Do females set the stage? The roles of female aggression and spacing in monogamous snapping shrimp

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Introduction

- **Significance:** Monogamy is a relatively uncommon social mating system in animals, and factors favoring this mating system in species without biparental care are poorly understood.
- Mating systems are primarily determined by the economic defendability of a mate/resource\(^1\), which is influenced by ecological and physiological factors.
- For example, different spatial distributions of females can result in different mating systems:
  - High female density (low spacing) gives males greater opportunity to guard or access multiple females.
  - Low female density (high spacing) can prevent males from guarding or accessing multiple females.

**Objective:** Determine if female aggression affects female spatial distribution and influences the social mating system in a monogamous crustacean.

**Study Species:** snapping shrimp, *Alpheus angulosus*
  - Burrow-dwelling decapods, monogamous, aggressive
  - Females more aggressive than males

**Hypotheses:**
1. Females with a limited ability to be aggressive (glued snapping claws) will be more closely spaced than those with intact claws.
2. Pair stability will be higher in pairs where females have intact claws than those containing females with glued claws.

**Study Site:** Charleston Harbor where shrimp are collected in tide pools under rocks.

Methods

- **Mesocosms:**
  - 3 treatments: female glued claw, female sham glued claw, female intact (unglued) claw control

- **Low Spacing**

- **High Spacing**

- **Burrows:**
  - 4 shrimp ○ 45 x 40 x 12 cm arena
  - 5 burrows ○ 1.5 cm sediment

**Pair in the same burrow:**
- Positions in arena recorded each morning for 7 days
- Derived Variables: distance between every 2 shrimp

**Glue treatments applied**

**Shrimp tagged**

**Acclimation in burrows prior to release**

Results

**Female Spacing:**
- As predicted, there was a significant effect of treatment on female-female spacing, as females in the glued claw treatment were more closely spaced than females in the Control or Sham Glue treatments ($F_{(2,17)} = 4.907, p = 0.02; \text{Fig. 2}$).

**Pair Stability:**
- Contrary to predicted, there was no effect of treatment on pair stability (Fig. 3A & B), however, the Pair Male got significantly closer to the Pair Female and farther from the Single Female throughout the 7 days ($F_{(1,17)} = 4.769, p = 0.04; \text{Fig. 3B}$).

Discussion

- As predicted, limiting female aggression reduces female spacing.
- However, reduced female spacing does not appear to affect pair stability.
- **Interpretation:** Female aggression does not appear to limit male access to multiple females. Thus it remains unclear how monogamy is maintained in this system. Pair stability may result from mutual mate choice; future work will explore mate choice in both males and females, and determine whether pairs comprised of ‘mutually preferred’ individuals show higher stability.

Acknowledgements

- We thank David Couillard (USDA), Pete Meier (Grice Marine Laboratory), and Stephanie Carrera (REU student) for assistance with this project.
Special thanks to committee members Erik Sotka (CofC), David Whitaker (SCDNR), and Mike Ruscio (CofC).


Figure 1. (A) *angulosus* male (top) and female (bottom), (B) male (top) and female (bottom) snapping claws used in aggressive interactions, and (C) intertidal collection site in Charleston Harbor where shrimp are collected in tide pools under rocks.

Figure 2. Mean Pair Female-Single Female distance of all replicates for each morning check for the Control ($n = 21$), Glue ($n = 20$), and Sham Glue ($n = 17$) treatments with a regression line for each treatment.

Figure 3. (A) Percent of replicates for each morning check that the Pair Male and Pair Female are found together, and (B) Mean Pair Male-Pair Female distance minus Pair Male-Single Female distance of all replicates for each morning check for the three treatments.

Image 1. (A) A. angulosus male (top) and female (bottom), (B) male (top) and female (bottom) snapping claws used in aggressive interactions, and (C) intertidal collection site in Charleston Harbor where shrimp are collected in tide pools under rocks.

Image 2. (A) A. angulosus male (top) and female (bottom), (B) male (top) and female (bottom) snapping claws used in aggressive interactions, and (C) intertidal collection site in Charleston Harbor where shrimp are collected in tide pools under rocks.