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Aspects of Reproduction and the Condition of Gravid Mud Crab (Crustacea: Brachyura: Potamon) in Ebonyi State, Nigeria

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Abstract: *Decline in the population of Ebonyi mud crab (Potamon ebonyicum) due to overfishing has been reported in the survey and fecundity study. The need to enhance the population was highlighted in the report. Apparently, there was need to study maturation of the ovary, and determine morphometric relationship to ensure availability of adequate scientific information, for hatchery production of seed. The relative condition of gravid P. ebonyicum and levels of maturation of the ovary were studied from March to May. BMI (Body Mass Index) was determined, and the highest (4.0) was recorded in April. There was no significant difference (P>0.05) between high and low BMI values. EMI (Egg Mass Index) was determined and that of April was also higher than those of other months. The EMI differed significantly (P<0.05) in all the months within the period. Perhaps the peak indicated that in April, most mature females' wereladen with fertilized eggs. Colour of the eggs ranged from orange to dark orange. The number of dark-orange eggs peaked in May, and accounted for 83% of the total. The colour of mud crab ovaries has been reported elsewhere, and this one seems to be a confirmation of the phenomenon in Potamon species. There was a poor correlation and nonlinear relationship between weight and size of the crab, and between the crab and egg mass.*

Keywords: *Condition, Maturation level, gravid crab, Ebony state, Nigeria.*

1. INTRODUCTION

Male and female mud crabs are difficult to identify as juveniles. The identification process becomes easier as they mature. The abdominal flap of females is much broader than that of males, and becomes heavily pigmented when the female reaches maturity (Fisheries Fact Sheet, 2013)[1]. An interesting aspect of maturation is their step wise process, where they pass through an apparent physiological maturation before becoming functionally mature. Subsequently, the development of ovary can be seen by depressing and pushing forwards the first abdominal segment next to the carapace (Shelley and Lovatelli, 2011)[2]. Mating period of crab is usually long. The female is carried by the male clasping her with three pairs of walking legs, and in this condition it is very easy to catch them. After five days, the female is finally released by the male. The fecundity of the mud crab has been studied around Ebonyi River Basin. There was negative correlation between fecundity and weight of the crab, and between fecundity and size. The highest number of eggs obtained from an individual was significantly lower than the number in marine species (Akpaniteaku, 2014) [3]. The reason for studying other aspects of reproduction was to identify various indices of development prior to controlling the process. Analyses of the relationship between weight and size of the female and the egg mass may provide necessary guide for controlling seed production. The research was therefore aimed at determining relative condition of the crab, maturation levels of the ovary, and relationships between morphometric variables.

2. METHODS

Specimens of P. ebonyicum were collected from Ogelegu and Idembia communities around the Ebonyi River Basin. The study period covered from March to May 2014. The females were separated from the males using the methods of Shelley and Lovatelli (2011)[2]: Abdominal flap

with the characteristic U shape was identified, and the species was confirmed by methods of Akpaniteaku (2013)[4]: Ensuring that the abdominal flap has the same red colour as the abdomen. A total of 272 specimens were collected from Ogelegu. At Idembia, a total of 249 specimens were collected. The crabs were transported dry in plastic containers to the biological science laboratory. Weight of the specimens was measured with triple beam balance of Bran Scientific Instrument England using the formula by Akpaniteaku (2014)[3]. Measurement of their size was obtained by meter rule. All size measurements were taken on the carapace along antero-posterior body axis. Body mass index (BMI) was calculated using the formula:

$$BMI = \frac{TWCg}{CWcm^2}$$

Where, BMI = Body Mass Index

TWC g = Total Weight of Crab (including eggs) measure in grammes

CW cm^2 = Carapace width (length of crab) measured in centimeter square

The abdominal flap was opened and the colour of eggs determined by direct observation. The eggs were collected in petri dish and counted immediately. The few unripe, sticky ones which could not be removed from the sponge were counted *insitu*.

