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***Research Article** (Open Access)*

THE FECUNDITY OF THE FRESHWATER PRAWN *MACROBRACHIUM HENDERSODAYANUM*, FROM TARAI REGION OF KUMAUN, UTTARAKHAND, INDIA

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ABSTRACT
Freshwater prawns are highly sought-after aquaculture commodities Tarai regions. The paper deals with fecundity and fertility of *Macrobrachium hendersodayanum* a fresh water crustacean. A study was conducted over a one-year period to examine the correlation between fecundity and other bodily parameters. A direct correlation was seen between the length of the prawn and its brood fecundity, as well as between the weight of the prawn and its brood fecundity. Additionally, a direct correlation was observed between the weight of the shrimp's ovary and its ovarian fecundity. The correlation coefficient (r) of the relationship between body length/brood fecundity and body weight/brood fecundity were 0.889 ($p<0.01$) and 0.841 ($p<0.01$) respectively, indicating a significant relationship between them. A highly significant relationship was observed between ovary weight and ovarian fecundity with the correlation coefficient (r) value as 0.981 ($p<0.01$). As the individual's body size increased, there was a corresponding linear increase in the number of eggs, indicating a positive correlation between fecundity and body growth in females.

Keywords: *Ovarian Fecundity, Brood fecundity, Macrobrachium hendersodayanum, Length, Bodyweight*

INTRODUCTION
The freshwater prawn under consideration falls into the category of minor prawns. It possesses distinctive attributes such as a unique taste, high unit value, and a continuously growing demand in the market, which have elevated its significance. Despite being overlooked in the past within the inland aquatic ecosystem, its rapid growth and early sexual maturity render it a suitable candidate for cultivation. This species, comparable in size and availability to other exploitable minor prawn species in our country, holds significance as a protein-rich local food resource.
"Fecundity refers to the total number of eggs potentially produced in a single spawn, serving as an indicator of reproductive capacity in egg-laying animals. The examination of reproductive biology, including fecundity and fertility, in palaemonid prawns is crucial for assessing potential candidates for aquaculture and devising strategies for biodiversity preservation (Mossolin and Bueno, 2003). Within this group, fecundity can be defined as the quantity of eggs laid per hatching, typically found attached to the female pleopods (Lima et al., 2014). Understanding species fecundity is vital for estimating the reproductive potential and stock size of natural populations."
The *Macrobrachium* species exhibits distinctive morphological characteristics, including modified second walking legs forming chelae, and displays notable sexual dimorphism, with mature males typically larger than females. Understanding such morphological differences between sexes is imperative in comprehending the reproductive strategies and behavior of *Macrobrachium hendersodayanum*. Male cephalothoraxes are proportionally larger than those of females, while female abdomens tend to be narrower. The female's pleura creates a brood chamber where eggs are carried from laying to hatching. A

mature ovigerous female can be easily identified by the presence of large, orange-colored ovaries occupying a significant portion of the cephalothorax.

These decapods have been documented in diverse freshwater habitats, ranging from clear, fast-flowing streams to slow-moving lowland rivers, freshwater swamps, stagnant ponds, rice fields, and even pools within tree holes and leaf axils. They primarily emerge at night to feed and are omnivorous, with some species serving as important food sources for various vertebrates (Yeo et al., 2008).

Macrobrachium hendersodayanum, a freshwater prawn native to the Tarai region of Kumaun, Uttarakhand, India, presents an intriguing subject for fecundity research. Fecundity, the reproductive potential of an organism, plays a crucial role in understanding its reproductive biology, population dynamics, and ecological significance.

The Tarai region of Kumaun, Uttarakhand, India, provides a unique habitat for *Macrobrachium hendersodayanum*, offering valuable insights into its fecundity and reproductive biology. By quantifying the number of eggs produced per spawn and examining factors influencing fecundity, such as environmental parameters and physiological characteristics, this research contributes to our understanding of the reproductive biology of this species. In the context of *Macrobrachium hendersodayanum*, elucidating fecundity holds significant implications for both conservation efforts and aquaculture practices.

