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The Fecundity of Brackish River Prawn (*Macrobrachium macrobrachion,* Herklots, 1851) from Great Kwa River, Obufa Esuk Beach, Calabar, Cross River State, Nigeria

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Abstract
The fecundity of *Macrobrachium macrobrachion* Herklots, 1851 from Great Kwa River, Obufa Esuk Beach, Cross River State, Nigeria. Shrimp were sample for a period of six months (February, 2006 - July, 2006). A total of 200 berried female shrimp were examined. The results show that the number of eggs ranged from 63 to 14,531. The mean number of eggs per female was 4,420.58. The eggs were spherical in shape; on the long axis the egg diameter ranged from 0.26 to 0.38mm with a mean of 0.33mm while on the short axis, the egg diameter ranged from 0.25 to 0.38mm with a mean of 0.31mm. There was a positive relationship between body weight, standard length, total length, carapace length and the number of eggs: Y = 155.7-1107x and r^2 = 0.986, Y = 1148.4- 9353x and r^2= 0.949, Y = 809.69-7578.8x and r^2 = 0.949, Y = 848.39-8567x and r^2 = 0.934 respectively. There was high correlation between female body weight, standard length, total length, carapace length and the number of eggs. Fecundity increases with the standard length, total length and carapace length. The number of eggs also increases with increase in body weight, standard length, total length and carapace length. Generally, fecundity was linear and a function of the body weight and body length. The study shows that the fecundity of the prawn was low when compared to other studies.
Keywords: Egg diameters, *Macrobrachium macrobrachion*, Great Kwa River, Obufa Esuk Beach, Nigeria.

1. INTRODUCTION

The fresh water shrimp; *Macrobrachium macrobrachion* belongs to the Phylum, *.Arthropoda*; Class, *Crustacea*; Subclass, *Malacostraca*; Series, *Eumalacostraca*; Order, *Decapoda*; Suborder, *Natantia*; Section, *Caridea*; Family, *Palaemonida*; Genus, *Macrobrachium*; Species, *M. macrobrachion* (Powell, 1980). It can also be found in low salinity brackish water (Powell, 1985). The body is divided into three main divisions: the head, thorax and abdomen. The head and thorax are joined to form a cephalothorax, which carries the mandibles, flagella, rostrum and the eyes containing a stalk and has five pairs of walking legs. The abdomen has six body segments with the last segment bearing a uropod or telson. The other five segments bear swimming apparatus known as swimmerets. A definite feature of *Macrobrachium* is that the second walking legs are modified to form the chelae. Most species are distinctively colored having either blue or brownish colors. The legs also have definitive features such as hairs or furs. Significant differences exist between the male and female. Mature males are considerably larger than females and the second walking leg is much thicker. The cephalothorax is also proportionally larger in the male than female while abdomen is narrower in the female. The genital pores of the male are between the bases of the fifth walking leg (New and Singholka, 1982). The female's genital pores situates at the base of the third walking legs. The pleura of the abdomen are lower and broader in the female than in the male. The pleura of the female form a brood chamber in which the eggs are carried between laying and hatching. A ripe ovigerous female can easily be identified because the ovaries can be seen as large orange-colored mass occupying a large portion of the cephalothorax. Studies by Marioghae (1982) on *M. macrobrachion* in the Lagos lagoon showed that the upper limit of salinity was 12%. He observed that the shrimps migrate from the estuaries to the freshwater in the peak of the dry season when the salinity is high. Apart from salinity, the physical attributes of the substratum are considered to be one of the major factors controlling the distribution of shrimps (Khan et al., 1995). Any change in the composition of the substratum may affect the distribution. Marioghae (1990) reported that it constituted about 60% of the catch in Lagos lagoon of Nigeria at a time.

The gear used for collecting the shrimp is locally known as "Kara". It is cone shaped and has two non-return value mechanisms at the center of the trap. The trap is constructed from either the blades of bamboo plant or blades of raffia fronds which are woven around three round frames made from cane. The total length of each trap was between 0.95 and 1 m while the opening aperture was between 25 and 30 cm. Fresh palm oil fruits were used as bait to set the trap along the creek lets against the water current. Fecundity is a measure of the reproductive capacity of organisms which may be fish or shrimp. Its knowledge forms an important tool in successful management of the stock (Nikolskii, 1969).

