

Observation of intersexuality in land hermit crabs (Anomura: Coenobitidae)

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We report here the first observation of intersexuality in a land hermit crab (Coenobitidae). Three species of land hermit crabs from Okinawa were investigated. In the population of the terrestrial hermit crab *Coenobita rugosus* two per cent of males were found to be intersex. Besides the true male gonopores on the coxae of the 5th pair of pereopods, they had additional openings on the coxae of the 3rd pair of pereopods. Both specimens examined had a normally developed male reproductive system. In the populations of two other species studied, *C. brevimanus* and *C. purpureus*, however, no intersex individuals have been found. Examples of intersexuality in decapod crustaceans are discussed and putative explanations of this phenomenon in land hermit crabs are proposed.

INTRODUCTION

Hermit crabs (Anomura) occur in various habitats of the world. A major step in the evolution of this group was adaptation to a fully-terrestrial life (Greenaway, 2003; Williams & McDermott, 2004). During this successful transition from marine to terrestrial ecosystems hermit crabs have developed many physiological and behavioural adaptations, including very complicated and still poorly-known reproductive behaviour (Helfman, 1977; Nakasone, 2001).

One of the most interesting features of reproductive morphology of hermit crabs is the phenomenon of intersexuality. Hermit crabs, like the other decapod crustaceans, are characterized by the sexual dimorphism. Males and females are clearly distinguishable by the position of their sexual openings (gonopores). The gonopores open typically on the coxae of the 3rd pair of pereopods (walking legs) in females, and on the coxae of the 5th pair of pereopods in males. However, some individuals have been found to possess gonopores in both 3rd and 5th pairs of pereopods (Turra, 2004, 2005). Such individuals are called intersex. Intersexuality has been previously described in other decapod crustaceans, but to-date there have been few reports in hermit crabs (McLaughlin & Lemaitre, 1993; Turra & Leite, 2000). Previously intersexuality has been observed only in aquatic species of Anomura, mostly members of families Paguridae and Diogenidae, but not in land hermit crabs (Coenobitidae). The present study aimed to screen the presence of specimens possessing the intersexual feature in the populations of the three species of Coenobitidae from the Iriomote Island (Okinawa, Japan). We report here the first observation of intersex individuals of terrestrial hermit crab *Coenobita rugosus* (Milne-Edwards, 1837). This species occurs from the mainland coast of East

Africa through the Indo-Pacific to Tahiti and Tuamotu Islands. Like all members of this group, this species exhibits high levels of terrestrialization and can be found up to 300 m from the seashore (Burggren & McMahan, 1988).

MATERIALS AND METHODS

Males of examined species, including 98 specimens of *Coenobita brevimanus* (Dana, 1852), 95 specimens of *C. purpureus* (Stimpson, 1858) and 100 specimens of *C. rugosus* (Milne-Edwards, 1837) were obtained from the populations of these land hermit crabs randomly collected in Iriomotejiima Island, Okinawa, Japan (124° E 24° N), near the sandy seashore at night during the period from May to June 2004 (breeding season).

The animals were carefully examined using a Zeiss 2000-C binocular microscope. The thoracic sternites and coxae of pereopods with gonopores of specimens of interest were photographed using a digital camera and sketched. The shield (carapace) length of intersex specimens was measured to within 0.1 mm using digital calipers. The reproductive system of intersex individuals was examined. Terminology concerning external morphology is as in McLaughlin (2003); and terms concerning internal morphology of reproductive system—are as used in Hess & Bauer (2002) and Kronenberger et al. (2004).

RESULTS

No intersex individuals have been found among the *Coenobita brevimanus* and *C. purpureus* specimens. Two out of 100 male *C. rugosus* proved to be intersex individuals. Both are relatively large, mature males. It should be noted that growth dynamics and longevity of *Coenobita* remain unclear. It was shown that specimens with a total weight of 1 g and