Short Communication

Fecundity of the Pantropical Fiddler Crab *Uca annulipes* (H. Milne Edwards, 1837) (Brachyura: Ocypodidae) at Costa do Sol Mangrove, Maputo Bay, Southern Mozambique

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Abstract—*Uca annulipes* (H. Milne Edwards, 1837) is probably the most abundant brachyuran crab inhabiting mangrove forests in East Africa. However, its fecundity is poorly understood. Crabs were randomly sampled during spring low tides from January to April 2002 at Costa do Sol mangrove, Maputo Bay, southern Mozambique. Carapace width (CW), abdomen width (AW), weight (W) and egg numbers (EN) were recorded. The average fecundity was 1599 ± 842 eggs, ranging from 529 (CW = 5.0 mm) to 4250 (CW = 24.1 mm) eggs respectively. Egg number increased significantly with increase in crab size. This information contributes to our knowledge of the reproductive potential and the reproductive processes occurring in this species of crab.

INTRODUCTION

Fiddler crabs (Genus *Uca*, Family Ocypodidae) are one of the most important group of brachyuran crabs in subtropical and tropical regions in terms of diversity and density (Ólafsson & Ndaro, 1997; Nobbs & McGuiness, 1999; Hartnoll et al., 2002).

Six species of *Uca* have been recorded in the western Indian Ocean (= eastern African) region: *Uca annulipes* (H. Milne Edwards), *U. gaimardi* (H. Milne Edwards), *U. inversa inversa* (Hoffman), *U. vocans hesperiae* (Linnaeus), *U. tetragonon* (Herbst) and *U. urvillei* (H. Milne Edwards) (Hartnoll, 1975; Skov & Hartnoll, 2001). Of these, *U. annulipes* is arguably the most abundant (Hartnnoll et al., 2002). It occupies a range of substrates and forms a significant component of East African mangrove brachyurans (Icely & Jones, 1975; Hartnoll et al., 2002). Like most other deposit feeders, *U. annulipes* dwells in burrows, which it digs to a depth of up to 0.5 m depending on shore level (Skov & Hartnoll, 2001; Skov et al., 2002). The species is diurnally active, emerging as the tide recedes (Backwell et al., 2000; Macia et al., 2001; Skov & Hartnoll, 2001). Surface activity terminates when burrows are re-entered and plugged. Burrow plugging also prevails at night and on hot days when the sediment is dry.

In East Africa, Icely & Jones (1975) correlated the distribution of *U. annulipes* with the morphology of its feeding appendages; Hartnoll (1975) studied its distribution in Tanzanian mangroves; Backwell & Passmore (1996), Jennions & Backwell (1998) and Backwell et al. (2000) reported on some behavioural aspects; Burford et al. (2001) studied inter-sexual differences in the mudballs of a population from Inhaca Island; and recently, Macia et al. (2001), Skov & Hartnoll (2001) and Skov et al. (2002) compared and estimated its density at Inhaca Island (Mozambique), Zanzibar (Tanzania) and Kenya, respectively.

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Fecundity (i.e. the no. of eggs per female) determines the reproductive potential of a species and the stock size of its population (Mantelatto & Fransozo, 1997). Information on fecundity is crucial for the management of crab fisheries (Mantelatto & Fransozo 1997; Muino, 2002).

The fecundity of East African ocypodids is scarcely known, and the only significant work is that of Emmerson (1999) who described the fecundity of five ocypodids from Magazana, South Africa. Nothing is known about the fecundity of *U. annulipes* from southern Mozambique.

The aim of this study was to describe the fecundity of an *U. annulipes* population from the Costa do Sol mangrove, Maputo Bay, southern Mozambique.

