

Timing and seasonality of the onset of maturity, gonad maturation and mating in the spider crab *Maja squinado*: Relationships with habitat use and social structure

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INTRODUCTION: Juveniles of *Maja squinado* inhabit shallow waters. During their second or third summer of life (depending on the recruitment season), they undergo the terminal moult, attaining sexual maturity (González-Gurriarán *et al.*, 1995; Sampedro *et al.*, 1999). During late summer and early autumn adults start a reproductive migration towards deep waters (Freire *et al.*, 1999; González-Gurriarán & Freire, 1994). The present study analyzes in detail the timing of morphometric and gonad maturity, and the onset of migration, and the reproductive status and body condition during this period, trying to define reproductive strategies including their individual and intersexual variability and the relationships with habitat use and social structure.



Figure 1. Experimental traps used in the study.

METHODOLOGY: Monthly samplings were carried out between December 1997 and November 1999 using experimental traps (Fig. 1). The sampling area was the Ría de A Coruña (NW Spain) (Fig. 2). Three shallow water (5-15 m) sampling stations were selected along the ría and another one in deeper waters (25-30 m) in the central channel of the ría, that constitutes the migration corridor for postpubertal adults. In the inner area of the ría (Bastiaqueiro), where the abundance is higher, sampling was done along a transect in the longitudinal axis of the ría where seven tows were carried out disposing the traps parallel to the coast, and each tow was separated approx. 180 m from each other.

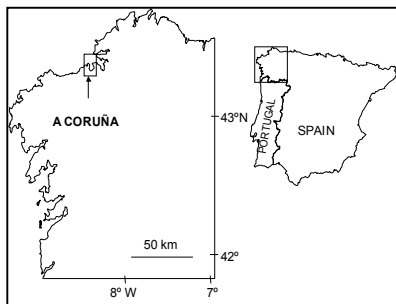
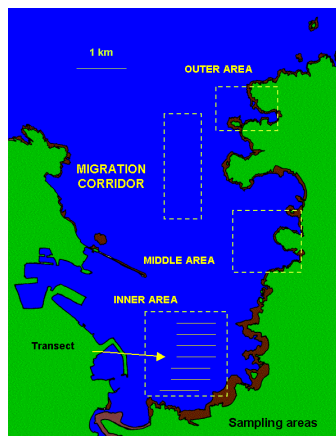


Figure 2. Sampling areas in the Ría de A Coruña.



Reproductive status and body condition: Monthly samples were taken between May 1998 and June 1999. Crabs were dissected in order to determine gonad maturation stage, gonad dry weight, dry weight of hepatopancreas and muscle of the second pereopod, presence and fullness of spermathecae in females, and presence of spermatophores in males. The condition indexes of

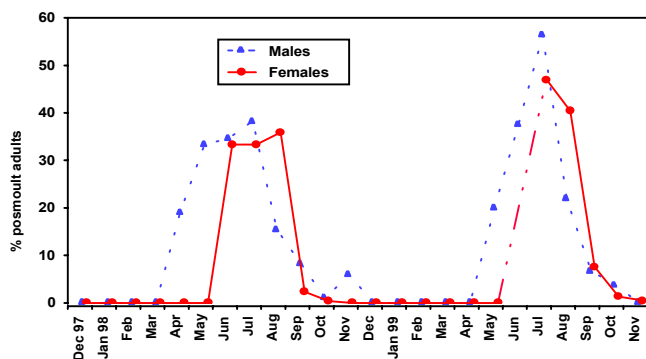


Figure 3. Percentage of soft adults in the shallow area

hepatopancreas, gonad and muscle were estimated from the residuals of a linear regression of the dry weight of each tissue against the carapace length (CL).

Terminal moult: Adult males inhabiting shallow waters in May and June were in a large percentage in soft-shell condition, while soft adult females were found mainly between June and August. As showed in the Figure 3, the terminal moult period was longer and took place one month before for males than for females.

Gonad development: Females started their gonad development in November, 2-3 months after the terminal moult (Fig. 4). Males developed their gonads before they attained morphometric maturity. More than the 76 % of the juvenile males larger than 96 mm (CL) and all morphometrically mature males had spermatophores.

