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Morphological Differences Between African River Prawn *Macrobrachium vollenhovenii* and Giant Freshwater Prawn *M. rosenbergii* During Larval Development

Abstract

Wild brooders of African river prawn *Macrobrachium vollenhovenii* were caught from Congo, and larvae were obtained by artificial propagation in a hatchery in the Central African Republic. The larvae were observed to have 15 stages. After that, its morphology transforms into post-larvae, where the 1st post-larval stage is the start of its freshwater life. In the giant freshwater prawn, *M. rosenbergii*, 11 larval stages have been previously described. Morphological differences during larval development of the two freshwater prawns are compared and discussed.

Key words: African river prawn *Macrobrachium vollenhoveni*, Giant freshwater prawn *M. rosenbergii*, Larval morphology

The African river prawn *Macrobrachium vollenhovenii* is widely distributed in several West African countries' river systems, from the uppermost Senegal to the lowermost Angola[1-3]. It has been considered as a candidate species for aquaculture in these countries because it grows faster than other *Macrobrachium* species in West Africa[4-6]. Previous investigators have attempted to study the biology of this prawn, e. g. food habit, the relationship between body weight and body length, and physiological responses[3,7,8]. A coastal marine laboratory in Germany reported the first larval production of this species[9]. However, Liu et al. (1996)[10] completed its entire larval production in the Central African Republic (an inland country). Based on the present study and on previous reports, the authors discuss the morphological difference in larval development between *M. vollenhovenii* and *M. rosenbergii*.

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Materials and Methods

Commercial artificial seawater salt (Aquarium systems, Inc.) was used to prepare the rearing water for the larvae at a salinity of 10-15 ppt. For larval feeding, two regimes were adapted (Fig. 1). First, plankton including algae, rotifers, and daphnia, which were harvested from an outdoor pond, and *Artemia* nauplii were provided immediately after hatching. Second, in addition, egg custard and cattle's liver were added to the feed respectively at the 2nd and 7th larval stage until the 15th larval stage. Rearing water temperature was maintained at 26-28 °C. In order to maintain the water quality on preferable condition, sediment removal and water exchange (1/5 of the tank volume per 24 hours) were regularly done.

Ten larvae were randomly collected to record their total length and morphological characteristics. Total

fork-shaped buds of the 1st and 2nd pereiopods were formed. At the 2nd stage, the 1st and 2nd pereiopods became movable as their exopodites and endopodites were formed; meanwhile, the 3rd pereiopod was just beginning to form a fork-shaped bud and the 4th pereiopod appeared to be a single bud. At the 3rd larval stage, the shape of the 3rd pereiopod remained unchanged but the 4th pereiopod progressed to a fork-shaped structure. Furthermore, the single bud of the 5th pereiopod was formed during this stage. The exopodite and endopodite of 3rd pereiopod which were developed now were the larva's movement organ at the 4th stage. The 5th pereiopod remained immobile notwithstanding the formation of its exopodite. At the 4th stage, the fork-shaped bud of the 4th pereiopod was unchanged and the 5th pereiopod, notwithstanding the formation of its exopodite, remained immobile. At the 5th stage, the 4th pereiopod remained to be immobile but the 5th pereiopod changed to a mobile form. When the larva molted to the 6th stage, the 4th pereiopod was the last to have fully developed exopodite and endopodite and became a functional movement organ. Some difference to what were observed in the larval stages of the giant freshwater prawn, *M. rosenbergii*[11] are shown in Table 1.

Table 1. Comparison of the morphological variations during larval metamorphosis of *Macrobrachium vollenhovenii* and *M. rosenbergii*.

