



## FECUNDITY AND GONADOSOMATIC INDEX OF NIGER RIVER PRAWN, *Macrobrachium felicinum* IN THE LOWER TAYLOR CREEK, NIGER DELTA, NIGERIA

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### ABSTRACT

The fecundity and Gonadosomatic index of *M. felicinum* was studied between June 2008 and May 2010 in the lower Taylor Creek, Niger Delta, Nigeria. The sex ratios showed that *M. felicinum* deviated significantly from the ratio 1:1 and females dominated ( $X^2 = 411.20$ ,  $df = 1$ ,  $P < 0.001$ ). Fifty percent of the female populations attained sexual maturity at size class 4.5 – 5.0 cm total length. The highest Gonadosomatic Index (GSI) for *M. felicinum* was attained in October 2008 while the lowest values were recorded in November 2008 and 2009 ( $P < 0.001$ ). There were no monthly and seasonal variations in the GSI means ( $P > 0.05$ ). However, there were significant differences in the GSI values of the size classes ( $P < 0.05$ ). The overall fecundity of *M. felicinum* ranged from 205 eggs (Total length, TL = 3.70 cm) to 8501 eggs (TL = 5.50 cm) with a mean of  $2617 \pm 207$  eggs ( $P < 0.001$ ). Relative fecundity ranged from 43 to 1546 eggs/cm or 155 to 3847 eggs/g with overall means ( $\pm$  S.E) of  $514 \pm 37$  eggs/cm or  $1652 \pm 102$  eggs/g. The correlations of fecundity – total length, fecundity – gonad weight and fecundity – body weight relationships were positive and gonad weight gave the best predictive values.

**Keywords:** Gonadosomatic index, fecundity, shrimps, ovigerous, berried

### INTRODUCTION

The Niger River prawn (*Macrobrachium felicinum*, Holthuis, 1949) is an inhabitant of large white water rivers with sandy and/or rocky bottoms (Powell, 1983). It constitutes 59.18% (by number) of Ingo trap catches in the lower Taylor Creek (Kingdom, 2012). Although, *M. felicinum* is the most important shrimp species in the non – tidal zones of the Lower Niger and associated rivers in Nigeria (Powell, 1983), little is known about its biology or ecology.

Aspects of the reproductive biology of this species had been studied by Inyang (1984) in the Lower Niger River and Hart *et al* (2003) in a pond in Port Harcourt. The present study is a continuation of those studies on this important species and provides information on its management for sustainable exploitation in the Taylor Creek.

### MATERIALS AND METHODS

The study was carried out in the lower Taylor Creek (a non – tidal freshwater creek) in the Niger

Delta, situated between 5° 01' N; 6° 17' E and 5° 02' N; 6° 18' E (Fig. 1). Sampling was carried out bi – weekly for twenty four months (June 2008 – May 2010) using two sets of basket traps at all the stations. The traps, which were made from canes, measured 31 – 62 cm in length, a mouth opening of 3 – 4 cm in diameter and rectangular mesh sizes of about 3 by 0.5 cm.

Specimens for the study of the reproductive biology were obtained from the samples of *M. felicinum* caught for each month. The total length (from tip of rostrum to tip of telson) of the shrimp was measured in centimeters (cm) with a plastic ruler and individual weights taken in grams (g) using Ohaus balance, Scout Pro Model SPU 402. The sex of each specimen was determined by visual observation of the base of the fifth pair of periopods (Hart *et al*, 2003). In males, the base of the fifth pair of periopods approximates to the middle while that of females is wide. The weights of the ripe eggs were taken in grams and counted.

