Sexual selection and reproductive isolation in field crickets

Submitted by:

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I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.
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Abstract

Barriers to interbreeding limit gene flow between sister taxa, leading to reproductive isolation and the maintenance of distinct species. These barriers come in many forms, and can act at different stages in the reproductive process. Pre-copulatory barriers may be due to individuals discriminating against heterospecifics in mate choice decisions. These decisions may be informed through a range of sensory modalities. If a female is mated and inseminated, then there may be multiple postmating-prezygotic barriers that affect the success of heterospecific sperm in attaining fertilisations. Post-zygotic barriers can be very early acting, resulting in embryonic fatality, or may be later acting, affecting the fitness of hybrid offspring. In this thesis I investigate potential reproductive barriers between the interbreeding field crickets *Gryllus bimaculatus* and *G. campestris*.

I find that females of both species show only weak preference for conspecific calling song, and may even respond phonotactically to songs typical of heterospecific males. Female *G. bimaculatus* are repeatable in their preferences and strength of response. *G. bimaculatus* females presented with synthetic songs prefer those with longer inter-pulse intervals, whereas *G. campestris* show no discrimination between these songs.

Upon meeting, *G. campestris* females strongly discriminate against heterospecific males, behaving aggressively towards them. This is likely driven by females responding to close range species recognition cues, including chemoreception. The species differ in their cuticular hydrocarbon profiles, and females that are no longer able to use their antennae to receive chemosensory information reduced their aggressive behaviour towards heterospecific males.

*G. bimaculatus* females will mate with heterospecific males, though less readily than to conspecifics. When sequentially mated to both conspecific and heterospecific males, these females will preferentially take up and store sperm from the conspecific male, and sperm from conspecific males is more likely to sire offspring than would be predicted from the proportion of sperm in storage.

Eggs from inter-species mating pairs are less likely to begin embryogenesis, and are more likely to suffer developmental arrest during the early stages of embryogenesis. However hybrid embryos that survive to later stages of development have hatching success similar to that of pure-bred embryos.

After mating, phonotaxis of *G. bimaculatus* females towards male songs follows a pattern of suppression and subsequent recovery, likely triggered through detection of seminal proteins.
transferred in the male ejaculate, or detection of mechanical filling of the spermatheca. This pattern of suppression and recovery of phonotaxis does not differ between females mated to conspecific or heterospecific males. Females that lay few or no eggs do not experience a refractory period.
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Author’s Declaration

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**Chapter 2** - Song recordings and extraction of data from these was carried out by Thor Veen, who also created two of the synthetic songs used. I created all other synthetic songs, and performed all other behavioural trials and analyses.

**Chapter 3** - Cuticular hydrocarbon samples were processed through the GCMS by Christopher Mitchell.

**Chapter 4** - I carried out the molecular analyses in collaboration with Xavier Harrison, who took part in all aspects of this work. Amanda Bretman provided technical advice. Thor Veen performed some of the mating trials, though I performed the majority. A version of this chapter has been accepted for publication in *Molecular Ecology*. We are grateful for the comments of three anonymous reviewers.


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**Appendix B** - cDNA preparation & sequencing was carried out by Yannick Pauchet, who also taught me the skills required to identify candidate genes for behaviour

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