MATERIALS AND METHODS

The climate of Costa do Sol mangrove, Maputo Bay, southern Mozambique (Fig.1) is tropical, with an average temperature of 25 °C and rainfall of ~1000 mm/year. The mangrove vegetation at the locality is dominated by *Avicennia marina*,
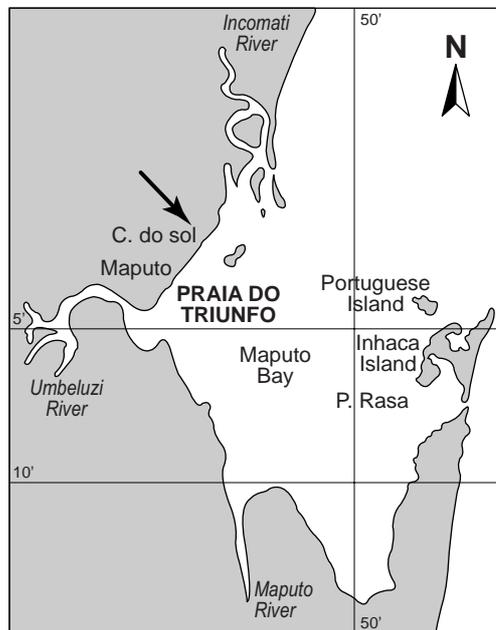
Fig. 1. Map of the study area showing Costa do Sol mangrove, the sampling location for *Uca annulipes*

although small patches of *Rhizophora mucronata* occur.

Monthly samplings were performed from January to April 2002 at low tide periods. Crabs were collected by hand using diving knives, with a catch effort of one person for one hour. All ovigerous females were preserved individually in 70 % ethanol, bagged and stored until further processing.

Crabs were weighed (± 0.001 g) and their carapace width (CW) and abdomen width (AW) measured using a vernier caliper (± 0.05 mm accuracy) or, for small specimens, under a dissecting microscope by means of a micrometric ocular. The egg masses were classified in terms of their embryonic development according to Litulo (in press) as follows: Stage I (Initial): egg mass laid a few days earlier, eggs with an orange colour due to a large quantity of yolk, no segmentation visible and the egg appears as a ball of cells; Stage II (Intermediate): incubation at its halfway period, the eggs have a light grey-brown colour tending to grey, the compound eyes of the larvae are visible and the embryo occupies 1/3 of the volume of the egg; and Stage III (Final): the larvae are a few days from eclosion and are totally formed, the egg is dark brown tending to black and little yolk is left.

To estimate fecundity, 127 egg-bearing females with stage I eggs were selected for egg counting. Pleopods were removed from females, placed in Petri dishes filled with seawater, and eggs detached by gradually adding a solution of sodium hypochlorite. Egg-free pleopods were then separated by gentle stirring in a beaker filled with 250 ml seawater. Three 1.5 ml subsamples were taken using a pipette, and eggs counted under a dissecting microscope. The average value obtained was then extrapolated for the whole suspension to estimate the total number of eggs.

Data were analysed using the power and linear regression analysis ($Y = aX^b$, $Y = ax + b$) of fecundity versus carapace width (CW), abdomen width (AW) and wet weight (WW) (Hines, 1982). Student's t-test was used to determine whether the morphometric relationship was positively or negatively allometric (Zar, 1999).

RESULTS

Individual fecundity of *U. annulipes* ranged from 520 (CW = 5.0 mm) to 4250 eggs (CW = 24.1 mm). Mean fecundity was 1599 ± 842 eggs. As shown in Fig. 2a, a positive correlation was found between egg number (EN) and carapace width (CW). The slope of the regression was positively allometric (b > 1, t-test = 1.66, d.f. = 126, p < 0.05) demonstrating that larger crabs have proportionately more eggs than smaller crabs.

The regression between egg number (EN) and abdomen width (AW) was significant (Fig. 2b) and the allometric slope was 2.1, indicating positive allometry (b>1, t-test = 1.97, d.f. = 126, p < 0.05). The relationship between egg number (EN) and female wet weight (WW) was also significant (Fig. 2c), although it was negatively allometric (b<1, t-test = 1.7, d.f. = 126, p > 0.05), suggesting that heavier crabs have proportionately fewer eggs.

The average egg number (EN) and female wet weight within female size classes are listed in Table 1.

DISCUSSION

The reproductive characteristics of a species are a result of the interaction between various endogenous and exogenous factors (Lopez Greco et al., 2000; Flores & Paula, 2002). Factors such as temperature, salinity, food availability, photoperiod and lunar cycles could determine the periodicity and extension of the reproductive period of a species, as well as its fecundity (Rabalais & Cameron, 1985; Thurman, 1985).