Diameter measurement of the eggs was estimated with ocular micrometer. Randomly selected eggs (20 in number) were used for estimating individual weight, and that of the egg mass. The weight was determined by using the formula:

$$WE = \frac{WS}{nS}$$

Where, WE = Weight of Egg

WS = Weight of Egg Sample

nS = Number of Sample

Weight of the egg mass was determined by using the formula:

$$WM = \frac{WS \times nE}{nS}$$

Where, WM = Weight of Eggs Mass

WS = Weight of Sample

nE = Number of Eggs in the ovary

nS = Number of Sample

The Egg Mass Index (EMI) was determined by using the formula.

$$EMI = \frac{\text{Weight of Egg Mass}}{\text{Weight of Crab}} \times \frac{100}{1}$$

Data were generated and subjected to regression and correlation coefficient analyses. The following weight and size variables were also determined statistically to establish relationship:

Log weight of crab and log carapace width

Weight and size of egg

Log weight (egg mass) and log weight of crab.

3. RESULTS

The BMI of the female crabs is presented in Fig I. In the month of March, the highest BMI was 3.0 and least was 2.1. In April, 4.0 was the highest and the least was 2.0. The highest BMI obtained in May was 3.5 and the least was 3.0. The value of all the BMI differed significantly ($P<0.05$) during the period.

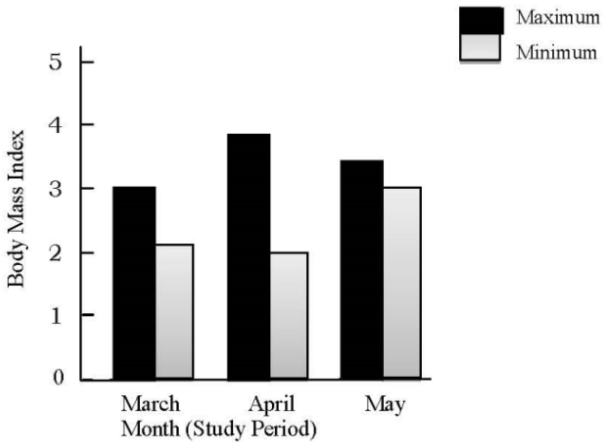

Fig1. *Indices of body mass of gravid Potamon ebonyicum from March to May, 2014*

Maximum and minimum EMI for each month are presented in Fig 2. Highest EMI (29.6) was recorded in April, and the least (2.3) was recorded in March. The gap between maximum and minimum EMI was significant, and the difference between the upper and lower limits of the maximum range was also significant.

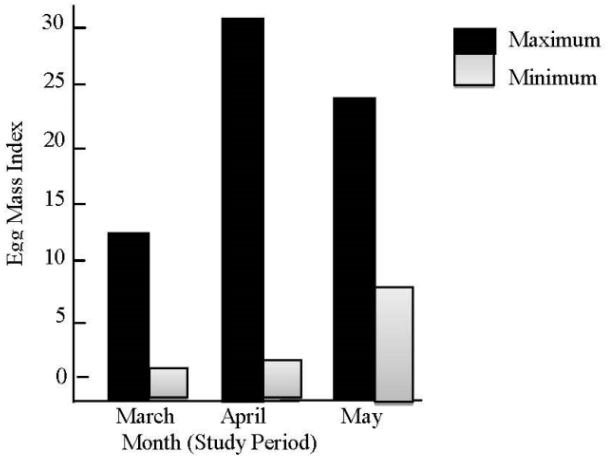

Fig2. *Indices of egg mass of gravid Potamon ebonyicum from March to May, 2014*

The indicators of egg maturation levels of the ovary were characterized by different colours. The colours ranged from reddish to orange and dark orange. Most of the eggs examined in the month of March were reddish. In April, orange and dark orange eggs were observed. The groups represented 55% and 45% of the total number respectively. In the month of May, dark-orange eggs were significantly ($P<0.05$) higher in number than the orange ones, and represented 83% of the total number.

