FECUNDITY AND GONAD DEVELOPMENT OF *ATYA GABONENSIS* FROM LOWER RIVER BENUE IN NORTHERN NIGERIA.

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ABSTRACT

The study investigated the fecundity and egg development of Atya gabonensis from Lower River Benue in Nigeria from May to August 2006. A total of 200 berried females were collected, weighed and the eggs striped and weighed using a top loading electronic balance. The total length of the prawn was also measured using a ruler to the nearest millimeter. The eggs were preserved in Gilson's fluid. The total number of eggs was estimated by the gravimetric method. The egg size was measured using the calibrated eye piece of a binocular microscope. The eggs were classified as immature, developing and ripe with two 'eye' spots called the larva stage. The highest number of eggs observed was 27,700eggs, while the lowest was 950 (mean = 7,227eggs). The egg diameter ranged from 0.02 2mm (0.63 ± 0.10mm). The relationship between fecundity and weight was F= 3.799 + 8.2400W (r = 0.7887), while the one between fecundity and length was F = 5.6067 + 1.9386L (r = 0.7504). There was positive correlation between length, weight and fecundity in A. gabonensis from Lower River Benue. The appearance of eggs in May to August coincides with onset of rain therefore rain is a triggering factor in egg production. A. gabonensis is a serial spawner as the berried females were found to carry eggs in various stages of development.

INTRODUCTION.

Atya gabonensis (Irvine) is a freshwater prawn which was first reported in Gabon (Powell, 1982). It inhabits clear waters, burrows on root masses, crevices and rocky bottoms (Powell, 1982). It has also been found in Ghanian Rivers, (Tay *et al,* 2008). .According to Powell (1982), *A. gabonensis* has a uniformly dark- greyish colour and has the body covered with cuticle, which forms an exoskeleton. The body is segmented and the thorax and head are fused to form the cephalothorax. It has a short rostrum, lacks dorsal teeth but has a pair of lateral teeth. The first and second legs (chelipeds) are reduced and specialized appearing as mouth parts. The modified chelae bear brushes of setae along the whole length where the eggs are attached

Reed (1967) reported the occurrence of *A. gabonensis* in Nigerian main rivers and tributaries. The genus *Atya* has other species found in the West Indies called *Atya lanipes*, *A. scabra* and *A. innnocus* (Lee and Wickins, 1995). *Atya gabonensis* which is the largest of the groups in West Africa can attain a weight of 50g and a length of 14cm (Powell, 1982). It has been found to occur in great abundance in lower River Benue (Obande, 2006). The exploitation of this prawn is not on a large scale possibly due to non- availability of information on stock abundance and lack of appropriate gear. Bagenal (1978); Wootton (1979), Fagade and Adebisi (1979) observed that fecundity (that is, the number of eggs produced in the ripe female) is an aspect of natural history, population dynamics, racial studies, production and racial recruitment, survival, stock evaluation and aquaculture based induced spawning and egg incubation. Reproduction potential therefore, can be determined through measurement of fecundity. Penn (1980) reported that multiple

spawning by adults and rapid increase in size after recruitment led to high egg production. Sagua (1980) gave an account of fecundity of *Penaeus hastatus* in Lagos area while Anetekhai (1990) reported on sexual dimorphism, fecundity and reproduction characteristics of *M. vollenhovenii* from Asejere Lake, Ibadan. He identified the distinguishing features of males and females of *M. vollenhovenii* to be in the ventral view of the male's first abdominal segment that has a lump which can be felt when touched with a finger. There is no such lump in the female's abdominal region, which are more prominent during the breeding season. The pleopods of the female have numerous threads - like setae for attachment of eggs during the breeding season. Anetekhai (1990) reported that 83% of females carried eggs in June which were in the early stages of development. The early eggs were orange in colour. In July, the peak of spawning, 75% of females carried brown eggs which were in advanced stage of development. In August, the proportion reduced to 43%; there after egg carrying females disappeared. Furthermore, he reported a fecundity of 173,940eggs for *M. vollenhovenii* and that fecundity increased with increased body weights. Bauer (2004) also made similar observation in *Sicyonia dorsalis* in America.

MATERIALS AND METHODS.

Fecundity.