Species	***Metamorphic stages***				
	Stage I	***Stage II***	***Stage III***	***Stage IV***	***Stage V***
M. vollenhove-nii	the compound eyes attached on the orbit	the compound eyes stalk form -ed and sepa- rated from the orbit	1/0* ; the 1st uropod formed and with buds at the base of 2nd uropod	2/0* ; 1st and 2nd uropod formed com- pletely ; trapezoid telson formed	the tip of 2nd uropod reached the base part of the telson
M. rosenber -gii	the compound eyes attached on the orbit	1/0* ; the compo- und eye stalks formed and sepa -rated from the orbit	the 1st uropod formed and with buds at the base of 2nd uropod	2/0* ; the 1st and the 2nd uropod formed completely and trapezoid telson formed	the rectangular telson formed with much longer setae on both sides

(to be continued)

Stage VI	***Stage VII***	***Stage VIII***	***Stage IX***	***Stage X***
the rectangular telson formed and the 4th pereiopod opened	the 2nd uropod's tip (except setae) reached at the mid part of side spines of telson	the length of 2nd uropod's setae to be 3 times compared with side spines of telson; the 5th pereiopod much longer than that at the prior stage	the trapezoid tel- son elongated; the buds on the base of 1-5 pleopods occur -red	the tip of telson formed ; 5 pleopods grew out and formed some setae on the forks
the buds formed at the base of the 1-5 pleopods	5 pleopods branch -ed out two seg- ments and formed forks	3/0*; setae occur -red between spines on rostrum; uropods with a few setae	9/1*;	10/1*; the telson formed sharp tip

(to be continued)

Stage XI	*Stage XII*	*Stage XIII*	*Stage XIV*	*Stage XV*	*Stage XVI*
the left appendage with 5 and right appendage with 3 segments of antennule; 4-6 setae formed on the upper edge of rostrum; with 11-12 segments in the antenna	4-6/0*; with a lot of branched fine setae on the upper edge of rostrum	7-9/0*; the right appendage of anten -nule with 4 segments; 15 segments in the antenna	12/0*; 6 setae existed between the first and second spine on the upper edge of rostrum; 20 segments in the antenna	14/3*; 6-7 setae occurred on the lower edge of rostrum and 25 segments in the antenna	post lar -vae I
12/2*;	post larvae I	-	-	-	-

Note: * data denote the spine pattern on the upper and lower edge of rostrum.
The characters of *M. rosenbergii* were derived from Uno and Kwon[12] and Liao et al.[13]

M. vollenhovenii, generally, required a longer time and went through a few more larval stages during metamorphosis than *M. rosenbergii*. In an earlier study, Ling[11] pointed out that the larvae of *M. rosenbergii* have only eight stages when reared at 26-28 ℃ and 7-16 ppt. Uno and Kwon[12] and Liao et al.[13] reported that the larva of *M. rosenbergii* passed through 11 larval stages in rearing water condition of 26-28.4℃ and 13-21 ppt. Later, Gomez-Diaz (1987)[14] claimed that there were 17 larval instars in *M. rosenbergii* reared at 28°C and 13.6 ppt. The water temperature could affect the larval development of *M. rosenbergii*[15]. Similar thermal and salinity conditions were used for *M. vollenhovenii* in this study, e. g. 26-28℃ and 10-15 ppt, respectively.

Ville[16] first reported an incomplete morphological description of larval development of *M. vollenhovenii* in which only eight stages were described. Willführ-Nast et al.[9] pointed out a total of 14 zoea-larval stages of *M. vollenhovenii* after hatching, and noted that 60 % of the larvae transformed into the post larvae in 47 to 63 days. However, no detailed morphological description of these larval stages was given.

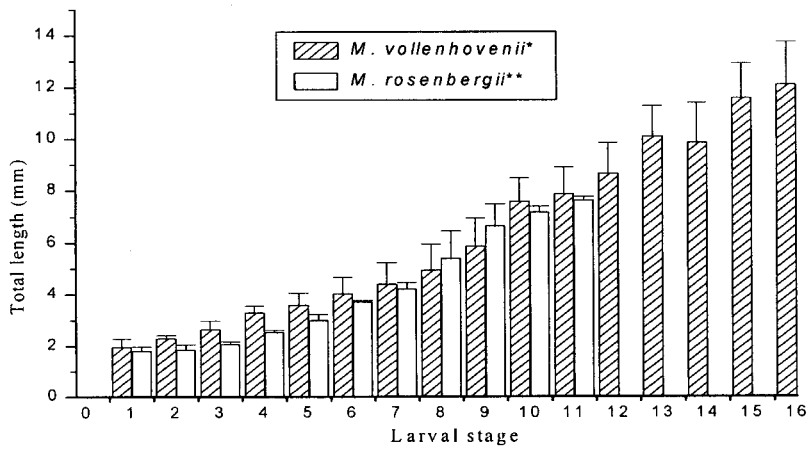

Fig. 2. The comparison of the total length variation between the two Freshwater prawn species *M. vollenhovenii* and *M. rosenbergii*
*: data from the present study; **: the averaged data from Liao et al.[13] and Uno and Kwon[12].

