The Fiddler Crab Claw-waving Display:
An analysis of the structure and function of a movement-based visual signal

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Title page: Photograph of a male *Uca mjoebergi* in mid-wave.
Declaration

This thesis is an account of research undertaken between March 2004 and September 2007 at the Research School of Biological Sciences, The Australian National University, Canberra, Australia. Except where acknowledged in the customary manner, the material presented in this thesis is, to the best of my knowledge, original and has not been submitted in whole or in part for a degree in any other university. I am the senior author and the principal contributor to all aspects of the co-authored papers within.

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Martin J. How
Abstract

Communication is an essential component of animal social systems and a diverse suite of signals can be found in the natural environment. An area of animal communication that, for technical reasons, we know very little about is the field of ‘movement-based’ or ‘dynamic’ visual signals. In this thesis, I make use of recent advances in measurement and analysis techniques, including digital video and image motion processing tools, to improve our understanding of how movement-based signals are adjusted according to signalling context. I measured and characterised the flamboyant claw-waving displays of male fiddler crabs (Genus *Uca*) and made use of their transparent lifestyle to record the behavioural contexts in which these signals are produced.

The claw-waving displays of seven Australian species of fiddler crab are compared and contrasted to show that these signals are species-specific, but also vary within and between individuals. I show that the species *Uca perplexa* produces different types of signal in different behavioural contexts, a lateral wave for courtship, and a vertical wave during short-range agonistic and courtship interactions. The structure of the lateral courtship waves of *U. perplexa* vary according to the distance of signal receivers, the first time this kind of relationship has been shown in a dynamic visual signal. Finally, I describe and analyse the signalling and orientation behaviour of *U. elegans* during courtship herding, an unusual mating system that uses the claw-waving display in a novel way.

The adjustments made by fiddler crabs to their displays during changes in behavioural contexts suggest that the fine-scale context-sensitivity of animal signals may be far more widespread in communication than hitherto recognised.
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