Fecundity studies are useful for providing estimates for possible recruitment or juveniles available for culture.

The reproductive capacity of a population is a function of the fecundity of the females (Abowei et al., 2006). Spawning fecundity is the numbers of eggs that a female is biologically capable of extruding in a single spawn (Abowei et al., 2008). Pre-hatch fecundity is the number of eggs carried by the female at any one time between spawning and larval hatch or release. Larvae Hatch Fecundity (LHF) is the number of larvae released from the egg mass following incubation (Abowei et al., 2010). Shrimps and prawns of the genus *Macrobrachium* and *Penaeus* are highly cherished by the people of the Niger Delta. The unfriendly fishing methods of local fishers who use poisons and chemicals are affecting the shrimp catch. Therefore understanding the biology, environmental parameters and population structure is essential to optimize production from the wild. The shrimp *M. macrobrachion* is exploited from Great Kwa River, Obufa Esuk Beach in large quantities yet there are no concrete reports on the population biology of this species in the area. A study of fecundity of *Macrobrachium macrobrachion* from Great Kwa River, Obufa Esuk Beach provides base line data for management decision and culture of the species in the area and similar water bodies.

2. MATERIAL AND METHODS

The sample of *Macrobrachium macrobrachion* used in this study were obtained from the catches of the artisanal shrimp fishery at Obufa Esuk Beach, one of the major shrimp landing beaches of the *M. macrobrachion* fishery in the outer estuary (Fig.1.) of the Cross River. The samples were collected from February, 2006-July, 2006, involving a total of 200 shrimps. The estuary receives sea water from the Atlantic Ocean and freshwater from a number of rivers including the Cross River and Great Kwa River. During the peak breeding season (May-July), the adult of *M. macrobrachion* migrates from the freshwater of the Great River into the estuary for spawning and it is normally in the estuary are densely populated with mangrove trees, bamboo trees and some species of shrubs. There is also the presence of some coconut trees. The estuary has a brownish colouration and along contains part at low tides during the dry season submerged portions of the bottom re-emerge through a short period. The estuary is located in the tropical rainforest belt of southern Nigeria and lies between latitudes $4^{o}15'$ and $4^{o}45'$N and longitudes $8^{o}5'$ and $8^{o}35'$E. The estuary has a mean salinity of 20ppt during the dry season and approximately 12ppt at the peak of the rainy season (Udo and Ekpe, 1991).

2.1 SPECIMEN SAMPLING

Samples of *M. macrobrachion* were collected from Obufa Esuk Beach lower section of Great Kwa River bi-monthly for six months; these samples were always bought from the artisanal fishermen early in the morning between 7am and 8am. As they landed from their fishing ground, samples collected include lives as well as dead but fresh individuals and they were also sorted into male and female; females were later separated into berried (ovigerous) and non-berried (non-ovigerous). 200 species of *M. macrobrachion* comprising of nearly all size groups were in the study. They were immediately injected with 4% formalin to reduce to the minimum of any post-homous digestion (Coasta and Wanninayake, 1986) and were later transferred to the laboratory. In the laboratory, the total length (TL)cm, standard length (SL)cm, carapace length (CL) cm and body weight (gm) of the specimens measured to the nearest 0.1cm and 0.1g using a measuring board calibrated in cm and triple beam balance respectively. Total length to the nearest 0.1cm was considered to be the distance between the tip of rostrum and the tip of telson (Arringnon *et al.,* 1994), standard length to the nearest 0.1cm considered to be the distance between the tip of the rostrum to the end of the 5^{th} segment of the abdomen in cm with the help of a measuring tape and carapace length (the distance from the base of rostrum to the first body segment) was measured with a Vernier caliper to the nearest 0.1mm. The shrimps were then weighed with triple beam balance to the nearest 0.1 g. Measurements were taken for each monthly collection and recorded accordingly. The eggs were preserved in Gilson's fluid, to help liberate them and breakdown the ovarian tissue. The diameters of thirty (30) eggs per berried female randomly selected were measured with an ocular micrometer insert into the eyepiece of the microscope. The eggs were placed on a slide and viewed. The Vernier measurement on the stage was then used to measure the long and short axes of each egg. The mean of these gave the egg diameter expressed in millimeters. Fecundity was estimated by using the method of volumetric analysis.

