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First stage zoeal morphology of four ghost crabs *Ocypode ceratophthalmus* (Pallas, 1772), *O. cordimanus* Latreille, 1818, *O. sinensis* Dai, Song & Yang, 1985 and *O. stimpsoni* Ortmann, 1897 (Crustacea, Decapoda, Ocypodidae)

GUO-CHEN JIANG¹, HONG-CHANG LIU², TIN-YAM CHAN^{1,3} & BENNY K.K. CHAN^{4,5}

¹Institute of Marine Biology National Taiwan Ocean University, Keelung 202, Taiwan, R.O.C.

²53, Chenggong 11th St., Zhubei City, Hsinchu County 302, Taiwan, R.O.C.

³Center of Excellence for the Oceans, National Taiwan Ocean University, Keelung 202, Taiwan, R.O.C.

⁴Biodiversity Research Center, Academia Sinica, Taipei 115, Taiwan, R.O.C.

⁵Corresponding author

Abstract

Light and scanning electron microscopy (SEM) were used to examine the first zoeal stage of four ghost crabs, *Ocypode ceratophthalmus* (Pallas, 1772), *O. cordimanus* Latreille, 1818, *O. sinensis* Dai, Song & Yang, 1985 and *O. stimpsoni* Ortmann, 1897. Finding diagnostic characters to distinguish between the four species proved difficult because their setal appendage patterns were identical. However the rectangular and pockmarked patterns on the ventral carapace are rather pronounced in *O. ceratophthalmus* and *O. stimpsoni* but weak in *O. cordimanus* and *O. sinensis*. The spinulation on the furca of the telson is less in *O. cordimanus* than in the other three species.

Key words: *Ocypode*, ghost crabs, morphology, first zoea

Introduction

Ghost crabs of the genus *Ocypode* Lamarck, 1801 are currently represented by 26 species world wide (Ng *et al.* 2008; De Grave *et al.* 2009). *Ocypode* crabs are common on sandy beaches of tropical and subtropical regions (Negreiros-Fransozo *et al.* 2002). Larval development of *Ocypode* has been studied in seven species [Z = zoea, M = megalopa, C = crab], including *O. ceratophthalmus* (Pallas, 1772) (Wellershaus 1971: Z1–Z5, M; Kakati 2005: Z1–Z5, M), *O. cordimanus* Latreille, 1818 (Rajabai 1954: M, C1), *O. gaudichaudii* H. Milne Edwards & Lucas, 1843 (Crane 1940: Z1, M), *O. stimpsoni* Ortmann, 1897 (Terada 1979: Z1–Z5; Fukuda 1980: Z1, Z5, M); *O. occidentalis* Stimpson, 1860 (Crane 1940: M), *O. platytarsis* H. Milne Edwards, 1852 (Rajabai 1951: Z1; Rajabai 1954: M, C1) and *O. quadrata* (Fabricius, 1787) (Diaz and Costlow 1972: Z1–Z5, M). However, all of these larval studies were based on observations using light microscopy at low magnifications. When using zoeal morphology to infer phylogenetic relationships, many fine details must be considered (see Clark *et al.* 1998, 2012). The present work used both light and scanning electron microscopy (SEM) to describe the ultrastructure of the first zoeal stage in four Indo-West Pacific species of *Ocypode*, *O. ceratophthalmus*, *O. stimpsoni*, *O. sinensis* Dai, Song & Yang, 1985 and *O. cordimanus* Latreille, 1818, with those of the latter two species being reported for the first time.

Material and methods

Source of adults and larvae. Ovigerous females of *Ocypode cordimanus* were collected from Guam in August 2001. Ovigerous females of *O. ceratophthalmus* were collected from Nanliao fishing port, Hsinchu in July 1999. *O. sinensis* and *O. stimpsoni* were collected at Huang-gang and Shui-wei in northern Taiwan from August to October 2011. The eggs of the ovigerous females generally hatched shortly after the ovigerous females were

the zoea described by Wellershaus (1971). Re-examination of the specimens of Wellershaus (1971) will be necessary to determine if the Cochin specimens and the present material belong to the same species. Comparing to the other *Ocypode* species with the characteristics of the first zoea known, the setation on the antennule, maxillule, maxilla, coxae of first maxilliped and second maxilliped are diagnostic among the described species (Table 1). Setal differences described for the first zoeas of the present study and those of *O. gaudichaudii* by Crane 1940, *O. platytarsis* by Rajabai, 1951 and *O. quadrata* by Diaz & Costlow, 1972 may be due to the latter authors overlooking some characters (see Table 1).

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