The Sex Ratio, Gonadosomatic index, Stages of Gonadal Development and Fecundity of the Grunt, *Pomadasys jubelini* (Cuvier, 1830) in the New Calabar-Bonny River

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Abstract. The sex ratio, gonadosomatic index, stages of gonadal development and fecundity of the grunt, *Pomadasys jubelini* in the new Calabar-bonny River were investigated. *P. jubelini* had a sex ratio of 1: 2.1 (male to female). Gonadosomatic index ranged from 0.33 to 7.29% with a mean of 2.89±0.08%. High gonadosomatic indices were recorded from September to October, which suggested the spawning period of the fish. Two stages, maturing and mature were observed for male fish while quiescent, maturing and mature were observed for female fish. Fecundity ranged from 9,085 to 37,926 eggs with a mean of 25,852±432 eggs. This is an indication that *P. jubelini* has low fecundity. Fecundity - body weight and fecundity body length were positively correlated. Fecundity – weight relationship was Log F=0.1243+2.74Log W (r = 0.950). Fecundity – length relationship was Log F = 0.0247 + Log 1.779 Log L (r = 0.114). Fecundity was more related to weight than length. *P. jubelini* spawns during the rainy season in marine and estuarine environments. During this period large number of fingerlings and juveniles are in abundance. The results of this study will assist in increasing the knowledge of the reproductive biology of *P. jubelini* which is relevant in aquaculture management adequate supply as well as breeding.

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Key words: Fecundity, gonadal development, gonadosomatic index, New Calabar-Bonny River, *Pomadasys jubelini*

Introduction:

Nigeria is blessed with abundant water bodies with diverse fish species. These fish species include both fish and shell fish which are obtained in large quantities. The grunters are among these fish species obtained in the marine and coastal waters, It is economically important for trawl fishery in Nigeria. *Pomadasys jubelini* is important in the riparian community of the Niger delta principally because of its abundance, availability (all year round) affordability, tasteful flesh, economic value and its nutritional value. It is mainly utilized as food (human consumption). It is known for its tasty flesh (palatability) and commercial importance. It can be cultured in ponds in tidal areas (Idodo-Umeh, 2003). It belong to the family Haemulidae and can be found in depths of 15 and 50m in soft, sandy and muddy bottoms of the West African Rivers.

Fecundity is the total number of ripe eggs prior to spawning in the female fish (Bagenal and Braun, 1978). Reproductive strategies depend on the abiotic environment, food availability, pressure of predators and the habitat of parental fish (Wootton, 1990). The study of fecundity is useful in the estimation of population and productivity.

Gonadosomatic Index (GSI) is the measure of the relative weight of the gonad with respect to total or somatic weight (King 1996). Total spawners are said to produce a large number of small eggs which are deposited over short period of time while multiple spawners produce fewer and larger eggs and with a longer breeding period which may last throughout the year, where only a proportion of the eggs ripe in the gonad at one spawning (Lowe-McConnell, 1987), though total spawners are said to have a higher GSI than multiple spawners (Wootton,

1990). The percentage of body weight of fish that is used for egg production is determined by the gonadosomatic index.

The studies on sex ratio provides information on the proportion of male to female fish in a population, it also indicates the dominance of sex in s given population and the basic information necessary for fish reproduction and stock size assessment. (Vicentini and Araujo, 2003). Research has been carried out on the reproductive biology of some economically important fish species which include Tilapia, and Claridae, Momyridae, (Akinola 1979, Eyo and Mgbenka. 1992, Ikom, 1996, Eyo and Olatunde. 2001). The studies of the reproductive biology of different species of fish form the basis for developing strategies and formulating policies for effective management of the fishery resources. There is paucity in the information on the study of reproductive biology of the grunters in the Niger Delta. The available information on *Pomadasys jubelini* is mainly at taxonomic levels thus making it limited. The aim of this study is to investigate the sex ratio, gonadosomatic index, stages of gonadal development and fecundity of *Pomadasys jubelini* in the New Calabar-Bonny River, Rivers State, Nigeria. The information obtained from this study could add to knowledge of the reproductive biology of *Pomadasys jubelini* more so add to the existing cultureable species in Nigeria and propagated nationally.

