

Certain aspects of biology of the freshwater crab *Travancoriana schirnerae* (Bott, 1969) (Brachyura: Gecarcinucidae)

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ABSTRACT

Biology of the freshwater crab *Travancoriana schirnerae* was studied with respect to sexual dimorphism and sex ratio from June 2009-August 2011. A total of 3605 individuals were collected of which 2168 (60.3%) were males and 1437 (39.7%) females. The sampled population comprised of juvenile males (15.3%), adult males (45%), juvenile females (9.3%), adult non-ovigerous (27.9%), ovigerous (0.6%) and juvenile bearing females (1.9%) and grouped into six size classes (0-1, 1.1-2, 2.1-3, 3.1-4, 4.1-5 and 5.1-6 cm). Results of this study indicated that the population exhibited sexual dimorphism with reference to size, chelae and cheliped dimensions and abdomen morphology. Adult males were heterochelous whereas females exhibited both heterochely and isochely in almost equal proportion (53 and 47% respectively). No significant difference was found in handedness preponderance for the sexes. Chi-square analysis showed that the sex ratio of the population significantly deviated from the 1:1 ratio with males outnumbering females.

Keywords: Chelae, Heterochely, Sex ratio, Sexual dimorphism

Introduction

The freshwater crab *Travancoriana schirnerae* (Bott, 1969) is abundant in the wetlands of Mananthavady (N 11° 46.116', E 075° 58.971', altitude 2417 feet), Wayanad, Kerala. They live in burrows made in rice field embankments, at the margins of waterholes and water channels in the areca, banana and coconut plantations, which were once paddy fields. The genus *Travancoriana* now comprises five described species (*T. schirnerae*, *T. pollicaris*, *T. convexa*, *T. kuleera* and *T. charu*) with distribution restricted to the highlands of south Indian states of Kerala, Karnataka and Tamil Nadu (Bahir and Yeo, 2007).

Though considerable information exists on various aspects of biology of marine, intertidal, estuarine (Sallam, 2005; Costa and Gomes, 2008; Gregati and Fransozo, 2009; Omolara, 2010; Soundarapandian *et al.*, 2013), semi-terrestrial and land crabs (Liu and Jeng, 2005, 2007; Venancio, 2009; Hartnoll *et al.*, 2010), there is dearth of information on biology of freshwater crabs (Silva *et al.*, 2012; Sudha Devi and Smija, 2013). This paper is an attempt to provide some information on aspects of the population biology such as sexual dimorphism and sex ratio of the freshwater crab *T. schirnerae*.

Materials and methods

The present study was carried out from June 2009 August 2011 in selected areca plantations in Mananthavady, Wayanad. Specimens were handpicked or collected during daytime from burrows using baits and brought immediately to the laboratory. The carapace width (CW), body weight (BW), colour and sex were recorded for all the specimens collected.

Sexual dimorphism

The CW and body weight of random subsamples of males and females (n=59 each; CW 3.7-5.7 cm) were compared through ANCOVA to find out whether dimorphism in size was significant or not. In order to determine the cheliped and chelae dimorphism, the length of major, minor chelipeds, length and width of propodus of both sexes (n=33 each, male CW 3.7-5.5 cm; female CW 3.7-5.1 cm) were recorded and tested using ANCOVA. For determining the handedness preponderance of chelae, males (n=800; CW 4.2-6.1 cm) and females (n=430; CW 4-5.5 cm) were selected randomly. The number of individuals showing preponderance for left, right and equal handedness was recorded. Chi-square analyses were carried out to find out whether there was any significant

difference in handedness preponderance. A total of 70 females (CW 2.9-5.3 cm) were selected randomly and their abdominal shapes were recorded to study sexual dimorphism.

Sex ratio

Sex ratio was calculated for juveniles (n=880, CW up to 3.6 cm) and adults (n=2711, CW 3.7-6.1cm). The overall sex ratio of the population as well as variation in sex ratio across months, years and size classes were compared through chi-square test.

Results

Sexual dimorphism

Travancoriana schirnerae exhibited sexual dimorphism with respect to size, cheliped and chelae dimensions and abdomen morphology. The ANCOVA tests for comparison of CW and body weight of male and female confirmed significant differences (F=12.909 and 18.758 respectively, $p < 0.01$).

