Interspecific activity of the sex pheromone of the European shore crab (*Carcinus maenas*)

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Summary

The recent identification of uridine diphosphate (UDP) as the female sex-pheromone in the European shore crab *Carcinus maenas* demonstrated not only the link between moult and pheromone production, but also how it may have evolved from a ‘simple’ metabolic by-product. Consequently, it is expected to be present in other moulting crustaceans, thus raising issues involving species specificity of the female pheromone. Bioassays were conducted using synthetic pheromone (UDP, \(10^{-3}–10^{-4}\) M) to examine if it induced sexual behaviour in other crustacean species that are neither closely related nor occur in the same ecosystem. The snow crab, *Chionoecetes opilio*, and the yellowline arrow crab, *Stenorhynchus seticornis*, both belonging to a different superfamily (Majoidea) and occurring in different habitats than *C. maenas* (Portunoidea), displayed significant sexual behaviour towards UDP treated objects \((p < 0.005)\). These and other examples demonstrate that the female sex-pheromone UDP is not species-specific but is present and active in some other decapod crustaceans.

Keywords: *Carcinus maenas*, sex pheromone, heterospecificity, *Chionoecetes opilio*, *Stenorhynchus seticornis*.

Introduction

Many animal species use similar or identical chemical compounds as sex attractants, often in the form of bouquets, with de novo species-specific
chemicals being a rarity. For example, the Asian elephant shares its female sex-pheromone with about 140 moth species (Rasmussen et al., 1996); however, attraction and mating between these two species are obviously non-existent. This provides an extreme example of species using similar common compounds as attractants, these secondary metabolites having other functions within the body. Several moth species use the same pheromone compounds due to common biosynthetic pathways (Roelofs & Brown, 1982). Every specific or unique communication channel in most moth species is based on multi-component pheromones (Baker, 1989; Sasaerrila et al., 2000) consisting of only a few unsaturated carbon chains in a certain, species-specific ratio (Byers, 2005). Although there is a high specificity amongst the pheromone channels, cross attractions have been reported in some species (Post & Jeanne, 1984; Landolt & Heath, 1987; Linn et al., 1988; Kimani & Overholt, 1995).

Chemical communication is widespread in aquatic species as other communication methods are often limited due to the complexity of the environment (poor light conditions, turbid waters, substrate and vegetation). In aquatic organisms heterospecific activity of chemical cues has been demonstrated in a few species, for example in polychaetes (Boilly-Marer & Lassalle, 1978; Hardege et al., 1998) and the molluscs *Aplysia* spp. (Painter et al., 2004; Cummins et al., 2005). Among the Crustacea, interspecific behavioural activity induced by female sex pheromones has been demonstrated in *C. maenas* and *Macropipus depurator* (Seifert, 1982) whereby males perform sexual behaviour towards a freshly moulted female of the other species when already stimulated by conspecific females.

Mating in crustaceans can be divided into ‘soft-shell mating’ where copulation occurs shortly after the moult of the female and ‘hard-shell mating’ where copulation occurs during the intermoult stage of the female (Hartnoll, 1969; Dunham, 1978). The existence of sex pheromones in crustaceans and its link with the moult of females has been described in a number of species including *C. maenas* (Berrill & Arsenault, 1982; Seifert, 1982; Bamber & Naylor, 1996a, 1997; Hardege et al., 2002). Starting several days before the moult and up to a week after ecdysis, female shore crabs release sex-pheromones which attract males and induce mate guarding behaviour (Bamber & Naylor, 1996b).

The association between the female moult and the attraction of the male in many brachyuran species, suggested that the moulting hormone, 20-hydroxyecdysone, was the potential sex pheromone (Kittredge et al., 1971).