Furthermore, the findings of this study hold practical implications for the conservation and management of freshwater prawn populations in the Tarai region of Kumaun, Uttarakhand, India. Knowledge of fecundity is essential for estimating population dynamics, designing effective conservation strategies, and promoting sustainable aquaculture practices. Through this investigation, we endeavor to enhance our understanding of the reproductive biology of *Macrobrachium hendersodayanum* and contribute to the sustainable management of freshwater prawn populations in the Tarai region of Kumaun, Uttarakhand, India.

MATERIALS AND METHODS

This research was done in Melaghat canal located at Khatima of Udham Singh Nagar. This canal site serves as a unique habitat. It is very difficult to catch lobsters from one place in freshwater. The area selected in this research is within the 10 km range in Malaghat. So the study area was divided into separate research stations (Figure 1).

The process of collecting prawn samples and identifying them involves putting up 36 and 6 cm-tall traps parallel to the canals. Ten traps were set in the water at each study sample point and left there for six hours. Following collection, every prawn specimen was examined in a lab. Every individual Prawns overall length (measured in centimeters), body weight (measured in grams), and sex (defined as the presence or absence of the male appendix on the second pair of pleopods) were recorded, among other anatomical body components. To the closest 5.8 cm, the total length (TL) was measured.

Fecundity of these species was estimated both in terms of brood and ovarian fecundity. The estimation was done by collecting the berried and ovigerous females from the site during their breeding period (January to March). To determine the brood fecundity of prawns, the weight and length of the females were initially measured before extracting eggs from their bodies (see Plate 1). Subsequently, the total number of eggs in the brood pouch was calculated by counting them with the assistance of forceps. In order to estimate the ovarian fecundity, fully matured females were taken then ovaries were dissected out from their body, weighed and then number of the ova counted. The counting of ova/eggs was done in 70% alcohol in a petridish. The relationship among brood fecundity/body length, brood fecundity/body weight and ovarian fecundity/ovary weight were established with the equation given by Santos (1978) as follows:

$F = a + bX$

Where,

F = Fecundity.
a, b = Constants
X = Body length or Body weight or ovary weight.