Observations on chelae and cheliped dimorphism revealed that both left and right chelipeds were strongly dimorphic with sex. Though heterochely was noticed in late juveniles (CW 3.2-3.6 cm) and adult females, it was more pronounced in adult males. For any given measure of CW, corresponding chelae were larger and stouter in males than females. Among adult males, 95% exhibited heterochely while 5% showed isochely. Among adult females, 53% were heterochelous and 47% isochelous. ANCOVA test for comparison of CW with major, minor cheliped length, propodus length and width between sexes presented significant results

The left chela was stronger and more stout in 50% of the males, while in 45% it was the right chela. The remaining 5% exhibited equal handedness. Left vs right of handedness preponderance of chelae was not significant ($\chi^2 = 2.314$, $p > 0.05$) while comparison of left, right and equal handedness revealed significant differences ($\chi^2 = 27.63$, $p < 0.05$). Among females, 47% showed equal handedness while 28 and 25% showed left and right handedness respectively. The chi-square value 0.72 obtained for left vs right comparison of chelae dimensions was statistically insignificant while the chi-square value of 35.2 obtained for comparison of left, right and equal handedness was significant at 5% level.

Sexes can be separated at a CW > 0.5 cm by observing the shape of the abdomen which is narrow and T-shaped in males and broad in females. Among females, three abdominal shapes were noticed: V, U and intermediate shaped. Immature females (up to 3.6 cm CW) had V-shaped abdomen while non-ovigerous adults had intermediate or

U-shaped abdomen. In the case of ovigerous and juvenile bearing females, the abdomen was broad and U-shaped.

Sex ratio

A total of 3605 specimens were sexed of which 2168 (60.3%) were males and 1437 (39.7%) females, giving a sex ratio of 1:0.66. Chi-square test indicated that this ratio was significantly different from the expected ratio of 1:1 ($\chi^2 = 37.92$, $p < 0.05$). Monthly evaluation of sex ratio showed that males were abundant than females in the population (Fig. 1). The sex ratio differed (male biased) statistically from 1:1 ratio except for the months June-November in the first year; October, November and January-March in the second year. The annual sex ratio (1:0.6 and 1:0.69 for the two years) also showed significant differences ($\chi^2 = 45.32$ and 24.0, $p < 0.05$).

Sex ratio variation according to size classes revealed the proportion of males was higher in all the size classes ($\chi^2 = 30.85$, $p < 0.05$); with highest (1:0.6) in the 3.1-4.0 cm size class. Females were more abundant (1:0.8) in the preceding class (2.1-3.0 cm), and comparatively less (1:0.3) in the 5.1-6 cm size class which included the aging population (Fig. 2).

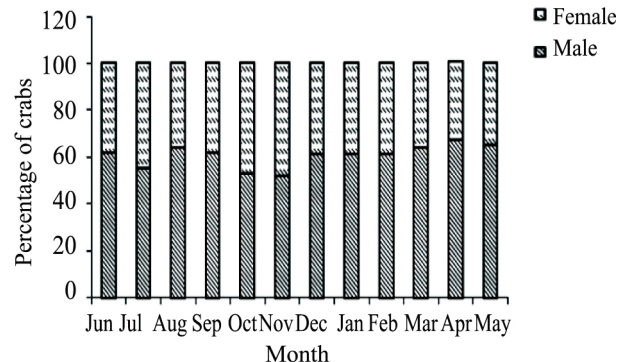


Fig. 1. Sex ratio of *Travancoriana schirnerae* population (June 2009 - May 2011)

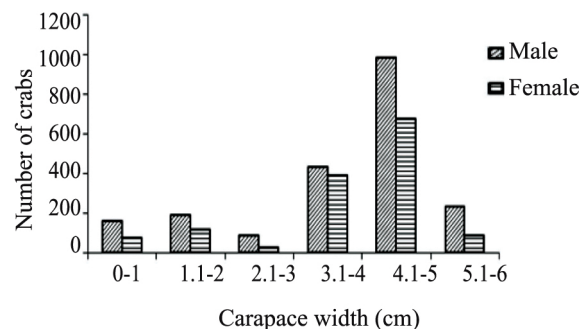


Fig. 2. Frequency and size class distribution of *Travancoriana schirnerae* population (June 2009 - May 2011)

Discussion

Sexual dimorphism

A clear sexual dimorphism was observed in *T. schirnerae* population with reference to size, cheliped dimension and abdomen morphology. Larger male is a common dimorphic trait found in decapods since females divert significant amount of energy for reproduction and do not moult during incubation of eggs while males continually apportion their energy for growth (Swiech-Ayoub and Masunari, 2001; Fransozo *et al.*, 2003; Colpo *et al.*, 2005). The larger size achieved by males is common to many freshwater/land and marine crab species (Potter *et al.*, 1983; Liu and Jeng, 2005; Hartnoll *et al.*, 2006a, b; Hirose and Fransozo, 2008). As reported by Omolara (2010) in *Callinectes amnicola*, *T. schirnerae* males were slightly heavier than females. On the other hand, in *Scylla serrata* females were found to be heavier than the males (Devi, 1985). The significant difference in weight between sexes in the present study may possibly be attributed to the bigger, strong chelipeds of males.