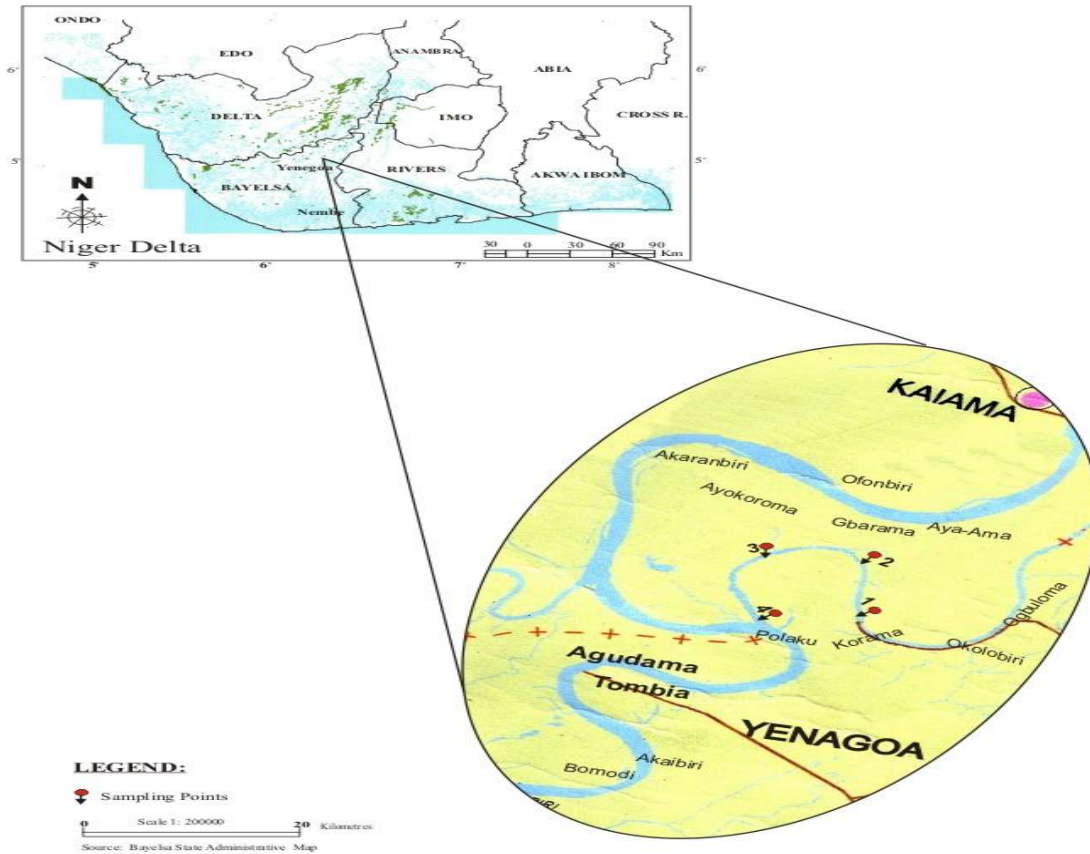


Fig. 1: Map of Niger Delta Showing Bayelsa State and Taylor Creek the Study Area

**Sex Ratio**

The numbers of male and female *M. felicinum* were recorded from the specimens collected. The deviation from the 1:1 ratio was tested using the chi-square test. Monthly ratios were estimated and seasonal and yearly variations of sex ratios were also tested for deviation from the 1:1 ratio with the chi-square test.

**Size-at-first Maturity**

The size at first maturity for the individual prawn refers to the smallest prawn with mature gonads. The size at first maturity for the population was obtained from the smallest size class in which 50% of the female prawns were ovigerous.

**Gonadosomatic Index**

The gonadosomatic index (GSI) was determined (King, 1995) as;

$$GSI = 100 \times \frac{Gm}{Tm}$$

Where Gm = Mass of Gonad  
Tm = Total mass of fish

Mean monthly values were computed and plotted to ascertain monthly, seasonal and yearly variation. Means also were computed for size classes and test of significant differences between males and females tested.

**Fecundity**

Fecundity (absolute fecundity), which is the total number of eggs in the ovaries of a fish prior to spawning (Bagenal, 1978) was estimated by direct counting of spawnable eggs from the ovigerous females. Whole ovaries were carefully detached for each selected individual with forceps and assessed separately. Total weight of each ovary was determined using digital Ohaus balance, Scout Pro Model SPU 402. A sub – sample of the ovary was weighed and the eggs in each sample were spread on a filter paper and counting was done with the aid of stereo microscope and hand – held tally counter. The number obtained was then extrapolated to determine the total number of eggs in the ovary.

