International Journal of Animal and Veterinary Advances 2(4): 148-154, 2010
ISSN: 2041-2908

Submitted Date: June 29, 2010 Accepted Date: July 31, 2010 Published Date: October 15, 2010

The Fecundity of *Macrobrachium macrobrachion* (Herklots, 1851) from Luubara Creek Ogoni Land, Niger Delta, Nigeria

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Abstract: The fecundity of *Macrobrachium macrobrachion* from Luubara creek in Ogoni land axis of the Niger Delta region of Nigeria was studied for a period of two years (January, 2006 - December, 2007). A total of 934 berried female shrimp were examined. The results show that the number of eggs ranged from 180 to 5, 800. The mean number of eggs per female was 1, 403. The eggs were spherical in shape; on the long axis the egg diameter ranged from 0.60 to 0.78 mm with a mean of 0.68mm while on the short axis, the egg diameter ranged from 0.40 to 0.59 mm with a mean of 0.48mm. There was a positive relationship between carapace length, total weight and the number of eggs: Y = 4207.9-3666x and r = 0.9737, Y = 0.4224-42244x and r = 0.9721, Y = 3666.11+2483.9x and r = 0.3736, Y = 500-0.3794.11x and r = 0.97372, y = 250-0.03794.0x and r = 0.9843 and Y = 333 + 674.71x and r = 0.3736. There was high correlation between female weight and the number of eggs. The range of absolute fecundity observed in this study was 180-5, 800 eggs and the mean number of eggs per female were 1403. A strong correlation exists between the number of eggs and total length of berried females (r = 0.969). Fecundity increases with the carapace length. The number of eggs also increases with increase in weight and carapace length. Generally, fecundity was linear and a function of the body weight and carapace length.

Key words: Fecundity, Luubara creek, *Macrobrachium macrobrachion,* Niger Delta, Nigeria

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.

Holthius (1951) reported that *M. macrobrachion* occurs from Senegal to Angola along the Atlantic Coast. It is one of major species of shrimps occurring in Nigeria and West Africa. It is found in dams, pools, creeks, streams and rivers where the salinity allows for its growth. Studies by Marioghae (1982) on *M. macrobrachion* in the Lagos lagoon showed that the upper limit of salinity was 12%. He observed that the

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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. It is an important fisheries resource and stock assessment studies by Enin (1995) showed that *M. macrobrachion* was excessively harvested from the Cross River estuary with an exploitation ratio of 0.68.

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). Fecundity is usually determined by the total number of mature ova in the ovary which are to be shed in the current season (Bagenal, 1967, 1968). Malecha (1983) in his work on the freshwater shrimp *M. rosebergii* in Hawaii reported that there are three types of fecundity in shrimps; spawning fecundity, Pre-Hatch Fecundity (PHF) and Larvae Hatch Fecundity (LHF). Spawning fecundity is the number 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 *Macrobrachuim* and *Penaeus* are highly cherished by the people of the Niger Delta. They are used as condiments in the preparation of food because of their high protein value (Umoh and Basir, 1977; Deekae and Idoniboye-Obu, 1995). They are highly priced and are in high demand in the market (Marioghae, 1990). It has been observed that there is significant reduction of the natural stock of shrimps in our coastal waters (Nwosu, 2007). This may be due to environmental degradation which is detrimental to the abundance and life cycle of *M. macrobrachion*. Also, there are few fishers now to exploit the available species as a result of rural migration.

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 in Luubara creek Rivers State in large quantities yet there are no reports on the population biology of this species in the area. A study of fecundity of *Macrobrachium macrobrachion* from Luubara creek provides base line data for management decision and culture of the species in the area and similar water bodies.

MATERIALS AND METHODS

Study area: The study was carried out in Luubara creek in Ogoni land axis of the Niger Delta region of Nigeria for a period of two years (January, 2006 - December, 2007). The creek is a tributary of the Imo River and is located between Longitudes 7º15′E - 7º32′E and Latitudes 4º32′-4º37′N in the Eastern part of the Niger Delta. The upper part of the creek extends from Bori and meanders through Wiiyaakara, Luegbo, Duburo and joins the Imo River at Kalooko.

The creek is divided into two distinct sections brackish water and freshwater. The brackish water stretch is between Bane and Kalooko while the freshwater stretch extends from Bane to Bori. The brackish water area has the normal mangrove vegetation comprising of trees such as Rhizophora racemosa, Avecenia africana, Laguncularia racemosa etc. whereas the freshwater has dense vegetation comprising of large trees, various palms and aquatic macrophytes at the low intertical zone. In freshwater area are Cocos species, Eliasis species, Nymphea species, Lemna species and Raffia species.