3. RESULTS

A total of 200 berried female shrimp were examined. The results show that the number of eggs ranged from 63-14,531. The mean number of eggs per female was 4,420.58 The eggs were spherical in shape; on the long axis the egg diameter ranged from 0.26 to 0.38.mm with a mean of 0.33 mm while on the short axis, the egg diameter ranged from 0.25 to 0.38 mm with the mean of 0.31mm (Table 1). There was a positive relationship between body weight, standard length, total length, carapace length and the number of eggs: $Y = 155.7\text{-}1107x$ and $r^2 = 0.986$ (Fig. 2), $Y = 1148.4\text{-}9353x$ and $r^2 = 0.949$ (Fig.3), $Y = 809.69\text{-}7578.8x$ and $r^2 = 0.949$ (Fig. 4), $Y = 848.39\text{-}8567x$ and $r^2 = 0.934$ (Fig.5). There was high correlation between female body weight, standard length, total length, carapace length and the number of eggs. Fecundity increases with the standard length, total length and carapace length. The number of eggs also increases with increase in body weight, standard length, total

length and carapace length. Generally, fecundity was linear and a function of the body weight and body length.

4. DISCUSSIONS

The egg diameter of *M. macrobrachion* recorded for Great Kwa River, Obufa Esuk Beach in Calabar was between 0.25 and 0.38mm with a mean of 0.31-0.33mm. This is small when compared to the results of Rutherford (1971) who reported the egg diameter of between 0.50 and 0.70mm in Cape Coast, Ghana. In comparing with *Nematopalaemon hastatus* an estuarine species, Sagua (1980) observed egg size in the range of 0.47-0.63mm which suggested that *M. macrobrachion* has larger eggs than *N. hastatus*. In the present study, a strong correlation exists between the number of eggs and body weight, standard length, total length, carapace length of berried females (r^2 = 0.986; 0.949; 0.949; 0.934) respectively. Similar trend was observed in other shrimp studied as *Penaeus latisculatus* (Penn, 1980); *Macrobrachium vollenhovenii* (Udo and Ekpe, 1991) and *M. nipponense* (Masshiko, 1990). The low egg count observed in this study could be as a result of some environmental factors such as sampling techniques and the age of eggs encountered. In *Macrobrachium* species like other aquatic organisms, fecundity is a linear function of the body weight and body length. Several studies (Patra, 1976; Penn, 1980) shows that positive relationship exists between body weight and the number of eggs that is the heavier the shrimp, the more number of eggs. Freshwater shrimps exhibit variation in fecundity from species to species. Fecundity also varies according to hydrographic region (Masshiko, 1990). Fecundity can be estimated by volumetric methods and by direct counting of the number of eggs found on the pleopods of a berried female. The later method is more frequently used because it is more reliable and accurate. New and Singholka (1982) reported that *M. rosenbergii* hatch between 100,000 – 700,000 eggs during the spawning season when they are mature. Rao (1998) estimated the fecundity of *M. rosebergii* by counting the number of eggs on the pleopods and it ranged between 20,000 and 70,000 eggs. He observed that the average hatching fecundity was 500 larvae per gram body weight of prawn. The number of eggs borne by a berried *M. macrobrachion* female is reported to be between 805 – 6 600 eggs (Ovie, 1986) and between 3,000 and 12, 060 eggs (Marioghae, 1987). Ovie (1986) showed that there was high correlation between female weight and the number of eggs.

5. CONCLUSION

I. The size of eggs of *M. macrobrachion* recorded in Great Kwa River, Obufa Esuk Beach was small compared to other studies.
II. The range of absolute fecundity and the mean number of eggs per female was also low compared to other results.
III. Strong correlation exists between the number of eggs and body weight, standard length, total length, carapace length of berried females as other studies.
IV. Fecundity was assumed to be linear function of the body weight and body length in *M. macrobrachion* in Great Kwa River, Obufa Esuk Beach as other studies.
V. The knowledge of fecundity is useful in fish stock assessment studies, in egg, larval survival studies, estimation of the size of a stock and for stock discrimination.
VI. The knowledge of size range of berried females is important for aquaculturist interested in culturing the species as it would enable them know the size of the brood stock to keep.

