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Egg production and shell relationship of the land hermit crab *Coenobita scaevola* (Anomura: Coenobitidae) from Wadi El-Gemal, Red Sea, Egypt

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Abstract The aim of the present study is to characterize the fecundity of the land hermit crab *Coenobita scaevola* as well as the influence of shell type on fecundity using morphometric relationships. Hermit crabs were collected monthly from January to December 2007 from the protected area of Wadi El-Gemal, at Marsa Alam on the Red Sea, and ovigerous females were selected. Hermit crab wet weight and the gastropod shell weight were recorded. The number of eggs carried by females of several sizes (CL, carapace length), stages of development and egg size were determined. Shells of eight gastropod species were occupied by ovigerous females of *C. scaevola*. Shells of *Nerita undata* was the most occupied (65.7%), particularly by individuals falling within the size range 5.0–7.0 mm CL. Only 35 berried females were recorded during May, July and September and the mean fecundity was 679.8 ± 140 eggs. Fecundity was found positively correlated with crab size and shell dimensions. The relationship between fecundity and the internal volume of the occupied shell was ranked as the most correlated. The impact of shell utilization on hermit crab fecundity is discussed.

Introduction

Hermit crabs are decapod crustaceans that have developed strategies to utilize empty gastropod shells and other types of cavities to shelter their uncalcified abdomen (Litulo, 2005). According to Martinelli et al. (2002), there are currently more than 800 species of hermit crabs worldwide, ranging from the deeper parts of the oceans to intertidal habitats. Despite their importance, the reproductive aspects of these organisms are still poorly known, principally in such tropical habitats.

Fecundity is defined as the number of eggs produced per clutch per spawn that are attached to the pleopods of the female (Mantelatto et al., 2002). It is an important parameter in crustaceans. Knowledge of the fecundity of a species determines its reproductive potential (Negreiros-Fransozo et al., 1992) and/or the stock size of the population (Mantelatto and Fransozo, 1997) and possibly explains its reproductive adaptations to environmental conditions (Sastry, 1983). Hermit crabs, in particular, because they inhabit gastropod shells, afford an opportunity to study the interaction between resources and reproductive strategy (Mantelatto et al., 2002). According to Wilber (1989), a female's shell may affect its

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reproduction by determining whether or not it becomes ovigerous and/or limiting the number of eggs produced.

Coenobita scaevola (Forskäl, 1775), is the only coenobitid species in the Red Sea area (Vine, 1986). This land hermit crab is very abundant above sea level on the beaches of the Red Sea and on the highly arid shores of the Sinai Peninsula. It is totally dependent on the sea for water and consequently limited to the near shore area (Achituv and Ziskind, 1985). It has been studied for its pattern of shell utilization (Sallam et al., 2008) as well as for its population features and breeding season (Sallam and Mantelatto, 2010). This species has been reported to be the first organism to disappear from any shore when a new tourist establishment is constructed (Sallam et al., 2008). The authors concluded that the rarity or abundance of this sensitive species on any shore could reflect the degree of healthiness of that shore.

Despite its ecological significance, nothing is known of the egg production of this species. The objective of this investigation is to characterize the fecundity of *C. scaevola* from Wadi El-Gemal at Marsa Alam as well as the role played by the shell type and size using morphometric relationships and to compare it to the fecundity of other species.

Materials and methods

Hermit crabs were obtained monthly from January to December 2007 from the protected area of Wadi El-Gemal at Marsa Alam, Red Sea (Fig. 1). A non-destructive sampling design was adopted in order to avoid a negative impact on this ecological reserve and the population. Collections were made on the last week of the month. It was carried out during daytime over an area 300 m long over a period of 30 min. Hermit crabs were captured by hand and fixed immediately in 10% formalin sea water solution and brought to the laboratory for analysis. Each ovigerous female was removed carefully from the shell in an anticlockwise fashion, weighed (female wet weight, FWW), and measured on the basis of carapace length (CL = from the tip of the rostrum to the V-shaped groove at the posterior edge of the shield). Measurements were made by means of a Vernier caliper (0.1 mm accuracy). Shell species were identified according to Sharabati (1984) and the following measurements were made: shell weight (SW), shell aperture width (SAW) and shell aperture length (SAL). Shell internal volume (SIV) was determined by the amount of water required to fill the empty shell by means of a measuring pipette. The eggs were carefully removed from the pleopods and classified into developmental stages according to the methodology of Turra and Leite (2001): initial stage: stages 1 and 2, without eyes and yolk partially consumed; intermediate stage: stages 3 and 4, eye formation started and yolk partially consumed; final stage: stage 5, eyes formed and yolk totally consumed. They were then counted under a light stereomicroscope.