Berried females of *A. gabonensis* were collected between May and August 2005 and 2006. The berried females were weighed; the eggs stripped and weighed using a top loading electronic weighting balance (Model 59174). The eggs were preserved in Gilson's fluid made up of 60% alcohol (100ml), Water (850ml), 80% Nitric acid (18ml), Glacial acetic acid (15ml) and Mercuric chloride (20ml).

This fixative helped to remove ovarian tissues from the eggs and to harden them for easy counting. The eggs were then washed in distilled water and cleaned by pouring the eggs into a filter paper in the funnel to drain and dry leaving the eggs separated. The total number of eggs was estimated by the gravimetric method (Bagenal, 1978).

The values of length and weight measurements of the berried females were used to estimate the relationships between fecundity, weight and length of the prawn. The relationships were expressed as:

F = a + b Lt or Wt (Bagenal, 1978)

Where F = fecundity estimate

a = regression constant

b. = regression co-efficient.

Lt or wt = total length (cm) or weight (g) of prawn.

Egg diameter

The diameter of 10 eggs from a female prawn was measured to the nearest millimetre using a calibrated eye piece of a binocular microscope. The mean of the diameter of 10 eggs from a female was used as the diameter of individual egg per female. Using the egg sizes, the eggs were classified as immature, developing and ripe (Anetekhai, 1990). The immature eggs were orange in colour, the developing eggs were grayish in colour and the ripe eggs were dark in colour with two eye spots referred to as 'eye' larval eggs (Xavier, 1997).

Egg Histology

The three groups of eggs, the immature, developing and ripe eggs were preserved in 10% bouin fluid for 24hrs. These eggs were thereafter fixed in alcohol-acetic formalin

mixture for 48 hours. The eggs were dehydrated in graded ethanol series (70%, 90% and absolute alcohol), cleared in xylene, infiltrated and embedded in paraffin wax with melting point of 56°C. The eggs were sectioned using a Microtome at 10m and placed on glass histological slides and stained in Erich haematoxylin as described by Maximow and Bloom (1972).

RESULTS.

Fecundity.

Two hundred (200) berried female specimens were collected and examined for the fecundity study of *A. gabonensis* between May and August. The highest number of eggs obtained for a female weighting 34.0g and length of 10.50cm was 27,700 eggs, while the lowest number of 950 eggs was obtained from a female of 15.20g and 3.2cm length. The mean egg number obtained was 7,227 eggs per female.

Egg Diameter.

A total of 1000 ripe eggs or oocyte diameters were measured. The egg diameter ranged from 0.02 2.00mm (0.63± 0.10mm) for the species of total length of 3.20 to 10.50cm.

Total length, body weight fecundity relationships in *A. Gabonensis.*

The relationship between body weight and fecundity in the species is shown in Figure.1. This shows the variation in number of eggs per each individual of varying weight. The relationship between fecundity and weight was:

$$F = 3.7998 + 8.2400W$$

$$(N = 200, r = 0.7887).$$

Where F = fecundity and W = weight (g).

There was a positive correlation between body weight and fecundity in *A. gabonensis.* The total length /fecundity relationship in *A. gabonensis* is shown in Figure 2.

Fecundity = 5.6067 + 1.9386L.

$$(n = 200, r = 0.7504)$$

The correlation coefficient showed a positive correlation between total length and fecundity in *A. gabonensis*. The r = value of 0.7887 for total body weight - fecundity relationship was higher than r value of 0.7504 for total length fecundity relationship in *A. gabonensis* which showed that body weight in the species was more correlated to fecundity than length.