Materials and methods

Study area

The New Calabar-Bonny River near Porthacourt metropolis, Rivers State, Nigeria was the research study area. It is located between latitude $4^{o}36'$ and $4^{o}55'$N and longitude $6^{o}45'$ and $7^{o}72'$E. Three stations were selected along the river for the purpose of this study based on the salinity of the river as reported by Nedeco, (1961). The stations are located at Choba (Oligohaline), Iwofe (Mesohaline) and Abonnema wharf (Polyhaline). Rain fall is heavy in the months of May- October and this reduces the salinity of the rivers. Other fish species found in the river include the Mullets (Mugilidae), silver cat fish (*Chrysichthys* nigrodigitatus), sardines (*Sardinella maderensis*), *Synodontis spp*, the red snapper (*Lutjanus agennes*), the barracuda (*Sphyraena afra*), *Tilapia spp*, the sword fish, the bagrid cat fish (*Auchenoglanis spp*).

Collection and sampling of specimens

Fish were collected from catch landings of fishermen using hooks, gill net, traps and calabashes at the three stations. *Pomadasys jubelini* were collected monthly, from June 2011 to May 2013. The fish were transported in an insulated box containing ice chips to the fisheries laboratory of Department of Fisheries and Aquatic environment, Rivers State University of Science and Technology, Porthacourt. Fish were identified using pictures, keys by F.A.0. (1981).

Morphological parameters

Measurement was taken for each fish, the length (standard length (cm) and total length (cm)) girth length (cm) and weight (g) of the fish was determined using a, measuring tape, a graduated ruler and an electronic scale QE – 400 respectively. These parameters were recorded on a data collection sheet.

Determination of Sex and Gonads Classification:

The abdominal region of the fish was dissected to determine the sex of the fish. Sex of fish was determined by visual and microscopic examination of the gonads. The proportion of the two sexes relative to one another was used to calculate the sex ratio.

The gonadosomatic index (GSI) was calculated for each gonad (Wootton, 1990) from the equation

$$GSI = \frac{\text{Gonad weight (g)} \times 100}{\text{Fish weight (g)}}$$

The maturity stages of the ovaries were classified according to Nikolsky (1963)

Stage 1, Immature; Stage 11, quiescent; Stage 111, maturing: Stage 1V, mature: Stage V running; Stage V1, 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 fish before the next spawning period was estimated by the ``sub-sampling dry gravimetric method'' modified after Simpson (1959). Ovaries were preserved in Gilson's fluid for over ninety (90) days after which they will be removed. The eggs were then washed gently using distilled water until they were disentangled from the ovarian tissues. The eggs were then poured into a filter paper in a funnel. When the water had dried off the paper and eggs were spread on blotting paper to remove excess moisture. Clamped eggs were gently separated and air-dried for 24-30 hours at room temperature. Fecundity estimation was obtained by firstly, weighing all the eggs of each fish. Then three samples of 200 eggs from each fish was randomly selected and weighed. Total weight of eggs was divided by the mean weight of the sub-samples and multiplied by 200 to give the fecundity estimate of the fish. The relationship between fish length/weight was described by the equation

$$F = aX^b$$

Where F = fecundity, x= body length (cm) or body weight (g), b = the slope, a= intercept (Ekanem, 2000). Through a logarithmic transformation the equation becomes:

$$\log F = \text{Log } a + b \log X$$

Results

A total of 93 were males and 194 females were examined with a ratio of 1: 2.1 (male to female). The gonadosomatic index of *P. jubelini* ranged from 0.33% (in a fish of standard length 38.90cm and weight 621.40g) to 7.29% in a fish of standard length 18.90cm and weight 133.70g. The mean gonadosomatic index was 2.89%. The gonad stages were observed in the months of September to October. (Table 1).

In this study only three stages of gonad development were observed in male and female *P. jubelini.* These were stage II- quiescent, stage III– maturing and stage IV- mature (Table 2). The estimated fecundity ranged from 9,085 eggs (in a fish with length 50.60cm and weight 1736.10g) to 37,926 eggs (in a fish with length 50.20 cm and weight 2125.10g) with a mean of 25,852 ± 644 eggs. The fecundity - weight relationship is represented by the equation Log F = 0.1243+2.74 Log W (r = 0.950). Fecundity – length relationship was Log F = 0.0247 + Log 1.779 Log L (r = 0.114).