Relative fecundity (RF) was obtained as the number of eggs per unit length (cm) or the number of eggs per unit weight (g) of prawns. Scatter diagrams of fecundity against total length, body weight and

gonad weight were plotted using linear regression technique and the best predictive equation for fecundity computed as logarithm transformation of the equation.

$$F = ax^b \text{ (Bagenal, 1978)}$$

i.e.  $\text{Log } F = \text{log } a + b \text{ log } x$

Where:

- a = constant
- b = exponent
- F = fecundity
- x = total length, total body weight, gonad weight

**RESULTS**

**Sex ratio**

The sex ratios of *M. felicinum* are given in Table 1. The overall sex ratio of *M. felicinum* deviated significantly from the ratio 1:1 ( $X^2 = 411.20$ ,  $df = 1$ ,  $P < 0.001$ ). Monthly sex ratio varied from 1:0 (in August 2008, April and May 2009, February, March and April 2010) to 1:88 male/female (November 2008). Within the months, male dominated in January 2009 ( $X^2 = 3.60$ ,  $df = 1$ ,  $P <$

0.05) and July 2009 ( $X^2 = 4.50$ ,  $df = 1$ ,  $P < 0.05$ ) and March 2010 ( $X^2 = 4.00$ ,  $df = 1$ ,  $P < 0.05$ ), while females dominated in September 2008 ( $X^2 = 17.29$ ,  $df = 1$ ,  $P < 0.001$ ), October 2008 ( $X^2 = 94.17.17$ ,  $df = 1$ ,  $P < 0.001$ ), November 2008 ( $X^2 = 123.00$ ,  $df = 1$ ,  $P < 0.001$ ), December 2008 ( $X^2 = 74.08$ ,  $df = 1$ ,  $P < 0.001$ ), September 2009 ( $X^2 = 17.33$ ,  $df = 1$ ,  $P < 0.001$ ), November 2009 ( $X^2 = 81.00$ ,  $df = 1$ ,  $P < 0.001$ ) and December 2009 ( $X^2 = 183.90$ ,  $df = 1$ ,  $P < 0.001$ ). There was seasonal variation in the number of individuals based on the sexes. Females were dominant in both dry and wet seasons of 2008 and 2009. However, male dominated in the wet season of 2010 ( $X^2 = 8.05$ ,  $df = 1$ ,  $P < 0.01$ ) while the sex ratio of dry season of 2010 did not deviate from the 1:1 ratio ( $X^2 = 0.25$ ,  $df = 1$ ,  $P > 0.05$ ).

**Size – at – first maturity**

The smallest ovigerous female for *M. felicinum* measured 3.70 cm total length. Table 2 shows that 55.75% of female *M. felicinum* were berried at the size class 4.5 – 5.0 cm total length, indicating that 50% of the female population attained sexual maturity at size class 4.5 – 5.0 cm total length.

**Table 1: Seasonal variation of mean monthly sex ratio of *M. felicinum* in the Lower Taylor Creek**

Month/Season Year	Numbers		Sex ratio	
	M	F	M	F
June 2008	0	0	0:0.00	
July	0	0	0:0.00	
August	1	0	1:0.00	
September	3	25	1:8.33***	
October	12	126	1:10.50***	
November	1	88	1:88.00***	
December	5	11	1:2.20***	
January 2009	8	2	1:0.25*	
February	2	1	1:0.50	
March	3	4	1:1.33	
April	1	0	1:0.00	
May	1	0	1:0.00	
June	4	2	1:0.50	
July	7	1	1:0.14*	
August	6	5	1:0.83	
September	28	69	1:2.46	
October	7	68	1:9.71***	
November	5	95	1:19.00***	
December	13	220	1:16.92***	
January 2010	0	7	0:1.00	
February	8	0	1:0.00	
March	1	0	1:0.00	
April	5	0	1:0.00	
May	12	4	1:0.33*	
Dry 2008	5	11	1:2.20***	
Wet 2008	6	99	1:16.50***	
Dry 2009	16	151	1:9.44***	
Wet 2009	31	322	1:10.39***	
Dry 2010	9	7	1:0.78	
Wet 2010	17	4	1:0.24***	