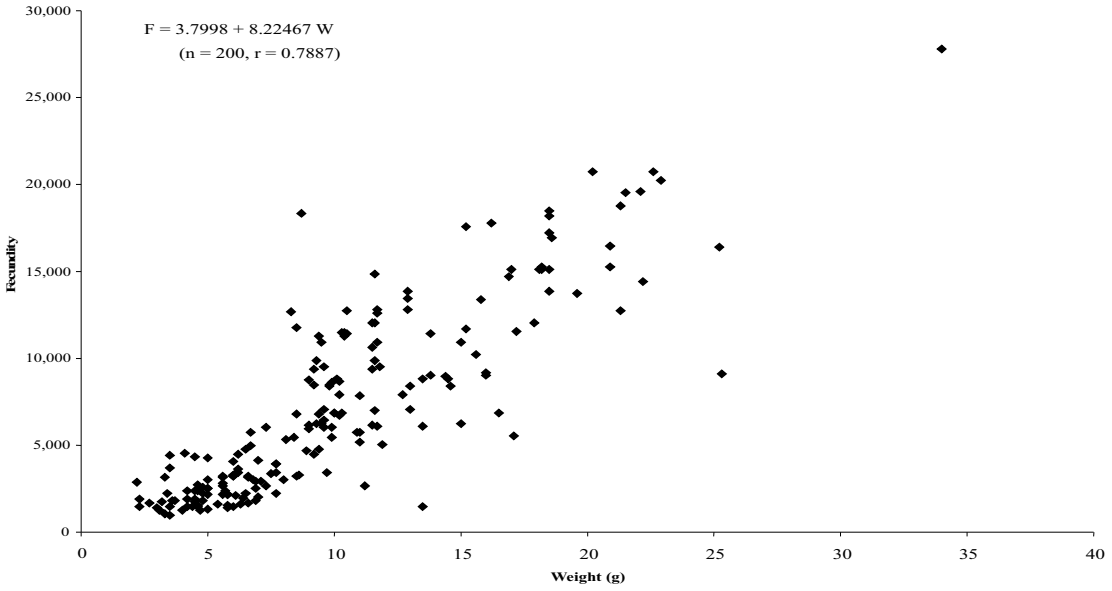

Fig 1: Total weight fecundity relationship of *A. gabonensis* from Lower River Benue

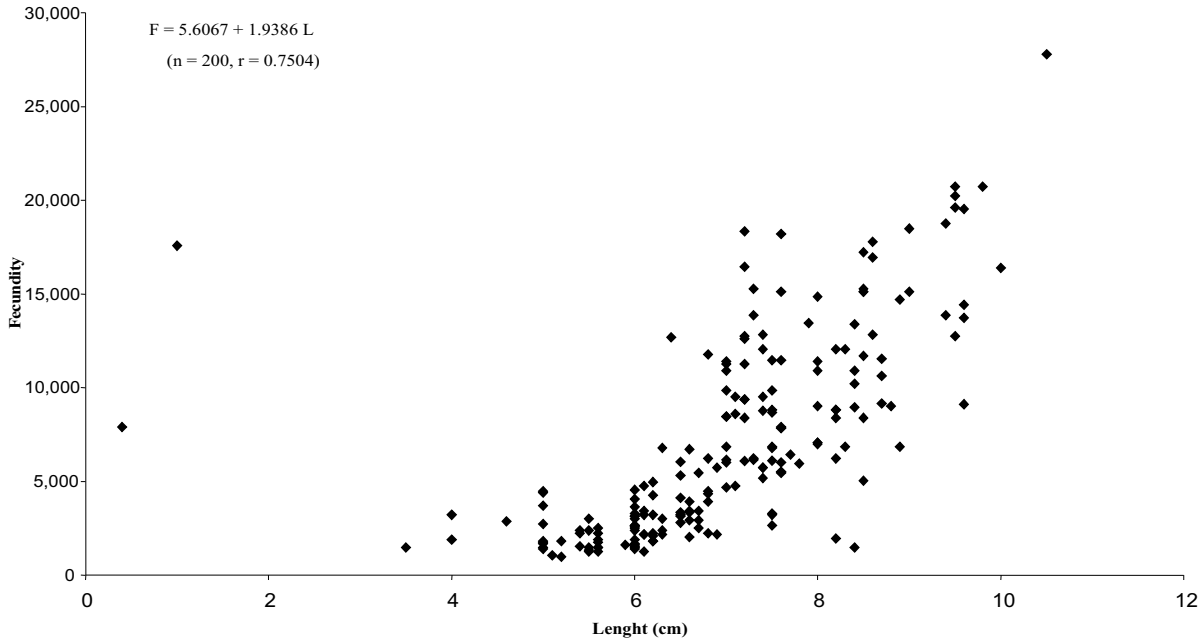

Fig 2: Total length - fecundity relationship of *A. gabonensis* from Lower River Benue