It is characterized by high ambient temperature usually about 25.5ºC and above; high relative humidity which fluctuates between 60 and 95% and high rainfall averaging about 2500 mm (Gibo, 1988). This high rainfall often increases the volume of water in the creek hence providing good fishing opportunity for the residents. Fishing is one of the major activities going on along the creek because it is the main water route of the Khana people in Ogoni area of the Niger Delta.

The fishes caught in the area include *Chrysichthys auratus*, *C. nigrodigitatus*, *Hydrocynus forskalii*, *Clarias gariepinus*, *Pellonula leonensis*, *Malapterurus*, *electricus*, *Gymnarchus niloticus*, *Synodontis nigri Hepsetus odoe*, *Hernichromis*, *fasciatus*, *Tilapia zilli*, *Tilapia guineensis*, *Sarotherodon melanotheron and Eleotris senegalensis and shellfish (crabs and shrimps) especially Uca tangeri Callinectes amnicola*, *Goniopsis pelli*, *Cardisoma armatum M. macrobrachion*, *M. vollenhoveni*,

Table 1: Size of eggs *M. macrobrachion* in Luubara creek

No.	Size of shrimp TL (mm)	No. of eggs measured	Mean egg diameter long-axis (mm)	Mean egg diameter short-axis (mm)
1	50	20	0.65	0.44
2	76	30	0.73	0.53
3	61	40	0.66	0.42
4	75	30	0.70	0.55
5	30	20	0.60	0.40
6	55	40	0.67	0.48
7	44	20	0.65	0.50
8	70	30	0.78	0.53
9	65	30	0.75	0.40
10	58	40	0.73	0.52
11	69	20	0.72	0.51
12	36	20	0.64	0.42
13	58	30	0.68	0.46
14	45	20	0.61	0.43
15	60	30	0.70	0.51
16	33	20	0.69	0.54
17	20	10	0.60	0.43
18	76	40	0.78	0.56
19	55	30	0.66	0.48
20	66	20	0.74	0.59
Mean			0.687	0.4805

M. equidens, *Palaemonetes africanus*, *Caridina africana and Desmocaris tripisnosa*.

Specimen sampling: The shrimp samples were collected fortnightly from three stations along the creek: namely Wiiyaakara, Luegbo and Duburo. Selection of the stations was purposefully based on fishing activities, ecological zonation and accessibility of site. For each station five fishermen were engaged and three traps were used. At each station the fisher men set the three sets of traps against the water current among aquatic macrophytes and left them overnight. The traps were retrieved the following day after about twelve hours corresponding to another low tide. The shrimps collected at each station were sorted into male and female; females were later separated into berried (ovigerous) and non-berried (non-ovigerous). Sampling lasted for twenty-three months from January 2006 to November 2007. The shrimp samples were then preserved in 4% formaldehyde and transported to the RSUST Fisheries laboratory for analysis after each day's sampling. The species was identified by use of the keys of Powell (1980, 1982) and Holthius (1980).

For each shrimp the Total length (the distance from the tip of the rostrum to the end of telson) and the carapace length (the distance from the base of rostrum to the first body segment) was measured with a Vernier caliper to the nearest 0.1 mm. The shrimps were then weighed with an Ohaus balance to the nearest 0.1 g. Measurements were taken for each monthly collection and recorded accordingly.

The size at sexual maturity (Lm) was determined for the females as suggested by King (1995) with for formula:

$$P = 1/(1 + \exp [-r (L - Lm)] \quad (1)$$

where,

P = Proportion of sexually mature individuals
L = Length of fish (shrimp)
r = Slope of curve
Lm = Mean length at sexual maturity or the length which correspond to a proportion of 0.05 (or 50%) in reproductive condition.

The length at first capture (Lc) was obtained according to the formula of King (1995) as follows:

$$P = 1/(1 + \exp [-r (L - Lc) \quad (2)$$

where,

P = Probability of capture
L = Length of fish (shrimp)
r = Slope of curve
Lc = Mean length at first capture (or point at which 50% of fish (shrimp) has chance of being retained by net (trap) or 0.5 probability of being caught).

RESULTS

A total of 934 berried female shrimp were examined. The results show that the number of eggs ranged from 180 to 5, 800. The mean number of eggs per female was 1, 403 (Table 1). The eggs were spherical in shape; on the long axis the egg diameter ranged from 0.60 to 0.78 mm with a mean of 0.68 mm while on the short axis, the egg diameter ranged from 0.40 to 0.59 mm with a mean of 0.48 mm. There was a positive relationship between carapace length, total weight and the number of eggs: Y = 4207.9-3666x and r = 0.9737 (Fig. 1), Y = 0.4224-42244x and r = 0.9721 (Fig. 2), Y = 3666.11+2483.9x and r = 0.3736 (Fig. 3), Y = 500-0.3794.11x and r = 0.97372 (Fig. 4), y = 250-0.03794.0x and r = 0.9843 (Fig. 5); and Y = 333+674.71x and r = 0.3736 (Fig. 6).