\*P < 0.05; \*\*P < 0.01; \*\*\*P < 0.001

**Table 2: Size – at – maturity of *M. felicinum* in the Lower Taylor Creek**

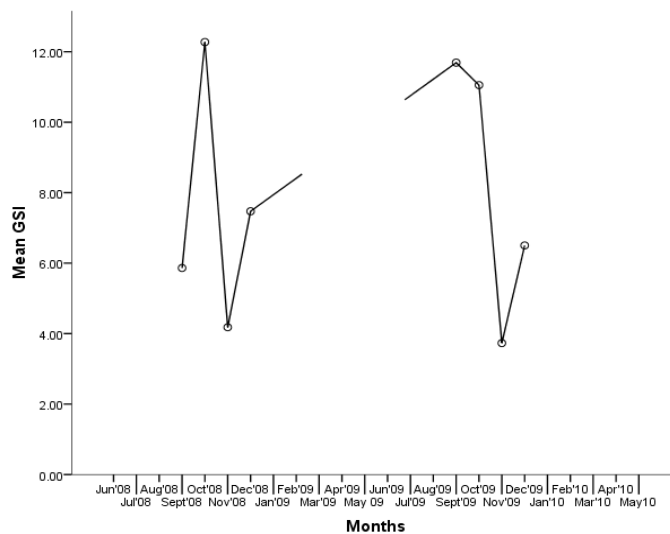
Size class (cm)	Number ovigerous	Percent ovigerous (%)
3.00 – 3.50	1*	-
3.50 – 4.00	3	2.65
4.00 – 4.50	24	21.24
4.50 – 5.00	36	31.86
5.00 – 5.50	40	35.40
5.50 – 6.00	10	8.85
6.00 – 6.50	1*	-

\*Sample with < 2 specimens was not included in analysis

**Gonadosomatic index**

Monthly GSI values for *M. felicinum* are shown in Fig. 2. The highest GSI values for *M. felicinum* were attained in October 2008 while the lowest values were recorded in November 2008 and 2009. There

were both monthly and seasonal variations ( $P < 0.001$ ) in GSI means. However, there was no significant difference in the mean GSI values of different class sizes (Table 3).



**Fig. 2: Mean monthly Gonadosomatic Index (GSI) of *M. felicinum* in the Lower Taylor Creek**

**Table 3: Mean GSI values of different size classes of *M. felicinum* in the Lower Taylor Creek**

Size class (cm)	Sample size	Range	Mean ±S.E
3.00 – 3.50	1*	-	12.20 ± 0
3.50 – 4.00	3	3.03 - 5.08	4.37 ± 3.15 <sup>a</sup>
4.00 – 4.50	24	1.37 - 21.95	7.58 ± 1.11 <sup>a</sup>
4.50 – 5.00	36	1.17 – 24.66	9.84 ± 0.91 <sup>a</sup>
5.00 – 5.50	40	1.37 – 21.95	10.10 ± 0.86 <sup>a</sup>
5.50 – 6.00	10	2.32 – 16.07	9.21 ± 1.72 <sup>a</sup>
6.00 – 6.50	1*	-	7.74 ± 0

\*Sample with < 2 specimens was not included in analysis

**Fecundity**

The ranges, mean monthly and seasonal fecundity of *M. felicinum* are given in Table 4. The mean monthly fecundity of *M. felicinum* showed three major peaks. The highest mean absolute

fecundity of  $498 \pm 379$  eggs was recorded in October 2008. The other peaks were observed in September 2009 ( $3188 \pm 310$  eggs) and October 2009 ( $3306 \pm 438$  eggs). But the overall fecundity of *M. felicinum* ranged from 205 eggs (Total length, TL = 3.70cm) to

8501 eggs (TL = 5.50cm) with a mean of  $2617 \pm 207$  eggs. There were both monthly and seasonal variations in the fecundity ( $P < 0.001$ ). Relative fecundity ranged from 43 to 1546 eggs/cm or 155 to 3847 eggs/g with overall means ( $\pm$  S.E) of  $514 \pm 37$  eggs/cm or  $1652 \pm 102$  eggs/g.

Fecundity/total length, fecundity/gonad weight and fecundity/body weight relationships of *M. felicinum* in the Lower Taylor Creek are shown in