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Table 1. Egg diameters of *Macrobrachium macrobrachion* form Great Kwa River, Obufa Esuk Beach, Calabar, Cross River State, Nigeria.

S/N	Number of eggs measured for short axis	Number of eggs measured for long axis	Mean egg diameter for short axis (mm)	Mean egg diameter for long axis (mm)
1	20	30	0.25	0.38
2	30	31	0.38	0.39
3	20	23	0.25	0.29
4	23	25	0.29	0.31
5	20	21	0.25	0.26
6	20	23	0.25	0.29
7	26	25	0.33	0.31
8	30	28	0.38	0.35
9	20	28	0.25	0.35
10	20	26	0.25	0.33
11	25	27	0.31	0.34
12	28	25	0.35	0.31
13	30	25	0.38	0.31
14	21	26	0.26	0.33
15	20	27	0.25	0.34
16	27	25	0.34	0.31
17	28	26	0.35	0.33
18	30	26	0.38	0.33
19	24	26	0.30	0.33
20	26	28	0.33	0.35
21	26	28	0.33	0.35
22	30	28	0.35	0.35
23	20	26	0.25	0.33
24	21	27	0.26	0.34
25	20	25	0.25	0.31
26	26	28	0.33	0.35
27	30	28	0.38	0.35
28	30	28	0.38	0.35
29	26	28	0.33	0.35
30	30	25	0.38	0.31
Mean	24.9	26.9	0.31	0.33