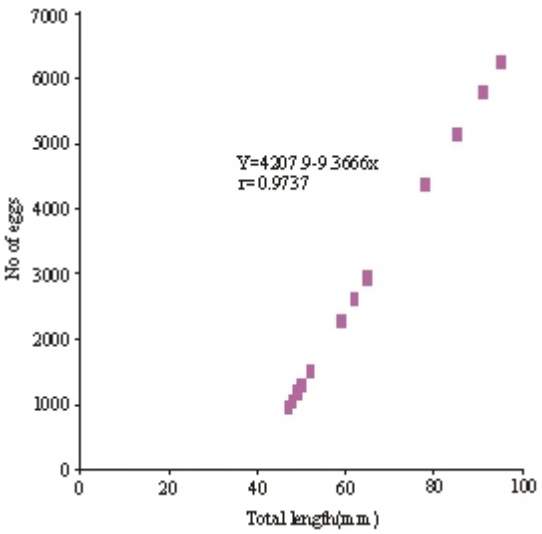

Fig. 1: Relationship between total length and number of eggs in *M. macrobrachion* (2006)

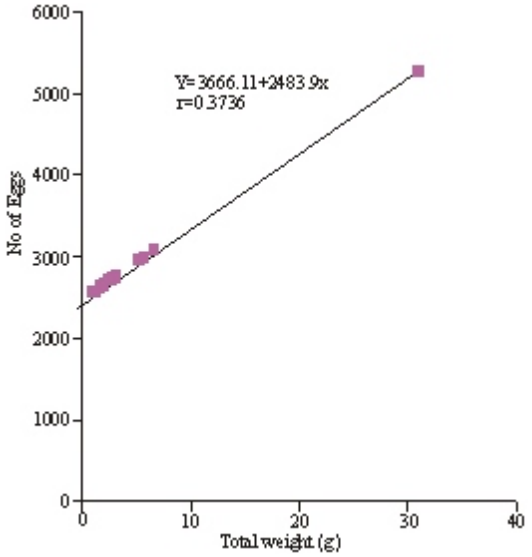

Fig. 3: Relationship between total weight and number of eggs in *M. macrobrachion* (2006)

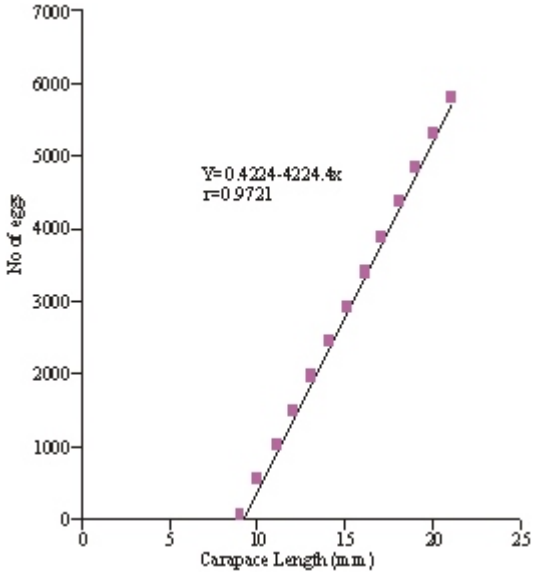

Fig. 2: Relationship between carapace length and number of eggs in *M. macrobrachion* (2006)

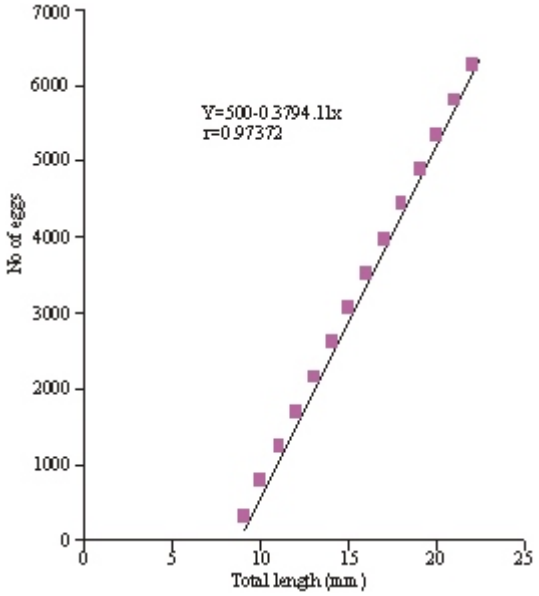

Fig. 4: Relationship between total length and number of eggs in *M. macrobrachion* (2007)

There was high correlation between female weight and the number of eggs. The range of absolute fecundity observed in this study was 180-5, 800 eggs and the mean number of eggs per female was 1403. A strong correlation exists between the number of eggs and total length of berried females (r = 0.969). Fecundity increases with the carapace length. The number of eggs also increases with increase in weight and carapace length. Generally, fecundity was linear and a function of the body weight and carapace length.