Figs. 3 - 5 respectively. The relationships of this population expressed in linear regression are as follows:

$$F = 0.45TL^{4.18} \quad (r = 0.55; r^2 = 0.30; P < 0.001)$$

$$F = 4.24GW^{0.95} \quad (r = 0.92; r^2 = 0.85; P < 0.001)$$

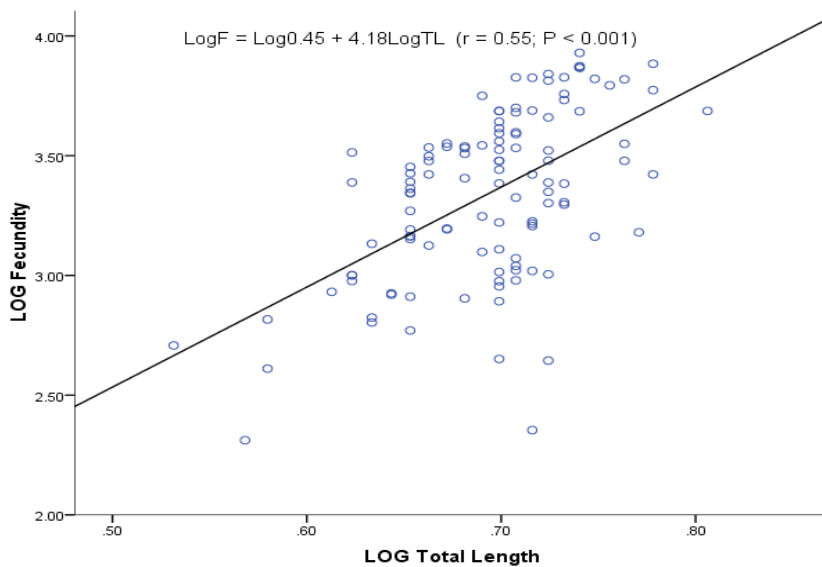
$$F = 3.11BW^{1.39} \quad (r = 0.61; r^2 = 0.37; P < 0.001)$$

The correlations were all positive and gonad weight had the best predictive value of 0.92.

**Table 4: Monthly and Seasonal variation of fecundity of *M. felicinum* in the Lower Taylor Creek**

W	Sample size	Fecundity		Relative Fecundity	
		Range	Mean $\pm$ S.E	Mean egg number/cm	Mean egg number/g
Sep-08	5	854 - 3325	$1654 \pm 759^{bc}$	$339 \pm 137^{bc}$	$1222 \pm 375^{bcd}$
Oct-08	20	1645 - 7658	$4981 \pm 379^a$	$928 \pm 68^a$	$2682 \pm 188^a$
Nov-08	7	226 - 3010	$1916 \pm 641^{bc}$	$345 \pm 116^{bc}$	$970.30 \pm 317^d$
Dec-08	6	2459 - 3222	$2766 \pm 692^{bc}$	$594 \pm 125^{bc}$	$2225 \pm 343^a$
Mar-09	1*	-	$510 \pm 0$	$150 \pm 0$	$1244 \pm 0$
Jul-09	1*	-	$408 \pm 0$	$107 \pm 0$	$6915 \pm 0$
Aug-09	1*	-	$655 \pm 0$	$172 \pm 0$	$1092 \pm 0$
Sep-09	30	448 - 7481	$3188 \pm 309^{bc}$	$630 \pm 56^{ab}$	$1982 \pm 153^{ab}$
Oct-09	15	900 - 8501	$3306 \pm 437^b$	$643 \pm 79^{ab}$	$1897 \pm 217^{abc}$
Nov-09	4	842 - 2306	$1418 \pm 848^c$	$288 \pm 153^c$	$1026 \pm 420^{cd}$
Dec-09	25	205 - 4862	$1709 \pm 339^{bc}$	$351 \pm 61^c$	$1213 \pm 168^{bcd}$
<b>Season</b>					
Dry	42	205 - 4862	$1953 \pm 328^b$	$395 \pm 59^b$	$1359 \pm 162^b$
Wet	70	408 - 8501	$3282 \pm 250^a$	$635 \pm 45^a$	$1946 \pm 124^a$
<b>Overall</b>	112	205 - 8501	$2617 \pm 207$	$514 \pm 37$	$1652 \pm 102$