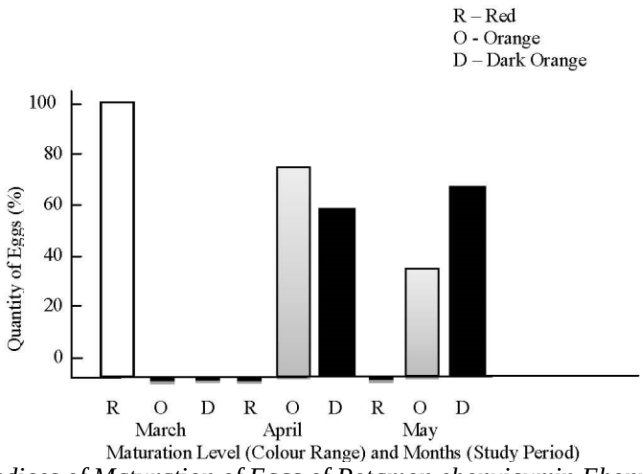

Fig3. *Indices of Maturation of Eggs of Potamon ebonyicumin Ebonyi State*

The correlation between weight of the crab and carapace width (Fig 4) was poor (r = 0). Crab with weight of 85g had carapace width of 4.7cm, and the one weighing 58g had carapace width of 5.2cm.

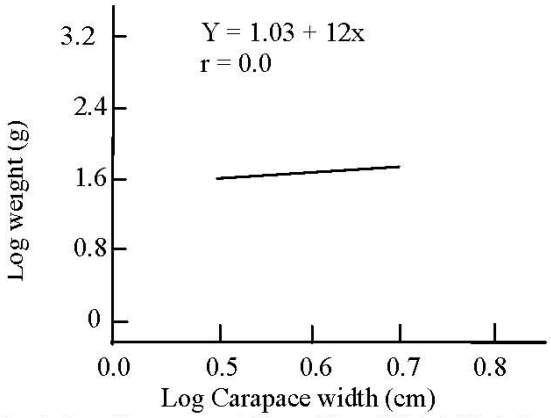

Fig4. *Log Carapace width and Log Weight Relationship of the Crab Species*

The relationship between weight and size of the eggs is presented in Fig 5.Most of the large eggs were heavier than the smaller ones, but the largest egg was as light as the smaller ones. The correlation coefficient of variables was poor (r = 0). Weight of crab and egg mass were poorly correlated (r = 0). The weight of eggs produced by the heaviest crab was almost the same as those produced by the light ones. Original weight of the crab that produced the heaviest egg, was lighter than the weight of those that produced light eggs.

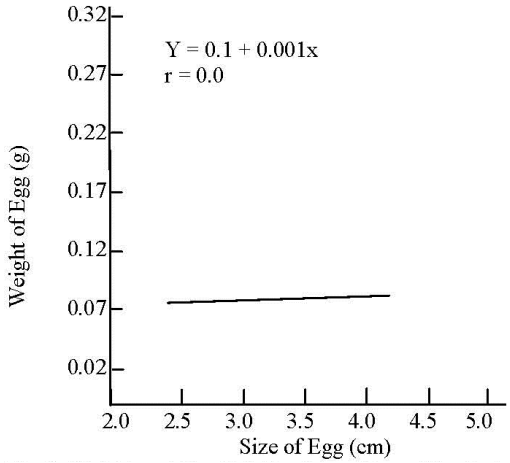

Fig5. *Weight and Size Relationship of Egg of the Crab Species*

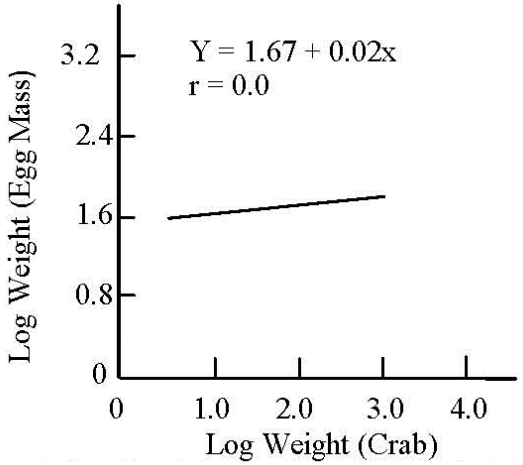

Fig6. *Log Egg Mass and Log Weight Relationship of the Crab Species*

The regression and correlation coefficients of the experimental data, and equations obtained after the analyses are shown in Table I. A poor correlation was noticed between the variables. Plot of log-log transformation of the ovarian indices and relative condition of the gravid crab showed poor linear relationship (Fig 4, 5 and 6).