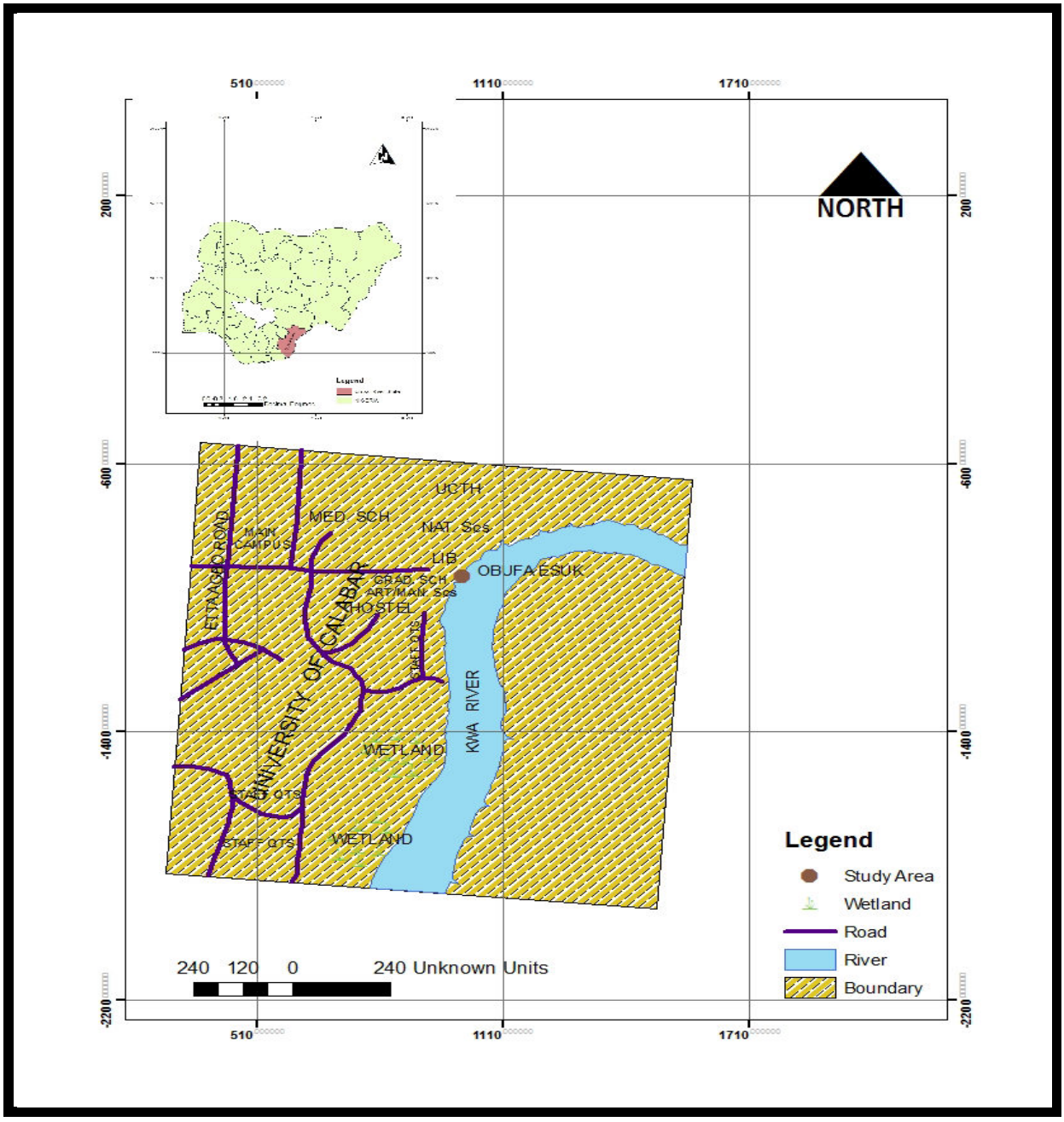

Figure 1. Map of University of Calabar showing Great Kwa River and Sampling Station (Obufa Esuk Beach), (Map of Nigeria indicating Cross River State).

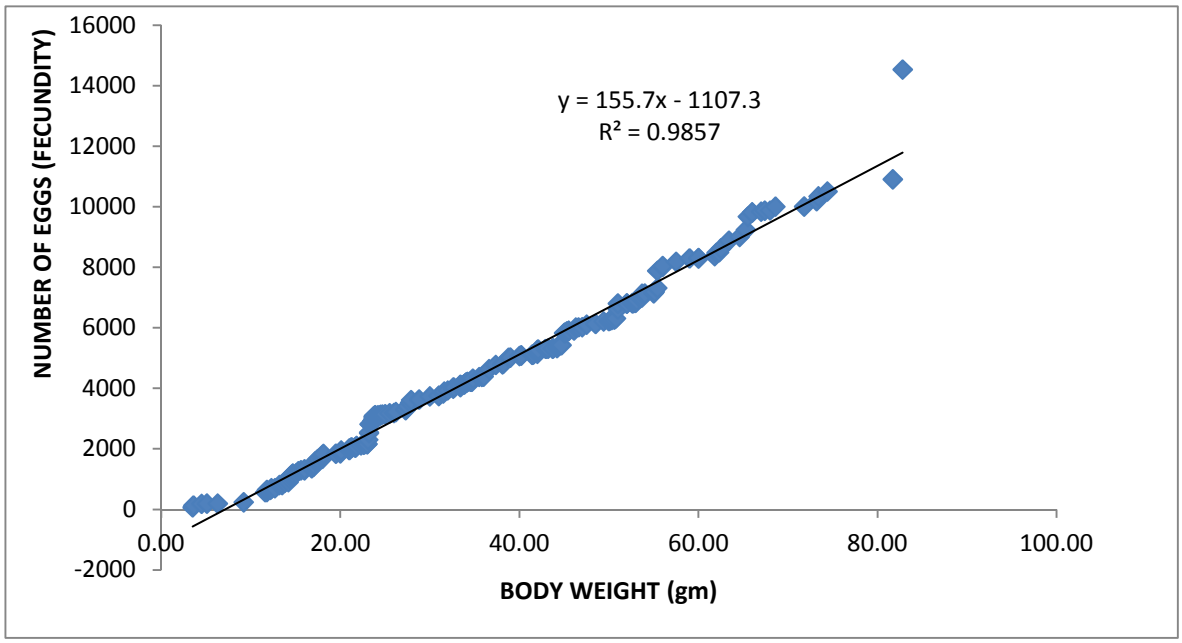

Figure 2. Relationship between body weight and number of eggs of *M. macrobrachion* from Great Kwa River, Obufa Esuk Beach.