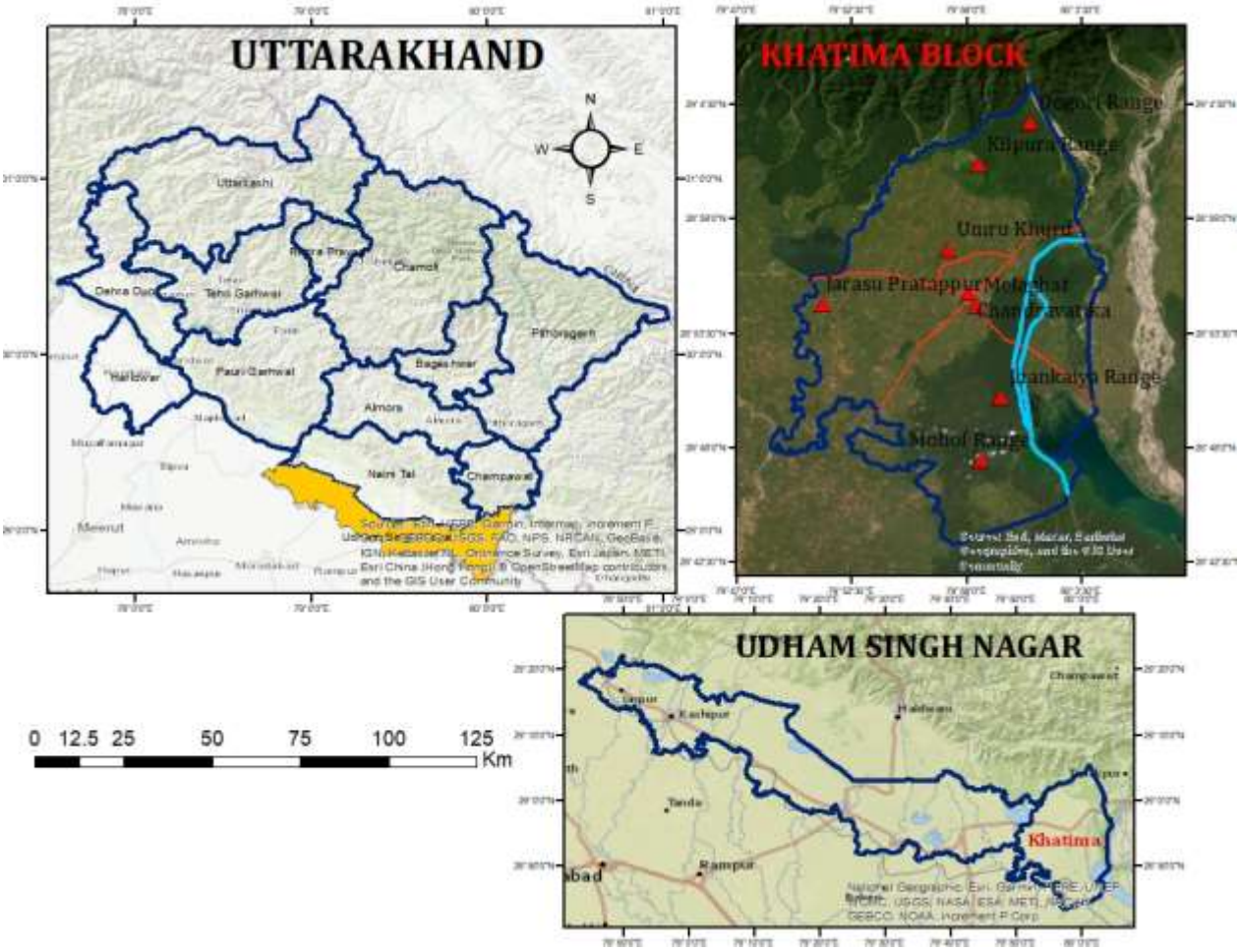

Figure 1. Melaghat canal at Khatima of Udham Singh Nagar in Uttarakhand State

RESULTS AND DISCUSSION

In this study, berried females with total lengths ranging from 48 to 64 mm were investigated for fertility. Also counted was the total number of ova throughout the whole ovary; matching data are shown in Figures 1, 2, and 3. The brood fecundity of individual prawns varied, with values ranging from 50 in prawns with a total length (TL) of 48 mm to 156 in prawns with a TL of 64 mm. Linear relationships were established between brood and ovarian fecundity and various body parameters (total body length, total body weight, and total ovary weight) for *M. hendersodayanum* in this study. The coefficient of correlation (r) for each relationship was also determined and presented in Table 1.

Table 1: Regression coefficients "b", intercept "a", and correlation coefficient "r" for Brood Fecundity/Total Body Length, Brood Fecundity/Total Body Weight, and Ovarian Fecundity/Ovary Weight values.

Sr. No.	Relationship		Intercept "a"	Regression coefficients "b"	Correlation coefficient "r"
	Dependent variable	Independent variable			
1	Brood fecundity	Total body length (TBL)	-154.1	4.759	0.889 ($p<0.01$)
2	Brood fecundity	Total body weight (TBW)	48.34	36.26	0.841 ($p<0.01$)
3	Ovarian fecundity	Ovary weight (OW)	59.26	597.1	0.981 ($p<0.01$)

The fecundity of the prawn was increasing with the increase of the total body length which can be expressed by the following equation:
Y= -128.3+4.324X, r = 0.889. i.e., Brood Fecundity = -154.1+4.759 Total length (TL)