In *T. schirnerae*, cheliped and chelae size is a distinct dimorphic trait, being significantly larger in males than females. For brachyuran crustaceans, changes are conspicuous in the male cheliped, female abdomen and pleopods of both sexes during the transition from juvenile to the adult stage (Castiglioni and Fransozo, 2004). The shape and size of chelipeds are important factors in the life of crabs, since these structures are utilised by males for guarding their mates from other males, in holding the females during courtship, in agonistic interactions as well as in feeding (Hartnoll, 1982; Mariappan *et al.*, 2000; Viau *et al.*, 2006; Costa and Gomes, 2008; Bueno and Shimizu, 2009).

In the present analysis, heterochely is observed in both the sexes with no preferential handedness. The same was reported in *Gecarcinus ruricola* by Hartnoll *et al.* (2006 b). In *Uca*, Castiglioni and Fransozo (2004) documented that males were heterochelic and females were isochelic. Heterochelous aeglids with handedness preponderance of the left were reported by several researchers (Rodrigues and Hebling, 1978; Viau *et al.*, 2006; Bueno and Shimizu, 2009). Conversely, the isochelous condition has been reported for both the sexes in *Aegla species* (Bueno *et al.*, 2000; Noro and Buckup, 2003) and *Munida subrugosa* (Bueno and Shimizu, 2009).

In *T. schirnerae* females, three abdominal shapes were noticed which agrees with observations made in *S. paramamosain* (Islam *et al.*, 2010). The abdomen showed a marked dimorphism in crabs, being the female's

body part where eggs are incubated during embryonic period (Costa and Gomes, 2008). Poovachiranon (1992) reported that the abdominal shape of the genus *Scylla* changes with pubertal moult or at maturity.

Sex ratio

Sex ratio analyses showed a clear predominance of males in the population. Similar reports were made in *U. capricornis* (Detto and Blackwell, 2009), spider crabs *Maiopsis panamensis* and *Stenocionops ovate* (Hendrickx, 1995; Fuerte *et al.*, 2001) and in fiddler crabs (Johnson, 2003). On the contrary, female biased sex ratio was reported in *Dilocarcinus dentatus* (Timothy and Steven, 1993), *Portunus validus* (Omolara and Barakat, 2009), *P. pelagicus* (Sumner and Malseed, 2004) and *G. ruricola* (Hartnoll *et al.*, 2006b). The sex ratio was found equal in *Dotilla* species (Clayton and Al kindi, 1998; Sallam, 2005), *Ilyoplax deschampsii* (Yasuhisa and Koga, 2009), *U. arcuata* (Yamaguchi and Henmi, 2008) and in *C. amnicola* (Omolara, 2010). Berglund (1981) suggested several hypotheses to interpret the skewed sex ratio. Higher mortality, differential primary sex ratio, selective predation of females by their natural enemies was indicated as possible causes of this pattern. The skewed male sex ratio in the present analysis may be attributed to differential primary sex ratio, behavioural characteristics or differential mortality between sexes.

The present analysis also revealed the sex ratio was tilted towards males in all the size classes indicating that the samples were drawn from a population in which there was preponderance of males over females. In *T. schirnerae*, there were higher proportion of male crabs in the largest size classes. This fact was also documented for *Sesarma rectum* populations from the north coast of São Paulo (Leme, 2002) and for *Neohelice granulata* (Gregati and Fransozo, 2009). On the contrary, in *U. burgersi* sex ratio showed a higher proportion of males in the intermediate size class. This differential growth between sexes can be explained by processes related to reproductive events. When females attain maturity, they grow more slowly as a result of energy allocation to egg production (Conde and Diaz, 1989). The reproductive activities of females delay the number of females in some size classes, especially in the reproductive size classes (Diaz and Conde, 1989). The information obtained from the present study will be of use in understanding the population structure and growth of *T. schirnerae* in its natural habitat.

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