\*Samples with < 2 specimens were not included in analysis



**Fig. 3: Relationship of Fecundity and Total length of *M. felicinum* in the Lower Taylor Creek**

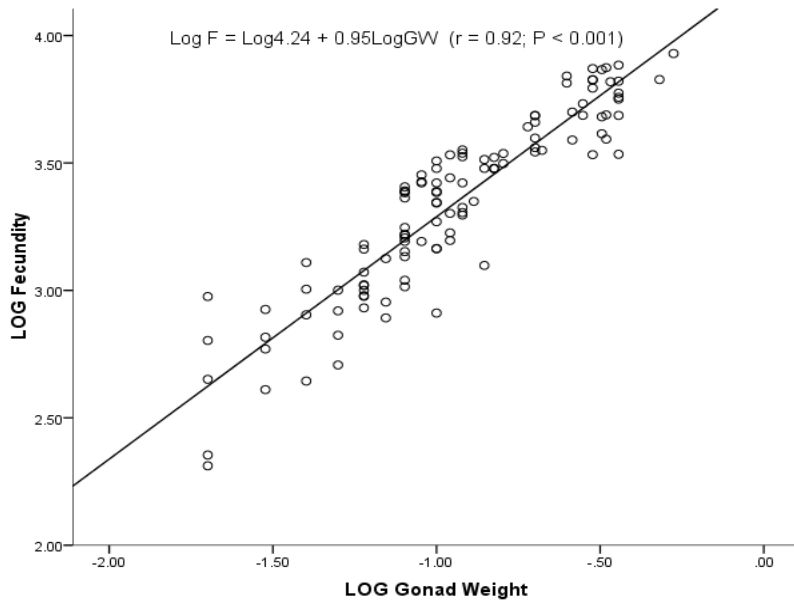


Fig. 4: Relationship of Fecundity and Gonad weight of *M. felicinum* in the Lower Taylor Creek

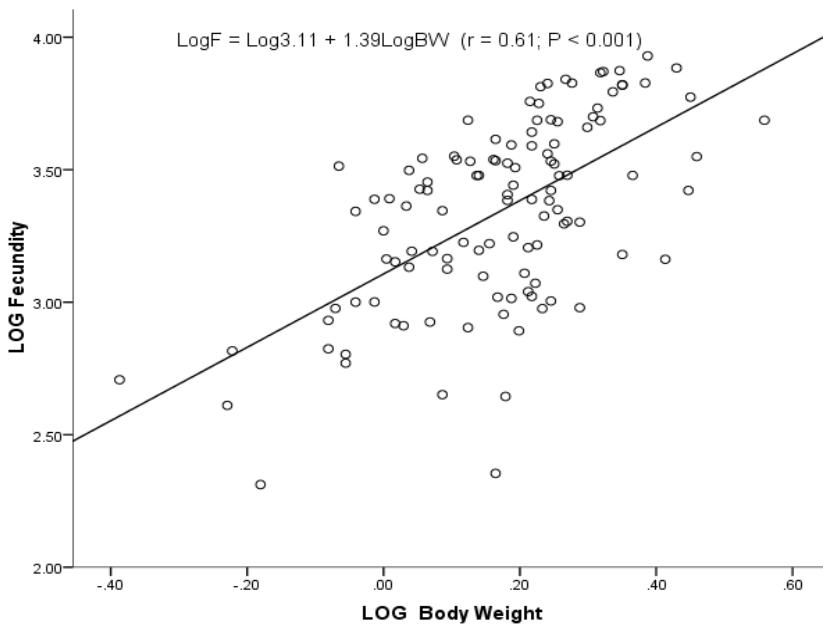


Fig. 5: Relationship of Fecundity and Body weight of *M. felicinum* in the Lower Taylor Creek

## DISCUSSION

### Sex ratio

The inequality in the sex ratio of *M. felicinum* observed in this study had earlier been reported by Inyang (1984) in the Lower Niger River and Hart *et al* (2003) in a pond in Port Harcourt. However, the ratio in favour of females was not as high as the 1:21 reported in that study. The seasonal variation of sex ratio observed in *M. felicinum* may be associated with breeding activities. Olatunde (1978) reported that during breeding season, more females are expected to associate with males, particularly in a situation where there are few males in the population. Reynolds (1974) had already posited that partial segregation of ripe forms, either through habitat preferences or school formation, can render one sex more vulnerable to capture than the other.

### Size – at – first maturity

The size at sexual maturity is of special interest in fisheries management and is widely used as an indicator for minimum permissible capture size (Lucifora *et al*, 1999). The highest frequency of ovigerous females of *M. felicinum* observed in the 5.0 – 5.5 cm size class is contrary to the 47 – 49mm size class reported by Hart *et al* (2003) in a freshwater pond in Port Harcourt. However, 50% of the female population attained sexual maturity at size class 4.5 – 5.0cm total length. Different sizes at first female maturity between areas have been related to differences in temperature and growth (Skulladottir, 1999). However, Stearns and Crandall (1983) maintain that organisms neither mature at a fixed size nor fixed age within the same species, and proposing that these factors are determined by both genes and environment.

