Effects of non-volatile female pheromones on male cricket aggression and dominance behaviour

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Abstract

The role of pheromones in cricket behaviour has been the subject of significant study in previous years. In this experiment we explored the role non-volatile female pheromones play in male dominance and subsequent aggressive behaviour in the Mediterrean field cricket, *Gryllus bimaculatus*. We observed no significant difference in any agonistic cricket displays in the presence of female scents, possibly emphasising the role of volatile cricket pheromones play in inter-sex relationships in crickets.

Introduction

All agonistic behaviour, be it for resources, territory or a mate has to be weighed against potential injury and metabolical cost of the display (Smith, 1974). As a result, agonistic behaviours are more likely to be displayed between individuals of similar mass, or social standing, due to individuals not being able to predict the outcome of the competition. However, as the value, or scarcity of the resource increases so does the frequency of agonistic displays between asymmetric pairs (Injaian & Tibbetts, 2015). Increased frequency of agonistic displays in the presence of females is common in the *Gryllidae* family (Adamo & Hoy, 1995; Tachon, Murray, Gray, *et al.*, 1999). (Rillich & Stevenson, 2011) This is likely because agonistic displays in field crickets is often an indicator of reproductive success, as winners are believed to have greater resource holding potential (Stevenson & Rillich, 2012). Previous studies have shown agnostic displays escalate in a linear manner, though they can de-escalate. Usual indicators of high-level agnostic displays are a similar mass of crickets.

Previous studies have examined the role female presence plays in agonistic displays in the field cricket. (Montroy, Loranger & Bertram, 2016) displayed a significant increase in male aggression and subsequent agonistic escalation in *Gryllus assimilis* in the presence of a female audience, although was unable to determine whether the cause was olfactory, visual or auditory. EXAMPLE B INDICATES Y.

(Hardy & Shaw, 1983)

(Otte & Cade, 1976)

(Paul, 1976)

(Adamo & Hoy, 1994)

(Nelson & Nolen, 1997)

(Rence & Loher, 1977)

(Kortet & Hedrick, 2005)

(Thomas & Simmons, 2009)

Pheromones have also been shown to play an important role in inter-sex behaviours in the *Gryllidae* family. (Tregenza & Wedell, 1997) was the first major study to prove the existence of cuticular pheromones in the *Gryllus*, by displaying the recognition of female pheromones on a live cricket and subsequent courting behaviour, and following alcohol wash of the female, a lack of courtship behaviour. This research was further expanded upon in (Nagamoto, Aonuma & Hisada, 2005), which explored the role of antennae and maxillary palpi in pheromone identification and subsequent behaviours, as well as emphasising the role age plays in pheromone secretion (Younger female crickets secreted a greater concentration of pheromones and elicited increased frequency of courtship behaviour in males).

From these previous studies, we predicted that the frequency agonistic displays would increase between sex-segregated male crickets, regardless of size difference under the presence of female scents.

Methods

Three 0.283m^2 circular sheets of filter paper were placed in enclosures of sex-segregated female crickets (n=28; n=16; n=34) over the weekend. The control sheets were placed in a cricket enclosure without any crickets over the weekend.

The sections were on the day of experimentation split cut into 1/12 sections (0.0236m^2). Male crickets were selected randomly from male segregated enclosures, and their pronotum were measured with digital callipers with an error margin of 0.01cm. The measured crickets were then placed in individual tubes to recover for a minimum of one hour. A pair of crickets were then placed into opposite sides of a plexiglass arena (pictured in figure. 1), and the larger male was marked with a white spot of correction fluid for subsequent identification. The control filter paper or experimental filter paper placed in the middle section, and the crickets were allowed 5 minutes to acclimatise before the barriers were removed. Levels of cricket aggression were measured using the linearly scaled ethogram from (Stevenson & Rillich, 2012) . The crickets were observed for 10 minutes, at the end of which the crickets were replaced into a large enclosure with other crickets and observations ended. The enclosures were cleaned with isopropyl alcohol between trials to eliminate residual male pheromones from previous experiments. The experiment and control tests were repeated a total of 36 times.

WELFARE

All treatments of the experimental animals (*Gryllus bimaculatus*) complied with the Animals (Scientific Procedures) Act 1986, as well as Directive 2010/63/EU on the protection of animals for scientific purposes.

Results

Discussion

Debate exists over the chemical structure and volatility of these pheromones, previous studies have shown Tregenza and Wedell- Role of volatile pheremones?

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