe running stage which was not encountered (Al-Nahdi *et al.*, 2010). Fehri-Bedoui and Gharbi (2008) observed immature, resting, maturation, mature and spawning and spent stages of gonadal development in bastard grunt *Pomadasys incisus*. This was unlike the stages of gonadal development observed in *P. jubelini* in this study. Only three stages of gonadal development (quiescent, maturing and mature stages) were encountered in both male and female fish. Eight stages of gonadal development were observed in silver grunt *Pomadasys argenteus*. These were immature, resting, developing, mature, gravid, spawning, spent, and recovering spent stages (Abu-Hakima, 1984). In this study, only three stages of gonadal development (quiescent, maturing and

mature stages) were observed in *P. jubelini*

Fecundity studies revealed that *P. jubelini* is a low-fecund fish, unlike high-fecund fish with millions of eggs. Fecundity and body length and fecundity and body weight were positively correlated. However, the relationship of fecundity and size of *P. jubelini* revealed that fecundity was more related to body length than to body weight. Fecundity of *Pomadasys commersonnii* was higher than that of *P. jubelini* in this study and it ranged from 214,510 to 1,421, 520 eggs (Al-Nahdi *et al.*, 2010). Al-Ogaily and Hussain (1990) reported a fecundity range of 495, 450 – 855, 067 eggs in 3 - 6 year old trout sweetlip grunt *Plectorhynchus pictus*. This appeared to be higher compared to the fecundity results obtained for *P. jubelini* in this study without taking age of *P. jubelini* into consideration. The value of fecundity of silver grunt *Pomadasys argenteus* ranged from 625, 848 to 2, 424, 846 eggs in fish with standard length 23.0-59.5 cm (Abu-Hakima, 1984). Whereas, fecundity of *P. jubelini* in this study was 10, 550 – 65, 248 eggs in fish with total length of 13.9-26.6 cm. Higher fecundity recorded for *Pomadasys argenteus* than *P. jubelini* in this study could be as a result of size of fish. Bigger fish were used by Abu-Hakima (1984), whereas in this study smaller fish were used for fecundity study.

This study will contribute valuable knowledge needed for fisheries management and aquaculture of *P. jubelini* by increasing the knowledge of reproductive biology of *P. jubelini*.

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