### Gonadosomatic index

The maximum GSI (peak of reproduction) of *M. felicinum* was evident during September – October which corresponds with the wet season, which also had a higher GSI than the dry season.

### Fecundity

The absolute fecundity values obtained for *M. felicinum* were highly variable. This situation had been reported by Khmeleva and Goloubev (1986), who observed that many crustaceans have highly variable absolute fecundity values, even in females of similar size. The mean number of eggs per female ( $2617 \pm 207$ ) of *M. felicinum* is a little bit higher than the  $2171 \pm 700$  eggs reported by Hart *et al* (2003) for the species in a pond in Port Harcourt. The differences in the absolute fecundity may be due to differences in environment, food supply (Bagenal, 1978) or egg sizes (Beacham and Murray, 1993).

The Fecundity/total length relationship for *M. felicinum* showed an increase in number of eggs produced with increasing female size; a situation also observed by Albertoni *et al* (2002) in *M. acanthurus*, Hart *et al* (2003) in *M. felicinum* and Deekae and Abowei (2010) in *M. macrobrachion*. The increase of fecundity with body size seems to be a rule that is applicable to many crustaceans (Udo and Ekpe, 1991; Llodra *et al*, 2000). Contrary opinion has been documented by Courtney *et al* (1996) who reported on the decline in number of eggs with an increase in the size of *Penaeus plebejus* and found out that this could possibly be due to ovarian senescence in large (old) females. The increase in the number of eggs with increase in female size of prawns suggests that there are differences in the pattern of allocation of food energy by the prawns at different sizes (Teikwa and Mgaya, 2003). Usually, in larger individuals, who have low growth rates, much of the energy is devoted to egg production while smaller individuals devote large fraction of their energy to growth rather than egg production. The slopes were all within the range of 2.3 – 5.3 calculated for a variety of species by Bagenal (1978). However, gonad weight was the best predictor of fecundity; similar to the observation of Albertoni *et al* (2002) for *M. acanthurus* in a tropical coastal lagoon.

The eggs per gramme body weight of *M. felicinum* were higher than their eggs per centimeter body length. This had also been reported by other workers (Hart *et al*, 2003; Sharma and Shubba, 2005). But it was the reverse in the Silver catfish, *Chrysichthys nigrodigitatus* in Cross River, Nigeria (Ekanem, 2000) and Sharpnose mullet, *Liza saliens* in Gorgan Bay – Miankaleh Wildlife Refuge, the Southeast Caspian Sea (Patimar, 2008), where eggs per centimeter body length were higher than eggs per gram body weight. A possible reason for this difference may be as a result of the differences in egg sizes.

## REFERENCES

- Albertoni, E. F., Palma-Silva, C. and Esteves, F. A. (2002). Fecundity of *Macrobrachium acanthurus* Eiegmann, 1836 (Decapoda: Palaemonidae) in a tropical coastal lagoon subjected to human impacts (Macaé, Brazil). *Acta Limnologica Brasiliensia.*, 14(1): 71 – 80.
- Bagenal, T. B. (1978). Aspects of fish fecundity. In: S. D. Gerking (ed) *Ecology of freshwater fish Production* Blackwell Scientific Publications. Oxford. P. 75 – 101.
- Beacham, T.D. and Murray, C.B. (1993). Fecundity and egg size variation in North American Pacific