DISCUSSION

The size of eggs of *M. macrobrachion* recorded for Luubara creek was between 0.40 and 0.78 mm with a mean of 0.45-0.65 mm. This is small when compared to the results of Rutherford (1971) who reported the egg diameter of between 0.5 and 0.7 mm in Cape Coast, Ghana. In comparing with *Nematopalaemon hastatus* an estuarine species, Sagua (1980) observed egg size in the range of 0.47-0.63 mm which suggested that *M. macrobrachion* has larger eggs than *N. hastatus*.

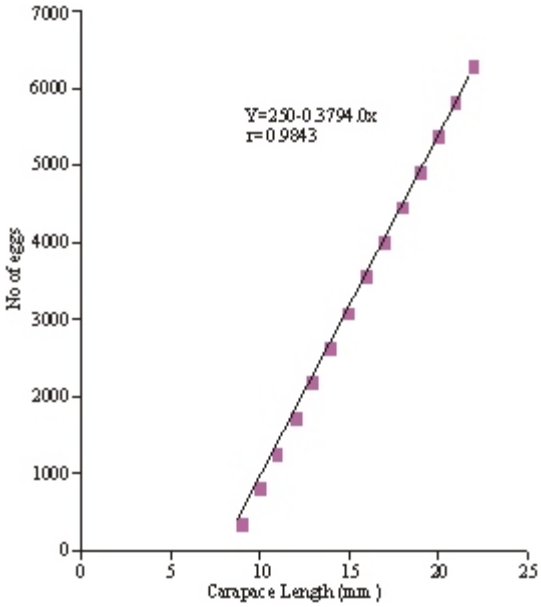

Fig. 5: Relationship between carapace length and number of eggs in *M. macrobrachion* (2007)

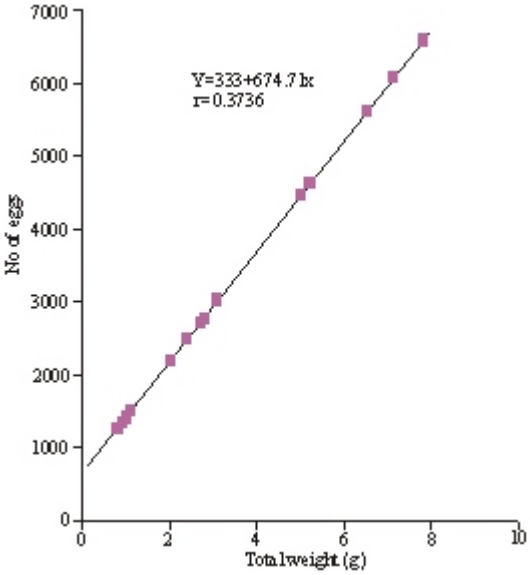

Fig. 6: Relationship between total weight and number of eggs in *M. macrobrachion* (2007)

The range of absolute fecundity observed in this study was 180-5, 800 eggs and the mean number of eggs per female was 1403 in *M. macrobrachion*. This value is low when compared to the result of Miller (1971) who reported a clutch size of 12,000-45,000 for *M. vollenhovenii*. Ovie (1986) reported a clutch size range of 805-6,666 eggs while Marioghae (1987) reported clutch size range of between 3,000 and 12,000 eggs for *M. macrobrachion*. Ovie (1986) also demonstrated that there was low correlation between fecundity and total length of berried female (r = 0.655).

In the present study, a strong correlation exists between the number of eggs and total length of berried females (r = 0.969). Similar trend was observed in other shrimp studied as *Penaeus latisculatus* (Penn, 1980); *Macrobrachium vollenhovenii* (Udo and Ekpe, 1991) and *M. nipponense* (Masshiko, 1990). Also fecundity increases with the body length of the species, a rule that seems more applicable to crustaceans than to fish (Sastry, 1983). The low egg count observed in this study might be related to environmental factors, the sampling techniques and the age of the 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) showed that is positive relationship exists between weight and the number of eggs. 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* lays 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 larva 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.

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CONCLUSION

- The size of eggs of *M. macrobrachion* recorded for Luubara creek was small compared to other studies.
- The range of absolute fecundity and the mean number of eggs per female was also low compared to other results.
- A strong correlation exists between the number of eggs and total length of berried females as other studies.
- Fecundity is a linear function of the body weight and body length in *M. macrobrachion* from Luubara Creek as other studies.

ACKNOWLEDGMENT

We are grateful to God Almighty for the strength, knowledge and wisdom in researching and writing this article. We also thank our numerous colleques, friends, wives and students whose names are too numerous to mention here due to space but contributed immensely to the success of this work.

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