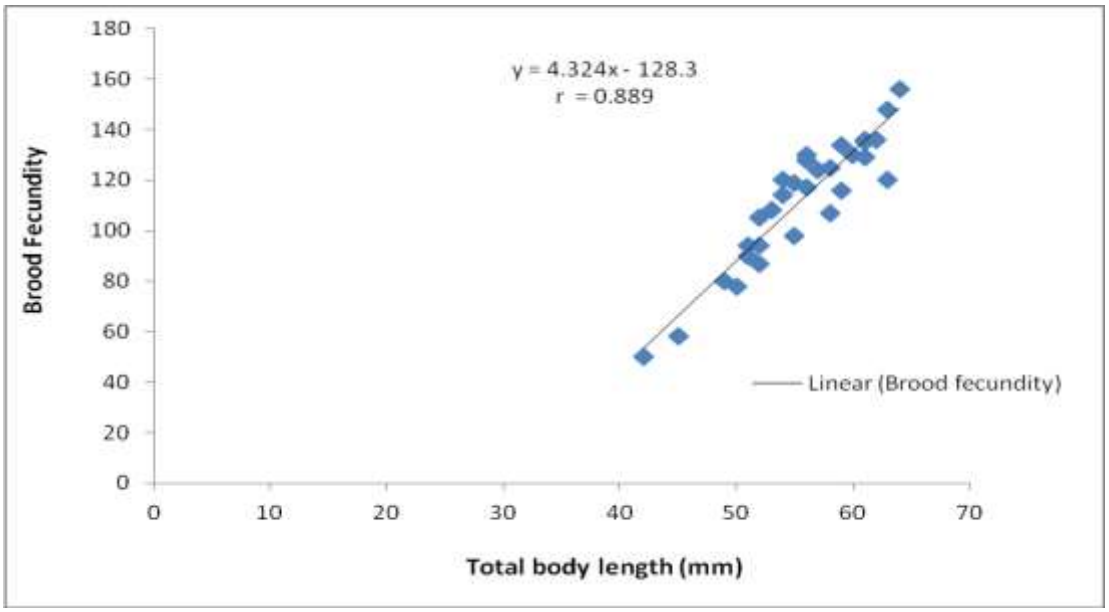

Figure 1: Showing the correlation among brood fecundity and total body length of *M. hendersodayanum*

As shown in Figure 1, the correlation coefficient (r) was determined to be 0.889, with a $p<0.01$, indicating that the association is statistically significant. The differences observed in fecundity could be due to varying factors such as the physiological state of the females and the conditions of the riverine environment, including seasonal variations. Graziani et al., (1993) noted that the fecundity of *Macrobrachium* species is linked to the age of the female, increasing as the female matures. To begin, knowing how fertile this species is is important for figuring out how many offspring it can have, which has a direct effect on population dynamics and management methods. One female prawn can lay a certain amount of eggs during a single reproductive cycle. This is called fecundity. It can measure population size and predict reproductive output by studying fecundity. These are important skills for managing fisheries and protecting wildlife. *Macrobrachium hendersodayanum* females ranged in fecundity from 50 to 156, with sizes between 48 and 64 mm. According to Sharma and Subba (2005), females of *Macrobrachium*

rosenbergii measuring between 14.3 and 23.5 cm shown fecundity ranging from 24,225 to 191,092, whereas females of *M. malcolmsonii* measuring between 5.4 and 16.5 cm demonstrated fecundity ranging from 3,500 to 94,000. Fecundity in female *M. malcolmsonii* ranges from around 3,500 to 94,000 throughout sizes from 54 to 165 mm, according to Rajyalakshami (1980).