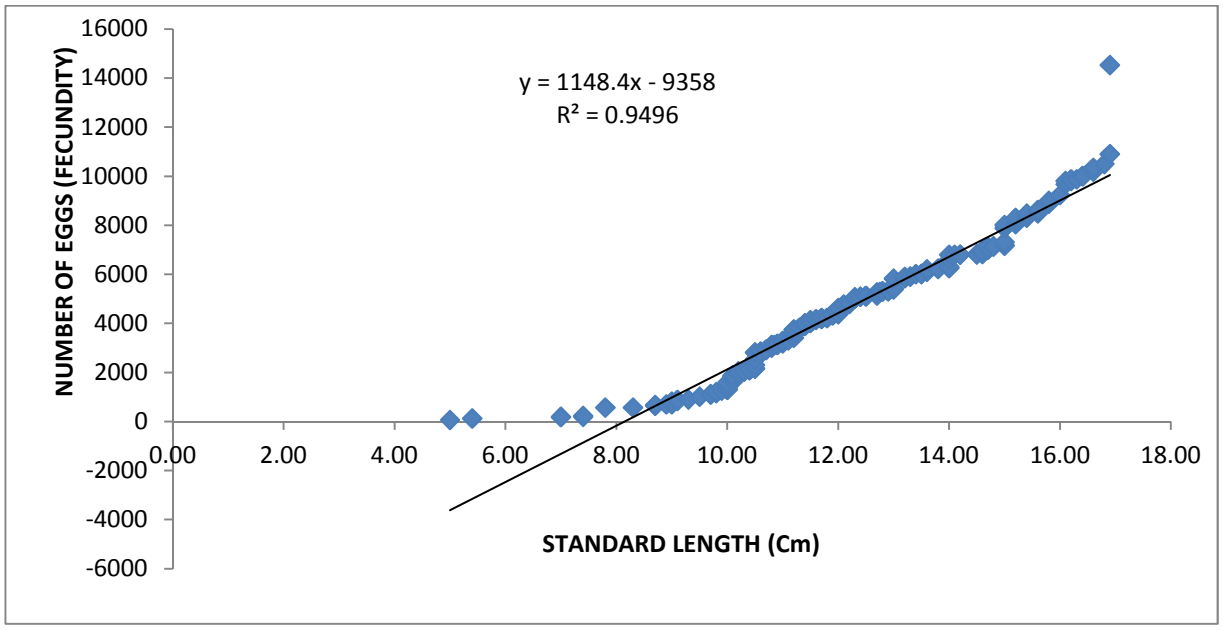

Figure 3. Relationship between standard length and number of eggs in *M. macrobrachion.* from Great Kwa River, Obufa Esuk Beach