The number of eggs produced by ocypodids varies widely. The fiddler crab *U. subcylindrica* studied by Thurman (1985) may carry up to 1000 eggs, with an increase in number of eggs as the
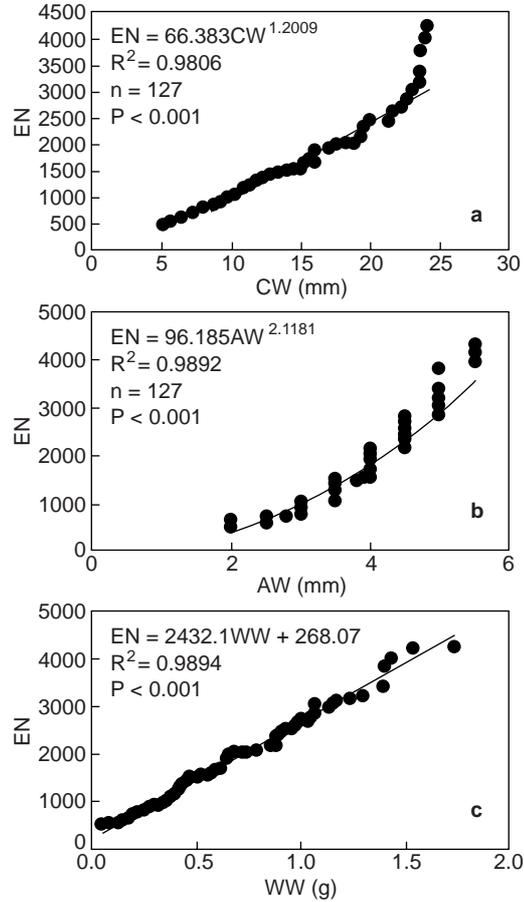
Fig. 2. *Uca annulipes*. **Regression of egg number (EN) against (a) carapace width (CW); (b) abdomen width width (AW); and (c) female wet weight (WW)**

crabs grow larger. *Uca tangeri* females produce more eggs and a large female can produce more than 77,100 eggs (Rodriguez et al., 1997).

The fecundity of *U. annulipes* found in our study was similar to that described for other ocypodids studied previously (see Emmerson,

Table 1. *Uca annulipes* (H. Milne Edwards). Mean egg number and mean female wet weight (g) of ovigerous females collected at Costa do Sol Mangrove, Mozambique

Size class (mm)	N	Egg number mean ± SD	Weight (g) Mean ± SD
5 – 10	44	807.70 ± 162.69	0.234 ± 0.083
10 – 15	36	1309.81 ± 169.74	0.453 ± 0.0613
15 – 20	25	2005.60 ± 206.61	0.703 ± 0.0963
20 – 25	22	3060.91 ± 351.04	1.154 ± 0.218

1999 for a further details), and increased with increase in carapace width, abdomen width and wet weight of the animals, as found in other brachyurans (e.g. Mantelatto & Fransozo, 1997; Litulo, in press). Moreover, the determination coefficient demonstrated that the carapace width, abdomen width and weight are good predictors of fecundity, since they explained more than 90% of the total variance. Emmerson (1999) obtained, for the same species, different values in egg number. These differences may be related to variation in female size, latitudinal range and habitat structure (Santos & Negreiros-Fransozo, 1997; Muino, 2002). Leme & Negreiros-Fransozo (1998) and Colpo & Negreiros-Fransozo (2003) found that the number of eggs in Brachyura may also vary seasonally, as the feeding factor is paramount for yolk formation.

Allometric relationships between fecundity and crab size variables have been attributed to the fact that egg mass is limited by the space available for the accumulation of reserves and gonadal development inside the cephalothorax. The wide variability in carapace shape affects the volume reserved for gonadal development and, consequently, spawn size, since the egg mass and the volume of the body cavity usually present similar allometries (Hines, 1982; Mantelatto & Fransozo, 1997; Koga, 1982; Litulo, in press). Thus, the abdominal size reached during the pubertal moult in brachyurans will be adapted to accommodate the maximum number of eggs produced by a species (Hines, 1982; Mantelatto & Fransozo, 1997).

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