Spawning Period in *A. gabonensis.*

Berried females started appearing in the month of May with most of the eggs being orange in colour. In June, most of the females were seen carrying both orange and brown eggs with the latter carrying two black spots. These are called the "eye larvae" eggs. In July and August, most of the eggs were brown in colour and the "eye larvae" eggs became more prominent, which was when the eggs were shed into the water. It was observed that 80.5% of the females were carrying eggs, with 69.5% of them carrying eggs in June and July. Therefore, it was deduced that the peak of breeding season for *A. gabonensis* was between June and July. However, the number of females carrying eggs dropped to 15.2% in August. After mid August, the egg carrying females started disappearing from the catch.

Histology of eggs in *A. gabonensis.*

The eggs of *A. gabonensis* were oval in shape and gelatinous. Four developmental stages of the oocytes were observed in the study. These were immature, developing and ripe oocytes and larval stage. The presence of the various stages of ooccyte growth and development in the species are shown in Plates 1, 2, 3 and 4.

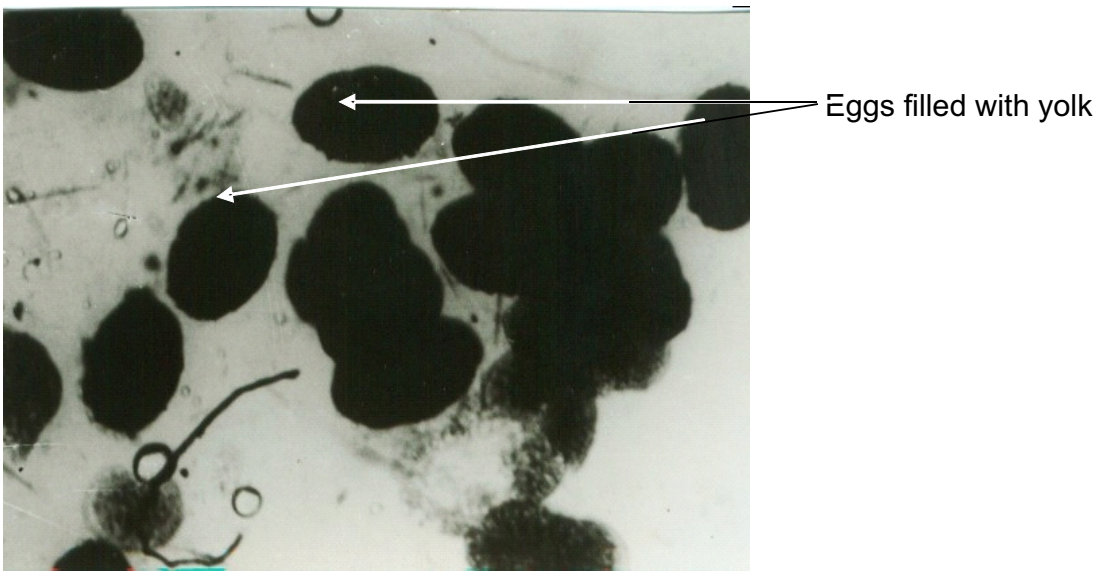

Plate 1: Immature oval shaped eggs of *A. gabonensis* (x 100) (0.42 0.65mm)