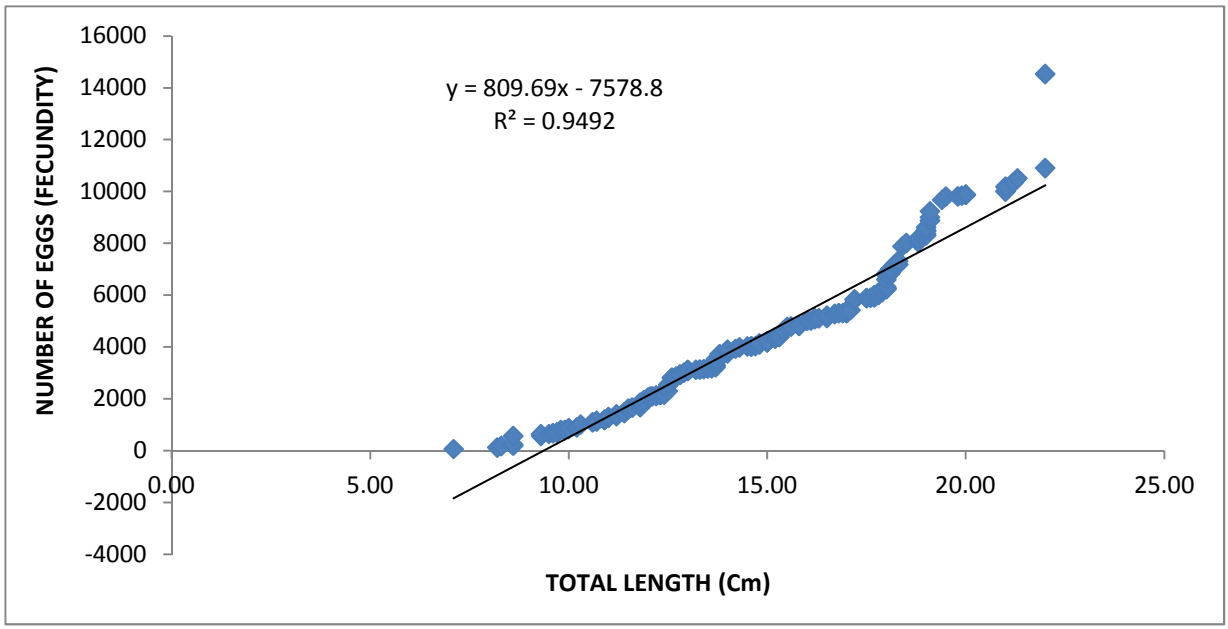

Figure 4. Relationship between total length and number of eggs in *M. macrobrachion* from Great Kwa River, Obufa Esuk Beach

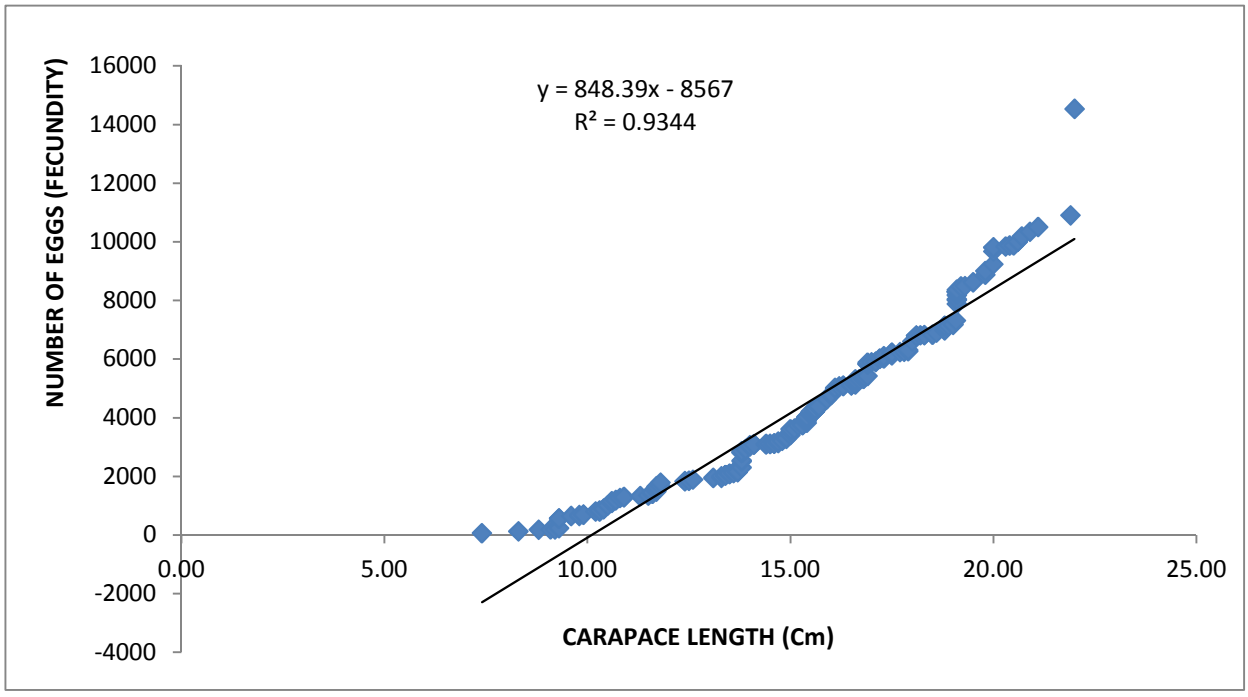

Figure 5. Relationship between carapace length and number of eggs in *M. macrobrachion* from Great Kwa River, Obufa Esuk Beach