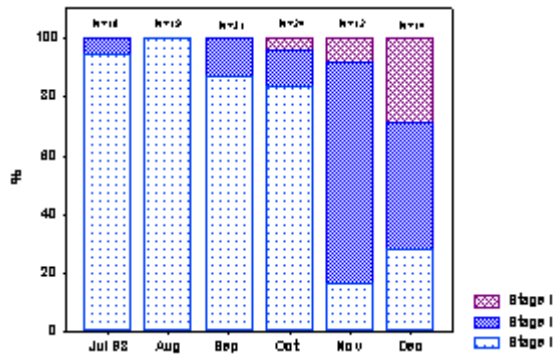


Figure 4. Gonad developmental stage of females in the shallow area (see González-Gurriarán et al., 1998 for a definition of development stages).

Spatial and social structure and timing of the migration: Juvenile crabs showed a very clear aggregative behaviour in shallow areas (Fig. 5), probably to avoid predation risk in these kind of sandy areas without refuges. Between June and November the aggregative pattern is broken by the presence of recently moulted adults, and both juveniles and adults are dispersed along the area.

(regardless of body condition, see below) seems to indicate that the migration is triggered by oceanographic signals (Freire *et al.*, 1999).

Adults move progressively to the outer part of the shallow area (Fig. 6), leaving it coordinately in September (males) and October (females) (Fig. 7). The coordination of the migration within each sex

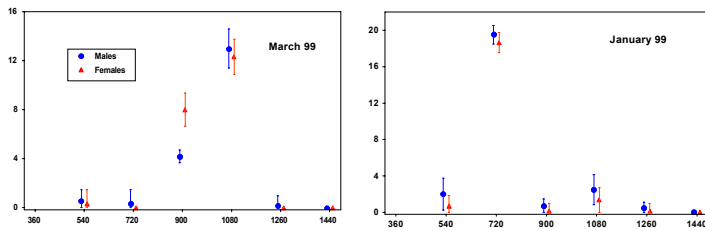


Figure 5. Aggregative behaviour of the juveniles of the shallow area in the winter: catch per unit of effort (no. of crabs per trap \pm 95% confidence interval of the mean) along the transect sampled in the inner area of the Ria de A Coruña. The x axis represents the distance to the coastline.

Body condition: From July to December, adult males in the shallow water area gradually increased their gonad, muscle and hepatopancreas condition (Fig 8). Crabs captured in November in the migration corridor showed a similar body condition to those captured in the shallow area, so the hypothesis of the acquisition of a minimum body condition level as a condition for the start of migration seems not to be supported by the data.

Males mature, start gonad development and migrate earlier, arriving earlier than females to the mating grounds. Thus, we propose the hypothesis that males aggregate in deep waters (supported by fishers' observations) and compete for the females, constituting probably a *lek* mating system.