- Salmon (*Oncorhynchus*). *Journal Fish Biology*, 42: 485 – 508.
- Courtney, A.J., Die, D.J. and MacGilvray, J.G. (1996). Lunar periodicity in catch rates and reproductive conditions of adult eastern King prawns, *Penaeus plebejus* in coastal waters of South eastern Queensland, Australia. *Marine and Freshwater Research*. 47: 67 – 76.
- Deekae, S.N. and Abowei, J.F.N. (2010). The fecundity of *Macrobrachium macrobrachion* (Herklots, 1851) from Luubara Creek, Ogoni Land, Niger Delta, Nigeria. *International Journal of Animal and Veterinary Advances* 2(4): 148 – 154.
- Ekanem, S.B. (2000). Some Reproductive Aspects of *Chrysichthys nigrodigitatus* (Lacepede) from Cross River, Nigeria. *Naga, The ICLARM Quarterly*, Vol. 23 (No. 2): 24 – 28.
- Hart, A. I. Ansa, E. J. and Sekibo, I. (2003). Sex ratio, Sexual dimorphism and fecundity in pond reared Niger River prawn, *Macrobrachium felicinum* (Holthius 1949). *The Zoologist* Vol. 2 (1): 56 – 61.
- Inyang, N.M. (1984). On the biology of *Macrobrachium felicinum* Holthuis in Lower Niger River of Southeastern Nigeria. *Revue de Zoologie Africaine* 98 (2): 440 – 449.
- Khmeleva, N.N. and Goloubev, A.P. (1986). *La production chez les crustaces role dans les ecosystems et utilization*. Ed. Ifremer:198pp.
- King, M. (1995). *Fisheries Biology Assessment and Management* Fishing News Books. Blackwell Science Ltd. London, 341 pp.
- Kingdom, T. (2012). Aspects of the Ecology and Fishery of *Macrobrachium* species in the Lower Taylor Creek, Niger Delta, Nigeria. *Ph.D. Dissertation*. University of Port Harcourt, Port Harcourt. 200 pp.
- Llodra, E.R., Tyler, P.A. and Copley, J.T.P. (2000). Reproductive biology of three caridean shrimp, *Rimicaris exoculata*, *Chorocaris chacei* and *Mirocaris fortunata* (Caridea: Decapoda), from Hydrothermal vents. *Journal of Marine Biological Association U.K.*, 80: 473 – 484.
- Lucifora, L.O., Valero, J.L. and Garcia, V.B., (1999). Length at maturity of the green-eye spurdog shark, *Squalus mitsukuii* (Elasmobranchii: Squalidae) from the SW Atlantic, with comparisons with other regions. *Marine and Freshwater Research*, 50: 629-632.
- Olatunde, A.A. (1978). Sex, reproductive cycle and variations in the fecundity of the family Schilbeidae (Osteichthyes: Siluriformes) in Lake Kainji, Nigeria. *Hydrobiologia*, 57 (2): 125 142.
- Patimar, R. (2008). Some Biological Aspects of the Sharpnose Mullet *Liza saliens* (Risso, 1810) in Gorgan Bay – Miankaleh Wildlife Refuge (the Southeast Caspian Sea). *Turkish Journal of Fisheries and Aquatic Sciences*, 8: 225 – 232.
- Powell, C. B. (1983). Fresh and brackishwater shrimps of economic importance in the Niger Delta. In: *Proceedings of the 2<sup>nd</sup> Annual Conference of the Fisheries Society of Nigeria (FISON), Calabar*, 25 – 27 January, 1982, p. 254 – 285.
- Reynolds, J.D. (1974). Biology of the small Pelagic fishes in the New Volta in Ghana. Part III Sex and reproduction. *Hydrobiologia*: 45: 489 – 508.
- Sharma, A. and Shubba, B. R. (2005). General Biology of Freshwater Prawn, *Macrobrachium lamarrei* (H. Milne- Edwards) of Biratnagar, Nepal. *Our Nature* (3): 31 – 41.
- Skulladotir, U. (1999). Defining populations of northern shrimp, *Pandalus borealis* (Kroer 1838), in Icelandic waters using maximum length and maturity ogive of females. *Rit Fiskideidar*, 16: 247 – 262.
- Stearns, S.C. and Crandall, R.E. (1983). Plasticity for age and size at sexual maturity: A life – history response to unavoidable stress. Potts, G.W. and Wootton, R.J. (eds). *Fish Production: Strategies and tactics*. Academic Press Inc., London Ltd., p. 11 – 33.
- Teikwa, E.D. and Mgaya, Y.D. (2003). Abundance and Reproductive Biology of the Pennaeid Prawns of Bagamoyo Coastal Waters, Tanzania. *Western Indian Ocean Journal of Marine Sciences* Vol. 2, No. 2: 117 – 126.
- Udo, P. J. and Ekpe, E. D. (1991). Fecundity in the African river prawn *Macrobrachium vollenhovenil* (Herklots, 1857) from natural habitats. *Journal of Aquaculture in the Tropics* 6:173 – 177.