Usually the average total length of the giant freshwater prawn was shorter than that of the African river prawn from the 1st to the 11th stage except at the 8th and 9th stages (Fig. 2). However, at these two stages, the young larvae of the giant freshwater prawn are closed to the post-larval stage.

References

1. Durand, J. R. and C. Leveque (1980) Flore et faune, aquatiques de l Afrique, Sahelo-Soudanienne. Editions de l' Office de la Recherche Scientifique et Technique Outre-Mer Collection Initiations Documentations Techniques n ° **44** Paris, 377-379.
2. Holthuis, L. B. (1980) Shrimp and Prawns of the world. FAO Species Catalogue, Vol. 1, Rome, FAO, p. 90.
3. Marioghae, I. E. (1982) Notes on the biology and distribution of *Macrobrachium vollenhovenii* and *Macrobrachium macrobrachion* in the Lagos Lagoon. Rev. Zool. Afr., **96**(3): 493-508.
4. Gordon, C. (1989) Prawn culture in Ghana. *NAGA*, **12**(1): 17.
5. New, M. B. (1990) Freshwater prawn culture: a review. Aquaculture, **88**: 99-143.
6. Ovie, S. O. (1991) A review of freshwater *Macrobrachium* culture and some preliminary observations on the rearing of *Macrobrachium vollenhovenii* in freshwater. Annu. Rep. Natl. Inst. Freshw. Fish. Res., Nigeria, **1990**: 59-69.
7. Miller, G. C. (1971) Commercial fishery and biology of the fresh-water shrimp, *Macrobrachium*, in the lower St. Paul River, Liberia, 1952-53. U. S. Dept. Comm., National Oceanic and Atmospheric Administration. National Marine Fisheries Services Special Sci., Rep. Fish., **626**: 1-13.
8. Udo, P. J. and M. Taege, (1991) Respiratory responses of the crustacean *Macrobrachium vollenhovenii* (Herklots, 1857) to various salinities. Aquacult. Fish. Manage, **22**(3): 351-356.
9. Willfüehr-Nast, J., H. Rosenthal, P. J. Udo and F. Nast (1993) Laboratory cultivation and experimental studies of salinity effects of larval development in the African river prawn Macrobrachium vollenhovenii (Decapoda, Palaemonidae). Aquat. Living Resour., **6**(2): 115-137.
10. Liu W. Y., W. H. Chiu, F.K. Hsieh and I. C. Liao (1996) The success of larval culture of Macrobrachium vollenhovenii (Herklots, 1851) in the Central Africa Republic. Bull. International Tech. Coop., **3**(2): 29-44.
10. Ling, S. W. (1969) The general biology and development of Macrobrachium rosenbergii (de Man). FAO Fish. Rep., **57**(3): 589-606.
11. Uno, Y. and C. S. Kwon (1969) Larval development of Macrobrachium rosenbergii (de Man) reared in the laboratory. J. Tokyo Uni. Fish., **55**(2): 179-190.
12. Liao, I C., N. H. Chao, and L. S. Hsieh (1973) Preliminary report of the experiments on the propagation of the Giant Freshwater Prawn, Macrobrachium rosenbergii, in Taiwan. J. Fish. Soc. Taiwan, **2**(2): 48-58.
13. Gomez-Diaz, G. and S. Kasahara (1987) The morphological development of Macrobrachium rosenbergii (de Man) larvae. J. Fac. Appl. Biol. Sci., **26**: 43-56.
14. Gomez-Diaz, G. (1987). Effect of environmental embryonic temperature on larval development of Macrobrachium rosenbergii (de Man). J. Exp. Mar. Biol. Ecol., **114**(1): 39-47.
15. Ville, J. P. (1971) Biologie de la reproduction des Macrobrachium de Cote-D'Ivoire (III)-- description des premiers stades larvaires de Macrobrachium vollenhovenii (Herklots, 1857). Ann. Univ. Abidjan. Ecologie, **IV**(1): 325-341.
16. Joseph, J. D. (1977) Assessment of the nutritional role of algae in the culture of larval prawns (Macrobrachium rosenbergii). Proc. World Maricul. Soc., **8**: 853-861.
17. Liao, I C., N. H. Chao, G. G. Tseng, and L. H. Pang (1980) Freshwater Prawn Macrobrachium rosenbergii (De Man) Culture. Tungkang Marine Laboratory (TML), Taiwan Fisheries Research Insitute, Tungkang, Pintung, Taiwan, 52 pp.
18. Suharto, N. H., A. Ksmail and A. Poernomo (1982) Breeding technique of Macrobrachium rosenbergii (De Man) in conical fiberglass tanks. Giant Prawn Farming. In Elsevier Scientific Publishing Company, M. B. New