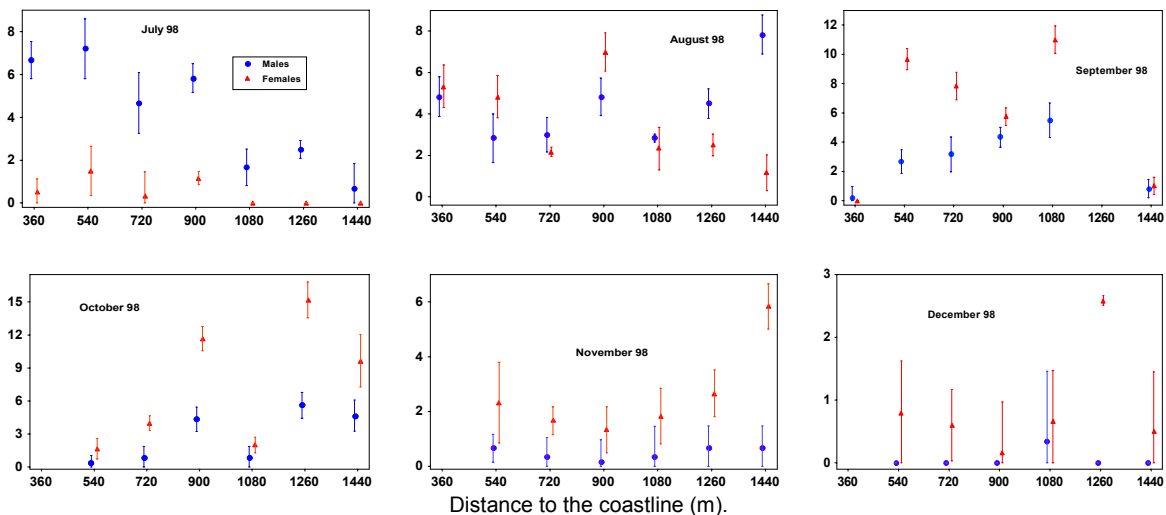


Figure 6. Spatial structure of adults in the shallow area prior to migration: catch per unit of effort (no. of crabs per trap \pm 95% confidence interval of the mean) along the transect sampled in the inner area of the Ria de A Coruña. The x axis represents the distance to the coastline.

Based in the above observations it could be hypothesized that intrasexual reproductive variability are due to the existence of different **reproductive strategies within the male population:**

- The “early migrators” carry out the migration in “bad” body condition, which involves a higher risk due to the energetic cost of these large-scale movements, but has the advantage of arriving earlier to the mating grounds.
- The “late migrators” carry out the migration in good body condition, but miss mating opportunities.

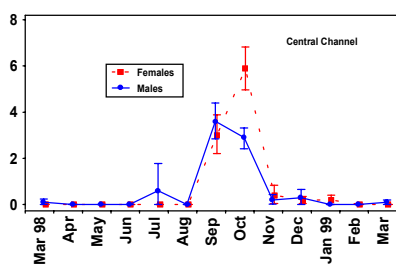


Figure 7. Adult catches in the migration corridor (central channel) (no. of crabs per trap \pm 95% confidence interval of the mean).

Adult females captured in the migration corridor also showed a similar body condition as that of their shallow water counterparts, although with larger gonad weights. They seem to have strategies similar to the males. However, females are in “bad” body condition until November. Females muscle condition is stable along the studied period, and this may indicate that they invest the energy in gonad development and energy accumulation rather than in muscle development, what might be due to a less intense mating competition than in the case of males (Fig. 8).

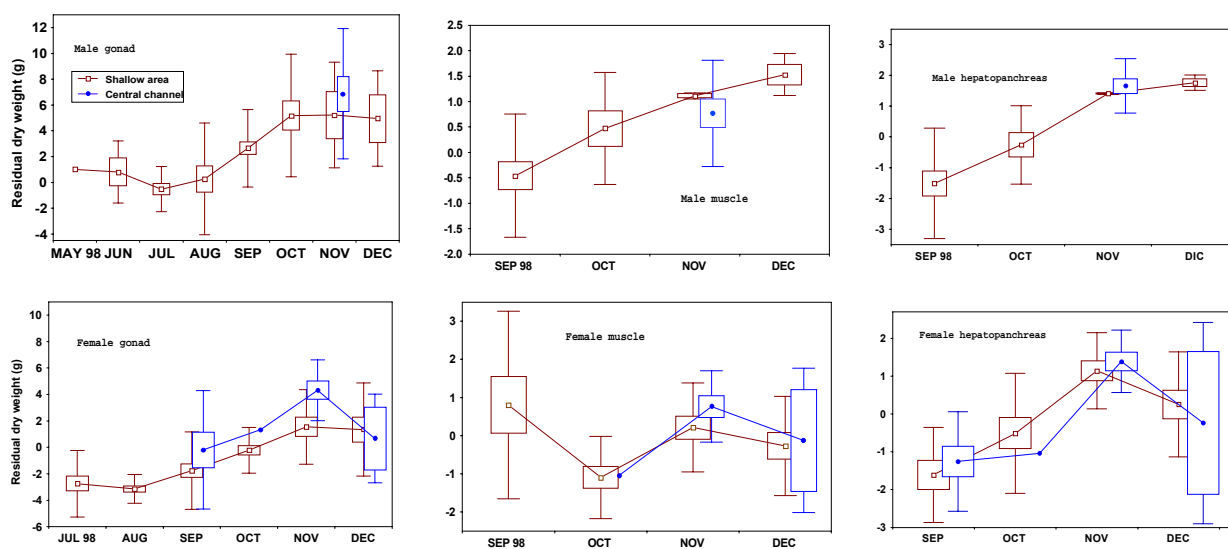


Figure 8. Body condition of adults in the shallow area and the migration corridor (central channel).

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