Table1. *Regression and Correlation Coefficient of the Relationship between Various Variables*

Variables	Equation	Coefficient
Log Carapace Width and Log Weight	Y = 1.03 + 1.12x	r = 0
Weight and Size of Egg	Y = 0.1 + 0.001x	r = 0
Log Egg Mass and Log Weight	Y = 1.67 + 0.002x	r = 0

4. DISCUSSION

The effects of weight on the activities of gravid crabs could not be exhaustively analysed, because of inadequate scientific information from other reports. However, the BMI that was determined in the present research may have been considered for the first time in the study of crabs. The insignificant BMI differential may indicate that weights of the crabs were enhanced by additional load from maturing eggs. The highest BMI at full maturity of ovary may serve as guide to determine weight issues in non-gravid females. In the present research, the egg mass is used instead of ovarian (gonad) index. The apparent reason is that the sponge (ovary) is not as compact as fish ovary, and may not be extracted without damaging vital organs (Akpaniteaku, Pers. Obs.). Shelley and Lovatelli (2011)[2] reported that once eggs have been spawned and egg mass produced, the time to hatching and release of larvae is temperature dependent. The temperature effects at the onset of the rainy season may naturally be responsible for the EMI peak. The peak may also indicate that most mature females are laden with eggs around April. According to Business Ideas (2013)[5], females develop eggs in April prior to the four month mating period (May to September). In the same month (April) in the present research, some specimens with larvae were observed. Although they are not the object of the study, observations indicate that period of spawning may be species specific or differs from region to region. Shelley and Lovatelli (2011)[2] reported that ovaries of mud crab change colour as they mature, progressing from transparent through to yellow and dark orange. The "orange ovaries" observed at the onset of the present research, may probably indicate that the colour is associated with early stages of maturation. The ovary colour observed toward the end of the investigation (May) was dark orange. At this stage, embryonic changes are somewhat visible to the naked eye. Perhaps this is the last colour in the maturation of ovary prior to hatching of larvae. The maturation level is in agreement with the observation of Shelley and Lovatelli (2011)[2] that the colours of ovary progress finally to dark orange.

However, the significant number of eggs recorded in May seemed to suggest that more hatchlings could be obtained than in other months. According to Fisheries Fact Sheet (2013), after digging a hole in the mud or sand with the abdominal flap, female Scylla releases her eggs into it and uses swimming legs to gather them under abdomen, where they look like a spongy mass. Akpaniteaku (2014)[6] suggested that gravid females may be encouraged to release larvae in pools and flood ponds for extensive aquaculture. Capture strategy may be developed in such a manner as to utilize relevant reproductive behaviours to enhance the culture system. In a conditional investigation of wild and cultured African catfish (Clariasgariepinus), Tsadu and Adebisi (1997)[7] observed that there was high correlation and a positive linear relationship between the total length and total body weight. The poor correlation between weight and size of the crab species in the present research irrespective of the body symmetry may possibly reflect their adaptive potentials. Akpaniteaku (2014b) reported a wide variation in fecundity of crab of the same body weight, and suggested that size should not be a factor in estimating offspring, especially at the early stage of maturation.

5. CONCLUSION

The study of some reproduction aspects of mud crab and condition of gravid P. ebonyicum revealed that in April most mature females were laden with eggs. Body mass index could be used to determine weight issues in gravid and non-gravid mud crabs. Judging from the condition of

ovary at various maturation levels, egg colour may be considered to differ slightly from species to species. Morphometric variables were poorly correlated, and should not be considered as guide for projecting seed production. However, relationship coefficients reflected the adaptive potentials of mud crab. The findings indicated that systematic intervention could be possible in the production of P. ebonyicum.

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