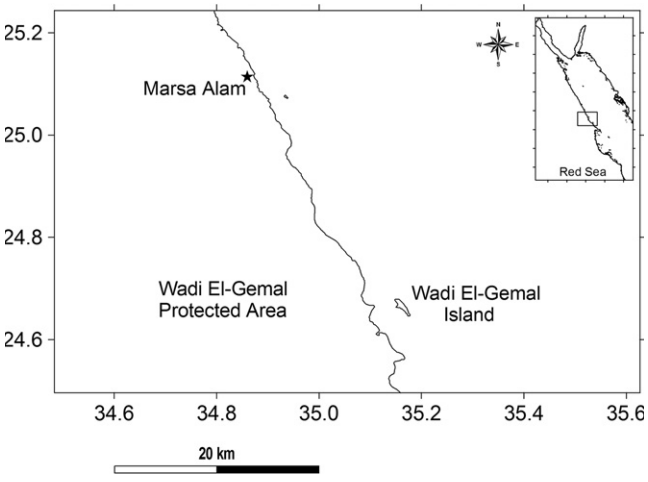

Figure 1 Map of indicating the area of sampling at Wadi El-Gemal, Marsa Alam, Red Sea.

Results

Shells of eight gastropod species were occupied by ovigerous females of *C. scaevola* (Plate 1). Shells of *Nerita undata* (Linnaeus, 1758) were the most occupied (65.7%). The other species with low percentage of occupation were *Nerita polita* (Linnaeus, 1758) (8.6%), *Cerithium caeruleum* (Sowerby, 1855) (5.7%), *Turbo radiatus* (Gmelin, 1791) (5.7%), *Nassarius arcularius plicatus* (Roding, 1798) (5.7%), *Modulus tectum* (Gmelin, 1791) (2.9%), *Nassarius coronatus* (Bruguière, 1789) (2.9%) and *Polinices tumidis* (Swainson, 1840) (2.8%). Shells of *N. undata* were the most inhabited by ovigerous females of the size range 5.0–7.0 mm CL (Fig. 2). Small-sized individuals (4.0–5.0 mm CL) occupied *N. coronatus* and *C. caeruleum*, while large-sized ones (6–7 mm) occupied the shells of *N. polita, M. tectum* and *T. radiatus*.

Out of 557 females collected, only 35 ovigerous females were found during the months: May (n = 16), July (n = 15) and September (n = 4) with 23.5%, 45.4% and 12.2%, respectively. The carapace length mean ± standard deviation of all ovigerous females was 5.84 ± 0.62 mm (range: 4.1–7.3 mm) and showed a unimodal pattern (Fig. 3). The mean fecundity was 679.8 ± 140 eggs with a range of 422 (CL = 4.1) to 945 eggs (CL = 7.3). Fecundity varied in function of the shell used by the females (Table 1). The occurrence of each of the three

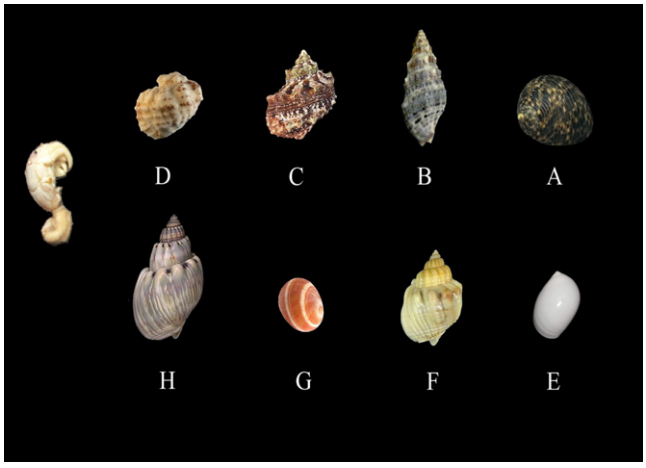

Plate 1 Ovigerous female *Coenobita scaevola* and the gastropod shells utilized. (A) *Nerita undata*; (B) *Cerithium caeruleum*; (C) *Turbo radiatus*; (D) *Modulus tectum*; (E) *Polinices tumidis*; (F) *Nassarius arcularius plicatus*; (G) *Nerita polita*; (H) *Nassarius coronatus*.