ed.). Amsterdam, 115-122.

19. Manzi, J. J. and M. B. Maddox (1980) Requirements for Artemia nauplii in Macrobrachium rosenbergii (de Man) larviculture. In The Brine Shrimp Artemia (III), Ecology, Culturing, Use in Aquaculture, (G. Persoone, P. Sorgeloos, O. Roels, and E. Jaspers eds.). Universa Press, Wetteren, Belgium, 456 pp.
20. Molina-Vozzo, R. E., J. M Heinen. and L. R. D' Abramo (1995) Supplementation of commercial feeds with beef liver for indoor nursery culture of freshwater prawns Macrobrachium rosenbergii. J. World Aquaculture Soc., **26**(1): 103-106.

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非洲淡水蝦 *Macrobrachium vollenhovenii* 及泰國長腳大蝦 *M. rosenbergii* 幼苗期之形態差異

摘 要

繁殖用野生非洲淡水蝦之種蝦係在非洲剛果捕獲，之後在內陸的中非共和國進行人工繁殖。觀察幼苗期的附肢及額角的變化結果，發現非洲淡水蝦幼苗第一期時，第一、二、三對顎足已經出現，第二、三兩對顎足並有游泳功能，同時第一、二對步足的形態爲分岔形的芽苞。當蝦苗進入第二期時，第一、二對步足的內、外肢已經形成，可幫助蝦苗運動；此時第三對步足的形態亦爲分岔形芽苞，同時第四步足之單肢原始芽苞開始長出。

蝦苗第三期時，第三對步足的形態仍未改變，此時第四對步足的芽苞開始分岔成對，而第五對步足的原始單一芽苞開始長出。蝦苗第四期時，第三對步足的內、外肢已經形成，可幫助蝦苗運動，而第五對步足的外肢雖然已經形成，但是仍然不能運動；此時分岔型的第四對步足芽苞仍然維持原狀，並未改變。

蝦苗第五期時，第四對步足還不能運動，而第五對步足則已經完全長成，可以協助蝦苗運動；第六期時，第四對步足開始分化形成內、外肢協助蝦苗運動。因此，在五對步足中，第四對是最後分化形成內、外肢的。其他以觸角齒式的變化亦可區分蝦苗的變態期，如第三期時觸角齒式爲 1/0，第三期至第十二期齒式爲 2/0，第十三期之齒式突然變爲 7-9/0，十五期時則成爲 14/3。因此，非洲淡水蝦幼苗的變態可分爲十五期（飼育水溫及鹽度範圍分別爲：26-28℃及 10-15 ppt），第十六期開始爲後期蝦苗。

東南亞產泰國長腳大蝦 幼苗的變態僅須十一期（水溫及鹽度範圍分別爲：26-28.4℃及 13-21 ppt），第十二期開始爲後期幼苗。其步足形態變化除所需的時間有不同外，與非洲淡水蝦並無差異，而兩者額角齒式的變化則有明顯的不同。

關鍵詞：非洲淡水蝦，泰國長腳大蝦，幼苗變態

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