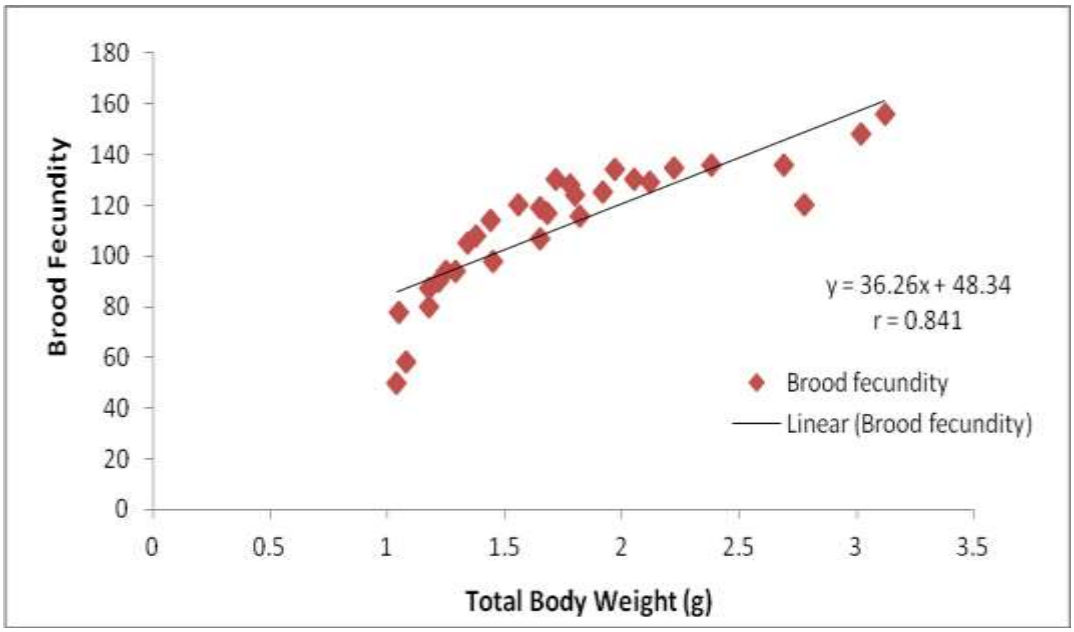

Figure 2: Showing the relationship among brood fecundity and total body weight of *M. hendersodayanum*

Total body weight was plotted against brood fecundity, and the results showed that there was a linear relationship between the two variables. The equation that may be used to represent the connection is as follows: Y = 48.34+36.26 X, r = 0.841, which means that F = 48.34+36.26 TW. As shown in Figure 2, the correlation coefficient (r) was determined to be 0.841, with a $p<0.01$. This correlation indicates that it is statistically significant.

In the fecundity studies of *M. hendersodayanum* a strong relationship between the prawn length and brood fecundity, prawn weight and brood fecundity, prawn ovary weight and ovarian fecundity has been observed with the linear model of regression. The correlation coefficient (r) of the relationship between body length and brood fecundity, and body weight and brood fecundity were 0.889 ($p<0.01$) and 0.841 ($p<0.01$) respectively, indicating a significant relationship. Highly significant relationship between ovary weight and ovarian fecundity has been observed with the correlation coefficient (r) value as 0.981 ($p<0.01$). The equation used for establishing the relationship was Y=a+bX. The other species which used this equation are *M. rosenbergii* (Rajyalakshmi, 1961) and *lobster Panulirus interruptus* (Barrera et al., 1981) etc. In *M. rosenbergii* also a linear relationship between body size and fecundity has been described by Ling (1969). *Macrobrachium hendersodayanum* is a medium sized prawn fish and it has a good breeding capacity considering its body size.

In terms of number of ova in ovary (Ovarian fecundity) it was noticed that the fecundity was highly correlated with prawn ovary weight. The relationship can be expressed by the equation: Y= 59.26+597.1X, r = 0.981 i.e., Ovarian Fecundity=59.26+597.1 of the total ovary weight. The correlation coefficient (r) was found to be 0.981 ($p<0.01$) which indicates that the relationship is highly significant (Figure 3).

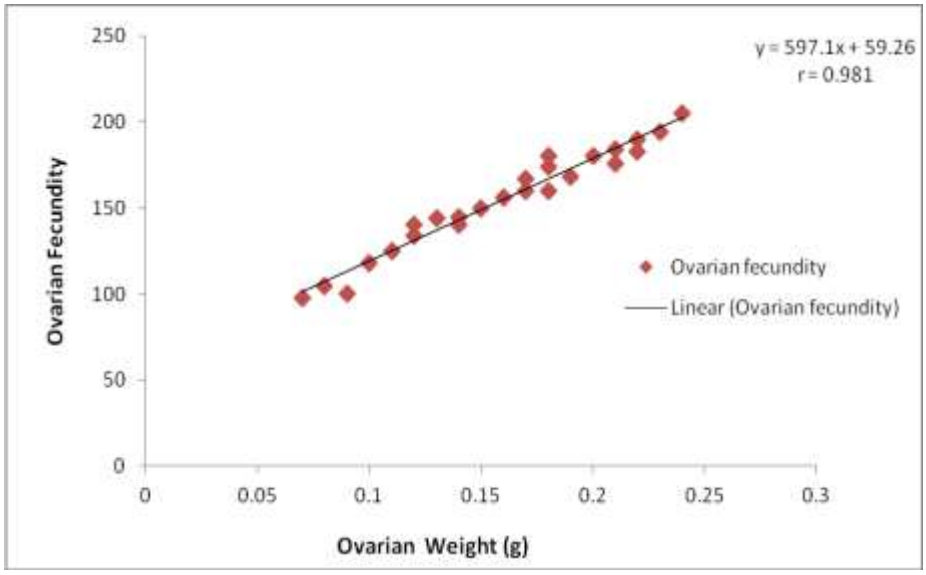

Figure 3: Showing the relationship among ovarian fecundity and total ovary weight of *M. hendersodayanum*.