Table 1. Gonadosomatic index (GSI) of *Pomadasys jubelini*

	Total length (cm)	Weight (g)	GSI (%)	No. of eggs
	40.30	1860.00	3.25	19,720
	43.10	2001.00	4.38	34,164
	50.60	1736.10	1.33	9,085
	50.20	2125.10	4.25	37,926
	49.80	1927.00	4.41	28,363
	18.90	133.70	7.29	
	12.50	34.30	2.25	
	16.10	84.90	2.12	
	17.10	80.20	1.62	
	30.10	520.80	0.50	
	38.90	621.40	0.33	
Mean	46.80	1929.84	2.89	25,852

Table 2. Stages of gonad developments of *Pomadasys jubelini*

Stages of gonad development		macroscopic characters	
		Testis	Ovaries
I	Immature	Not encountered	Not encountered
II	Resting/Quiescent	Not encountered	Ovaries were tiny, translucent and creamy in colour, oocytes were not visible
III	Maturing	Testes were large, opaque and creamy	Ovaries were large, opaque and light yellow in colour in colour. Blood vessels were seen on the surface
IV	Mature	Testis were enlarged and whitish in colour. Milt could be released if the testis were under pressure	Ovaries were enlarged, Yellowish in colour and the eggs were clearly visible
V	Spawning	Not encountered	Not encountered
VI	Spent	Not encountered	Not encountered

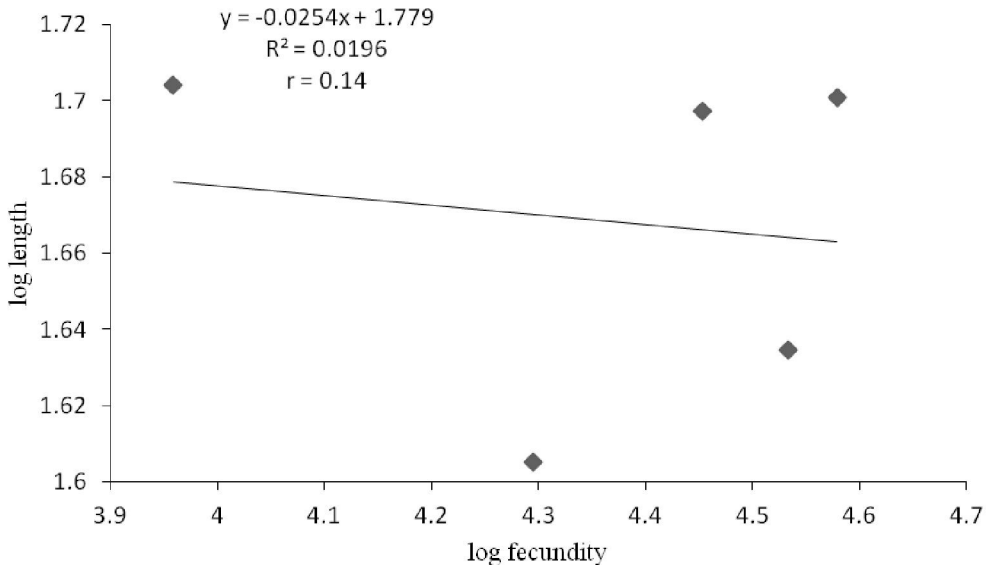

Figure 1: Relationship between total length (cm) and fecundity of *Pomadasys jubelini*

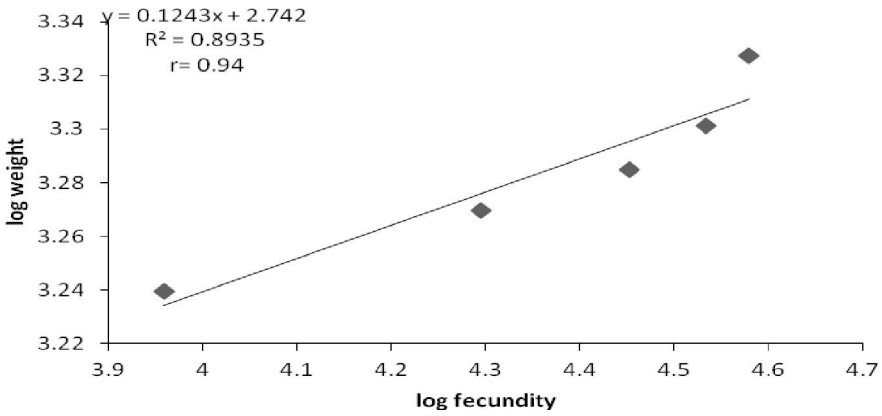

Figure 2: Relationship between total weight (g) and fecundity of *Pomadasys jubelini*