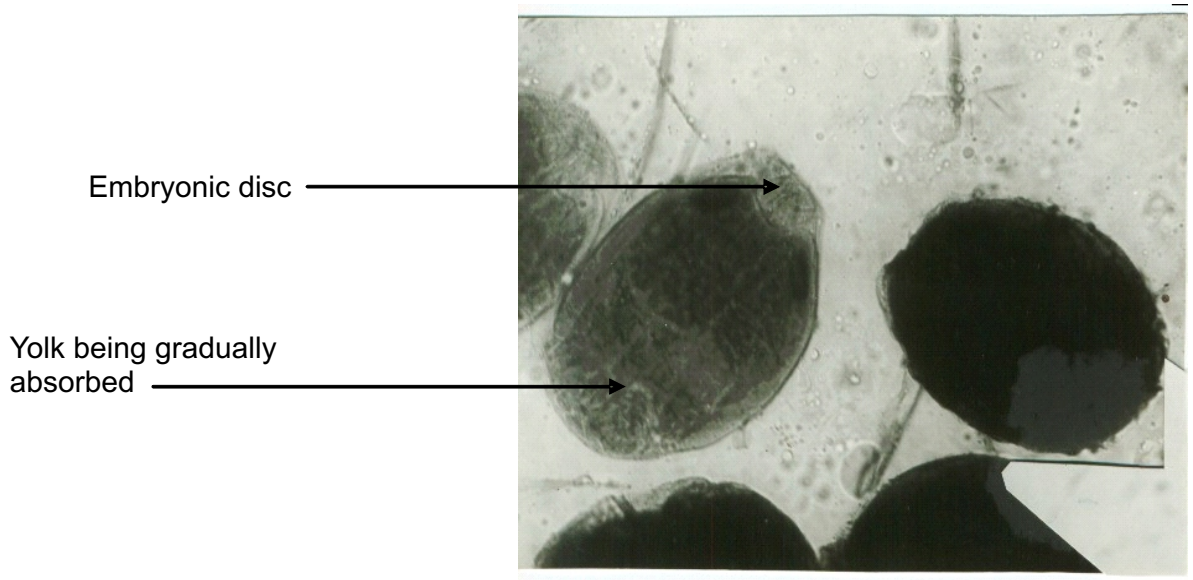

Plate 2: Developing oocyte of *A. gabonensis* showing early blastular stage (x100) (2.0mm) of fertilized eggs

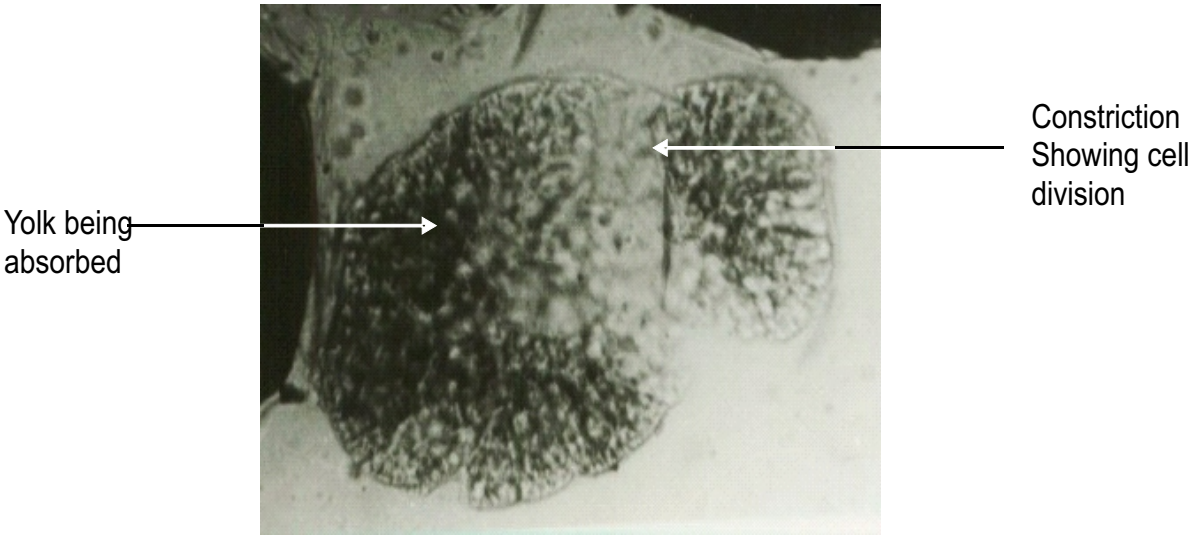

Plate 3: Advanced gastrular state with embryonic shield formed in *A. gabonensis* (x100) (2.0mm) of fertilized eggs