Plate 2: Fully matured eggs of prawn *M. hendersodayanum*.

Prawns' ability to reproduce clearly shows a relationship between body weight or size and the total number of eggs laid. Fecundity in freshwater prawns is positively correlated with a number of parameters, including total length, standard length, and total weight, according to Bilgin and Samsun (2006). George et al., (2013) found a significant relationship between the number of eggs laid and the weight of the female *Macrobrachium* macrobrachion. According to Deekae and Abowei (2010), *M. macrobrachion's* carapace length correlates with an increase in the number of eggs laid and the weight of the female. In *P. semisulcatus*, Sarada (2010) demonstrated a strong positive correlation between ovarian weight, total length, body weight, and fecundity. In *M. vollenhovenii* and *Pellonula leonensis*, Kingdom and Alison (2011) and Kingdom and Eronadu (2013) observed an increase in egg number with increasing female size. During their investigation, Lima et al., (2015) discovered a linear rise in fecundity with the size of female *M. surinamicum*. As Gjedrem (1983) points out, a number of variables, including the physicochemical characteristics of the aquatic habitat, geographic location, and food availability, can have a substantial impact on a species' fecundity.

There is a significant variation in the quantity of eggs laid by the various prawn species. *Macrobrachium equideus* has lower fertility than *Macrobrachium acanthurus*, according to Valenti et al., (1989). Furthermore, as noted by Bal and Rao (1990), individuals of the same species may produce different numbers of eggs depending on parameters including age, length, weight, and environmental circumstances. According to Graziani et al., (1990), fertility in *Macrobrachium* species is directly correlated with the age of the females and may rise as the females attain maturity. *Macrobrachium hendersodayanum's* ability to reproduce depends on a lot of things, like the quality of its habitat, the conditions of its environment, and the supply of food. To better understand how the species reproduces and make conservation efforts more effective and reproductive studies of *Macrobrachium hendersonianum* in the Terai region of Kumaon have thrown light on its reproductive potential. In *M. hendersodayanum*, larger females produce more eggs per reproductive cycle, according to (Tripathi, 2010). This shows the importance of size-based management in sustainable prawn fisheries.
In conclusion, studying *Macrobrachium hendersodayanum* reproduction in the Tarai area of Kumaun, Uttarakhand, India is important for learning about the species' reproductive biology, helping with conservation efforts, and promoting long-term aquaculture practices. To fill in the gaps in our knowledge and protect the long-term survival of prawn populations in the region, we need to keep doing study across disciplines and working together.

REFERENCES

Bal DV and Rao V (1990). Marine Fisheries of India. *Tata Mac. Graw-Hill Publishing Company Limited* (New Delhi) 472.

Barrera GP, de Leon CAJD and Osorio FV (1981). Fecundiad de la Langosta Roja *Panulirus interruptus* (Randall, 1842) en Baja California. *Ciencia Pesquera,* **1** 99-118.

Bilgin S and Samsun S (2006). Fecundity and egg size of three shrimp species, *Crangon crangon, Palaemon adspersus* and *P. elegans* (Crustacea: Decapod: Caridea) off *Sinop peninsula* (Turkey) in the Black sea. *Turkish Journal of Zoology,* **30** (11) 413-421.

Deekae SN and Abowei JFN (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.

George E, Bassey A, Joseph I and Ubong G (2013). The fecundity of brackish river prawn *Macrobrachium macrobrachion* (Herklots, 1851) from Great Kwa River, Obufa Esuk Beach, Calabar, Cross River State, Nigeria. *Journal of Biology, Agriculture and Healthcare,* **3**(11) 75-82.

Gjedrem T (1983). Genetic variation in quantitative traits and selective breeding in fish and shell fish. *Aquaculture* **33** (1-4) 51-72. ISSN 0044-8486, https://doi.org/10.1016/0044-8486(83)90386-1.

Graziani CA, Chung KS and Dunato M (1990). Comportamiento reproductive y fertile dad de *Macrobrachium carcinus* (Decapoda: Palaemonidae) en Venezuela. *Revista de Biología Tropical,* **41**(3) 657-665.