In this study, there were more females than males. The male to female ratio was significantly different (P<0.05) from the expected ratio of 1:1. In the west coast of the United Arab Emirates, stripped piggy grunt *Pomadasys stridens* had a sex ratio of 1: 2.5 (male to female) Al-Ghais, 1995). More female were observed in the population which is similar to the findings of this study. Asabere – Ameyaw (2001) reported the sex ratio of the big eye grunt *Bachydeuterus auratus* off Cape Coast Ghana, to be in favor of the females. Adebiyi (2013), observed the dominance of male to females in the study of *P. jubelini* in the Lagos coast. However, the difference in sex ratio was not significantly different. This was in contrast to the sex ratio of *P. jubelini* in the New Calabar – Bonny River.

High gonadosomatic index recorded for both male and female in the months of September and October suggest the possible spawning period of *P. jubelini* which coincided with the rainy season. High gonadosomatic indices were also observed from other studies; the Bastard grunt *P. incisus* had a GSI range of 0.159 to 7.88 from July to September, the GSI of *P. commersonnii* ranged from 0.4 – 5.5% for both sexes, from July to November, and the GSI of *P. jubelini* ranged from 0.07 to 7.30 from July to September (Fehri-Bedoui and Gharbi, 2008, Al Nahdi *et al*., 2010 and Adebiyi 2013). According to Al-Ogaily and Hussain (1990) high gonadosomatic index was recorded for trout sweet lip grunt *Plectorhynchus pictus* in March, April and May. The spawning period of *Pomadasys argenteus* were February, April and October (Abu-Hakima, 1984). These are in contrast with the findings of this study for GSI index of *P. jubelini* in September and October. Furthermore, spawning was reported to occur in *Pomadasys incisus* (Pajuelo et al., 2003) throughout the year. This is also in contrast with the finding of this study on *Pomadasys jubelini.*

The stages of gonad development observed in this study were maturing and mature for males and quiescent, maturing and mature for females. Other stages of gonadal development were not encountered. The gonad stages encountered in this study of *P. jubelini* in the New Calabar-Bonny River is similar to the findings of (Adebiyi 2013) in the Lagos coast were the stages of gonad development encountered were quiescent, maturing and mature for both male and female *P. jubelini* though in this study the quiescent stage in males was not encountered. Eight stages of gonadal development were found in the silver grunt *Pomadasys argenteus*. These were the immature, resting, developing, mature, gravid, spawning,

spent, developing, mature, gravid, spawning, spent and recovering stages (Abu-Hakima, 1984). Fehri-Bedoui and Gharbi (2008) observed immature, resting, maturing, mature, spawning and spent stages of gonad development in bastard grunt *P. incisus*. In *P. commersonnii* all the developmental stages were observed for both male and female fish except the ripe running stage (Al Nahdi *et al*., 2010).

The fecundity of *P. jubelini* in this study was 9,085 to 37,926 eggs with a mean of 25,852±432 eggs. This is similar to the range observed by Adebiyi (2013) on the fecundity of *P. jubelini* in the Lagos coast. The value of fecundity observed in the silver grunt, *Pomadasys argenteus* ranged from 625,848 to 2,424,846 eggs (Abu-Hakima, 1984). This is very high when compared to the results of fecundity obtained in this study. The fecundity range of 495,450 – 855,067 eggs in trout sweet lip grunt *Plectorhynchus pictus* (Al-Ogaily and Hussain, 1990) was high when compare to the fecundity results obtained for *P. jubelini* in this study. 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). With the aforementioned, fecundity studies have revealed that *P. jubelini* is a low fecund fish when compared to other high fecund fish with millions of eggs. Fecundity – body length and fecundity – body weight were positively correlated. However in this study the relationship between fecundity and size of fish revealed that fecundity was more related to body weight than body length. This was though in contrast to the results of Adebiyi (2013) were Fecundity was more related to body length than body weight of *P. jubelini* in the Lagos coast.

High gonadosomatic indices recorded for both male and female in the months of September and October suggest the possible spawning period of *P. jubelini* which coincided with the rainy season. *P. jubelini* may be considered as a low fecund fish when compared to other species of fish with millions of eggs. Weight of fish was more important to fecundity than its length.

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