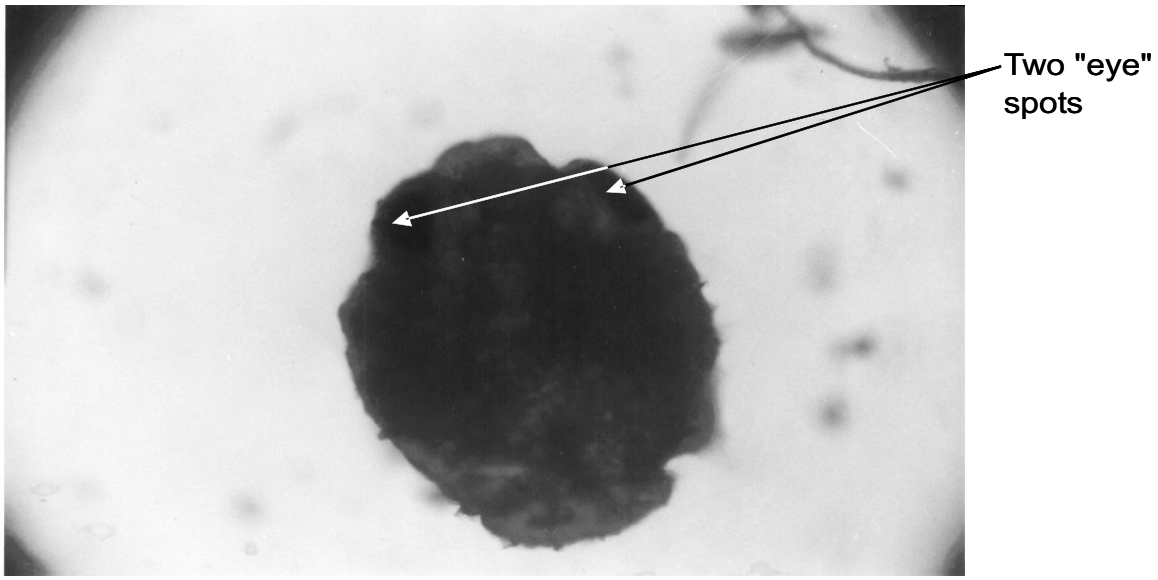

Plate 4: Two "eye" larval stage in *A. gabonensis* (x 100)

DISCUSSION.

The fecundity estimate of *A. gabonensis* ranged from 980 to 27,790 eggs. Although the number of eggs was low compared to what has been recorded for other related species such as *Macrobrachium vollenhovenii,* from Asajere Lake in Oyo State, (Anetekhai, 1990). Lower values of fecundity have been reported by Ovie (1986) and Marioghae (1995) for *Macrobrachium vollenhovenii* in Nigeria.The fecundity increased with increase weight and length in *A. gabonensis.* This agreed with the work of Anetekhai (1990) who reported increase in number of eggs with weight and length in *Macrobrahium vollenhovenii* and Ovie (1986) in *Macrobrachium macrobranchion*.

The relationship between fecundity and body weight and fecundity and total length in the species shows a very high positive correlation, (r = 0.7887 and r = 0.7804) respectively. This high correlation between total body weight and fecundity in *A. gabonensis* agreed with earlier work on related species by Anatekhai (1990), that in decapod crustaceans, the number of eggs produced by a female was dependent on the size. The gonad cycle of the species possibly showed that berried females start appearing in May to August. The appearance of egg caring females in May coincided with the onset of the rain. It is possible that rain may be a triggering factor in egg production as it increased the water level and reduced temperature which agrees with similar observations made Penn (1980) on *Penaeus latisulcatus* and Anetekhai (1990) on *M .vollenhovenii*

The egg diameter of *A. gabonensis* ranged between 0.02 2.00mm with a mean of 0.63 $\pm$ 0.10mm. The most frequent egg sized were eggs of diameter 0.50 0.60mm, while the least frequent were eggs with diameter 0.02 0.04mm. The egg size was not dependent on the size of the females but rather on the stage of development. This might be attributed to the fact that each berried females of this species carried eggs of different sizes at various stages of development. *A. gabonensis* was not a total spawner but could rather be called a serial spawner according to Pitcher and Hart, 1982 cited by New (1990). The egg histology revealed that the eggs were oval in shape. The various developmental stages such as the immature stage consisted of very small and spherical oocytes. The advanced gastrular stage showed when cell constriction started. The two "eye" larval stage which is the advanced state of development of the egg were observed and this according to Bauer (2004) is when the eggs are shed into the water in penaeid prawns to continue further development as penaeid prawns do not brood their eggs. The egg histology gave an insight to the developmental stages of the egg of the prawn and the observations made conform to similar ones made by Grooves (1985) and Xavier (1997) on other related species.

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