The Recruitment Pattern of *Macrobrachium macrobrachion* (Herklots, 1851) from Luubar Creek, Ogoni Land, Niger Delta, Nigeria

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**Abstract:** The recruitment pattern of *Macrobrachium macrobrachion* from Luubar creek in Ogoni land area of Niger Delta region in Nigeria was studied for a period of twelve calendar months (January - December, 2007). The recruitment pattern of *M. macrobrachion* showed that there were two peaks per year (a major one in March while the secondary one was in August). However, there is a year round recruitment with the highest recruitment in March (16.16%) while the lowest recruitment was in October (0.42%). The growth parameters obtained for the recruited shrimps were $L_\infty = 88.01$, $K = 0.58$, $C = 0.05$, $WP = 0$ and $C = 0$. $C$ indicates the amplitude of seasonal growth oscillations (that is, the magnitude of the growth patterns) and has values ranging from 0 to 1. $WP$ (winter point) indicates the time of the year during which growth is minimal for temperate species but may not be applicable for tropical species. Juveniles and females were observed in the creek throughout the study period. Ovigerous females were also observed in the creek throughout the study period. There were more females than males in the population and probably this allowed for continuous replacement.

**Keywords:** Luubar Creek, *Macrobrachium macrobrachion*, Niger Delta, Nigeria, Ogoni Land, recruitment pattern

**INTRODUCTION**


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 distincstively 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 Singhokla, 1982). The female’s genital pores situate 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 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

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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.

Shrimps and prawns of the genus Macrobrachium 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 Bassir, 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.

Recruitment is a complex process involving a chain of events in the life cycle of the shrimp. Recruitment occurs when an age group integrates itself for the first time into the exploitable stock (Pitcher, 1982). It is more or less a function of age (or size) when the juveniles grow large enough to stay with the main body of adults. Recruitment depends on where shrimp of catchable sizes are located and to some extent this depends upon the kind of gear and fishing boats used. Garcia and Reste (1981) suggested four situations when shrimps can be said to be recruited to the fishery:

- When the shrimps leave the nursery edges and become accessible to artisanal fisheries.
- When they reach the large bays where they are accessible to small trawlers.
- During migration, when they are caught by fixed nets.
- When they reach the sea and are caught by industrial trawlers.

If a certain percentage of a shrimp population present in an area is recruited, a recruitment curve can be obtained if the percentages are plotted against the size of the shrimp. Knowledge of recruitment is necessary for proper management of a fishery. It is necessary to know the sizes (or age) which the shrimp get encountered with the fishing gears so that the amount of catch can be controlled.

Recruitment can be a gradual process where the young shrimp slowly migrate into deeper water as they grow larger. There are situations where a whole cohort of shrimp is recruited and leading to an early end of recruitment. This type of recruitment is termed “Knife-edge recruitment”. It is common in small fishes and shrimps (King, 1995; Abowei et al., 2006, 2008).

Recruitment patterns thus vary considerably in shrimp species. Recruitment can easily be estimated using such models as FAO ICLARM Stock Assessment Tool (FISAT) (Gayanilo and Pauly, 1997), analysis of the length - frequency data of the shrimp available (Sparre et al., 1989; Abowei et al., 2010) and by using the electronic frequency analysis (ELEFAN) (Gayanilo et al., 1988; Abowei, 2010).

Various models have been used to describe the type of curve, stock and recruitment relationships (Ricker 1954; Beverton and Holt, 1957). Pitcher (1982) stated that Ricker (1954) recruitment model describes a family of humped curves with low recruitment at high stock levels, whereas the Beverton and Holt (1957) models covers a family of asymptotic curves exhibiting constant recruitment beyond a certain stock density.

The Ricker (1954) model implies strong density dependence, increasing geometrically over a certain range of stock densities whereas the Beverton and Holt (1957) model implies an arithmetically progressive reduction in the recruitment rate as stock density increases. Both models can be used to describe the stock/recruitment relationships of shrimp. The Ricker model is often applied when strong density-dependent mechanisms operate (e.g. cannibalism by adults on fry) while the Beverton and Holt model is more applicable when a ceiling of recruit abundance is imposed by available food or habitat or when a predator continually adjusts its own attack rate to changes in prey abundance. A study of The Recruitment Pattern of Macrobrachium macrobrachion from Luubara Creek in Ogoni Land will provide information for the management of the species in the fishery and similar water bodies.