Kingdom T and Allison ME (2011). The fecundity, Gonadosomatic and Hepatosomatic Indices of *Pellonula leonensis* in the lower Nun River, Niger Delta, Nigeria. *Current Research Journal of Biological Sciences,* **3**(2) 175-179.

Kingdom T and Erondu ES (2013). Reproductive biology of African river prawn *Macrobrachium vollenhovenii* (Crustacea, Palaemonidae) in the Lower Taylor Creek, Niger Delta, Nigeria. *Ecologia, Balkanica,* **5**(1) 49-56.

Lima JF, Silva LMA, Silva TC, Garcia JS, Pereira IS and Amaral, KDS (2014). Reproductive aspects of *Macrobrachium amazonicum* (Decapoda: Palaemonidae) in the State of Amapá, Amazon river mouth. *Acta Amazonica,* **44** 245 – 254.

Lima JDF, DA Cruz CM and Silva LMA (2015). Reproductive biology of *Macrobrachium surinamicum* (Decapoda; Palamonidae) in the Amazon River mouth. *Acta Amazonica*, **45**(3) 299-306 DOI: 10.1590/1809-4392201402824.
Ling SW (1969). Methods of rearing and culturing *Macrobrachium rosenbergii* (de Man.) FAO fisheries report **3**(57) 607-619.
Manna AK and Raut SK (1991). Clutch size in two shrimp species *Macrobrachium lamarrei* and *M. dayanum*. *Journal of Environment and Ecology* **9**(2) 349-351.
Mossolin EC and Bueno SLS (2003). Relative growth of second pereiopod in *Macrobrachium olfersi* (Wiegmann, 1836) (Decapoda, Palaemonidae). *Crustaceana*, **76** 363-376 DOI: 10.1163/156854003765911748
New MB and Singholka S (1982). Freshwater prawn farming: Manual of the culture of *Macrobrachium rosenbergii*. *FAO Fisheries Technical Paper No.* 225; 116.
Rajyalakshmi T (1961). Studies on maturation and breeding in some estuarine Palaemonid prawns. *Proceedings of the National Institute of Sciences of India,* **27B** (4) 179-188.
Rajyalakshmi T (1980). Comparative study of the biology of the freshwater prawn *Macrobrachium malcolmsonii* of Godavari and Hoogly river system. *Proceedings of the Indian National Science Academy,* Part B. *Biological sciences***, 46**(1) 72-89.
Santos EP (1978). Dinamica de populaces aplicada a pesca e piscicultura. *Sao Paulo,* HUCITEC/EDUSP 130.
Sarada PT (2010). Fishery biology of green tiger shrimp *Penaeus semisulcatus* (De Haan, 1844) landed at Puthiappa, Kozhikode, Kerala coast. *Journal of the Marine Biological Association of India*, **52**(1) 24-28.
Shakuntala K (1976). A note on changes in egg weight during the early development of *Macrobrachium rude* (Heller). *Journal of Inland Fisheries Society of India,* **8** 109-110
Sharma A and Subba BR (2005). General biology of freshwater prawn, *Macrobrachium lamarrei* (H. Milne Edwards), of Biratnagar, Nepal. *Our Nature* **3** 31-41.
Valenti WC, Mello JTC and Lobai VL (1989). Fecundidada em *Macrobrachium acanthurus* (Wiegmann, 1836) do Rio Ribeira de Iguape (Crustacea, Decapoda, Palamonidae). *Revista Brasileira Zoologiia* **6**(1) 9-15 https://doi.org/10.1590/S0101-81751989000100002.
Yeo DCJ, Ng PKL, Cumberlidge N, Magalhaes C, Daniels SR and Campos MR (2008). Global diversity of crabs (Crustacea: Decapoda: Brachyura) in freshwater. *Hydrobiologia*. **595**(1) 275-286. https://doi.org/10.1007/s10750-007-9023-3.
Tripathi R (2010). Studies on fecundity in prawn, *Macrobrachium dayanum* (henderson) (crustacea : decapoda), in River Gomti, Uttar Pradesh, India. *Biochemical and Cellular Archives*, **10** (1) 63-68 ISSN 0972-5075