**MATERIALS AND METHODS**

**Study area**: The study was carried out in Luubara creek in Ogoni land area of Niger Delta region in Nigeria was studied for a period of twelve calendar months (January - December, 2007). The creek is a tributary of the Imo River and is located between longitudes 7°15’ E - 7°32’ E and latitudes 4°32’ - 4°37’ N in the eastern part of the Niger Delta. The upper part of the creek extends from Bori and meanders through Witiyaakara, 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, Aveceinia africana, Laguncularia racemosa etc. whereas the freshwater has dense vegetation comprising of large trees, various palms and aquatic macrophytes at the low intertropical zone. In freshwater area are Cocos species, Eliasi species, Nymphae species, Lemna species and Raffia species.

It is characterized by high ambient temperature usually about 25.5°C 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 Chrysiptchys auratus, C. nigrodigitatus, Hydrocynus forskali, Clarlias garteipinus, Pellonula leonensis, Malapterurus, electricus, Gymnarchus niloticus, Synodontis nigri Hepsetus odoe, Herichromis, 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, M. equidens; Palaemonetes africanus; Cardina africana and Desmocrates tripisosa.

**Specimen sampling:** The shrimp samples were collected fortnightly from three stations along the creek: namely Wiyyaakara, 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 fisherman 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 the formula:

$$P = \frac{1}{1 + \exp \left[-r (L - L_m)\right]}$$

where;

- \( P \) = Proportion of sexually mature individuals
- \( L \) = Length of fish (shrimp)
- \( r \) = Slope of curve
- \( L_m \) = 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:

$$P = \frac{1}{1 + \exp \left[-r (L - L_c)\right]}$$

where;

- \( P \) = Probability of capture
- \( L \) = Length of fish (shrimp)
- \( r \) = Slope of curve
- \( L_c \) = 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).

The recruitment pattern of the shrimps was estimated by using the FiSAT programme (Gayanilo and Pauly, 1997). In this method recruitment patterns was analyzed by fitting the frequency data for each month and pooling them together for each year.

**RESULTS**

Recruitment pattern estimated during the study is given in Table 1. The recruitment pattern of

**Table 1:** Recruitment pattern of *M. macrobrachion* in Luubara creek for 2007

<table>
<thead>
<tr>
<th>Month</th>
<th>% Recruitment</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>12.97</td>
</tr>
<tr>
<td>February</td>
<td>11.32</td>
</tr>
<tr>
<td>March</td>
<td>16.16</td>
</tr>
<tr>
<td>April</td>
<td>14.87</td>
</tr>
<tr>
<td>May</td>
<td>12.14</td>
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<tr>
<td>June</td>
<td>7.80</td>
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<tr>
<td>July</td>
<td>5.74</td>
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<tr>
<td>August</td>
<td>9.43</td>
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<tr>
<td>September</td>
<td>5.41</td>
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<tr>
<td>October</td>
<td>0.42</td>
</tr>
<tr>
<td>November</td>
<td>3.73</td>
</tr>
<tr>
<td>December</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The presence of berried females throughout the year observed in the Luubara creek suggests that recruitment of *M. macrobrachion* was continuous and that breeding activity is all year round. In fact, Sastry (1983) observed that shrimps exhibit various spawning patterns depending on the geographical location. Consequently, majority of tropical shrimps shows several spawning peaks per year.

This trend has also been reported for *M. macrobrachion* (Marioghae and Ayinla, 1995), *Macrobrachium olfersii* (Mossolin and Bueno, 2002), *Atya Scabra* (Galvao and Bueno, 1999), *Rimapenaeus constrictus* (Costa and Francozo, 2004a, b) and in the spine shrimp *Exppolysmata oplphoroides* (Franzozo et al., 2005). There were more females than males in the population and probably this allowed for continuous replacement of population hence Luubara creek may be a breeding / nursery ground for the species. In most cases shrimps are recirculated throughout the year but seasonal variations occur.

For instance Garcia (1985) and Reste (1978) reported that penaeid shrimps were more abundant in the dry season than in the wet season. They observed that annual migration of *Penaeus duorarum* (*P. notialis*) and *P. setiferus* was related to the rise in temperature in the dry season and consequently high recruitment during this period. Enin (1995) reported a year round recruitment for *M. macrobrachion* in Cross River estuary. With two peaks in the months of December and June.

Waribugo (2005) reported that recruitment of *Nematopalacmon hastius* in the River Nun estuary had two peaks which occurred in the months of July and November. She also reported two peaks of recruitment for *Palaemon maculatus* which occurred in the months of September and February equivalent to rainy season and early dry season, respectively.

**CONCLUSION**

- The recruitment pattern of *M. macrobrachion* showed two peaks in the year similar to other study reports.
- Recruitment was all year round.
- The growth parameters indicated the amplitude of seasonal growth oscillations.
- Juveniles and females were present in the creek throughout the year.
- Ovigerous females were also present in the creek throughout the year.
- There were more females than males in the population and probably this allowed for continuous replacement.

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**REFERENCES**


