ABSTRACT

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Many important behaviours of marine animals are triggered and controlled by chemical signals. Pollutants that impair the ability to release, detect and respond to chemosensory cues, could profoundly affect these behaviours. The aim of this thesis is to investigate how pollutants affect foraging and mating behaviour of different benthic crustaceans, by disturbing their chemosensory ability. This has been investigated in laboratory assays with the decapods Norway lobster *Nephrops norvegicus* and shore crab *Carcinus maenas*, and the amphipod *Corophium volutator*, exposed to pollutants that may occur in their natural habitats.

N. norvegicus lives on muddy sediments, naturally rich in manganese (Mn). In hypoxic conditions, Mn is reduced and released from the sediment, so increased concentrations of dissolved Mn^{2+} become bioavailable. We found that environmentally realistic concentrations of dissolved Mn (5.5 and 11 mg l^{-1} for 12 days) severely affect the foraging behaviour of *N. norvegicus*, with a more than doubled reaction time to food odour and 36-60% fewer lobsters able to locate the food odour source.

In contrast to *N. norvegicus*, *C. maenas* and *C. volutator* are found in shallow coastal waters that are often heavily trafficked by leisure boats. One problem with harbours and heavy boat traffic is the leakage of toxic compounds, such as copper (Cu), from antifouling paints. Pollution from leisure boats occurs during a concentrated summer period when most coastal animals have their reproductive season and, therefore, are most sensitive. It was found that Cu exposure (0.1 and 0.5 mg Cu(II) l^{-1} for 5 days) clearly alters the foraging behaviour of *C. maenas*, with considerably decreased and delayed reactions to food and less feeding. In addition, Cu exposure impairs the mating behaviour of *C. maenas* males, with delayed and less directed search for distant female pheromones. Inhibited pheromone detection also decreases the display of mating behaviour and increases non-mating behaviours, as well as delays pair formation.

In contrast to the well known pheromone communication of *C. maenas*, the presence of sex pheromones in *C. volutator* was not established. My studies show that in *C. volutator*, males are attracted to pheromones released by females, while females do not follow pheromones, but also that male mate search behaviour can be disturbed by pollutants. Medetomidine is a candidate antifouling biocide which effectively impedes settlement of barnacles. We found that medetomidine exposure (0.01 and 0.1 μg ml^{-1} for 24 h) reduces pheromone induced mate search in *C. volutator* by 42-71%, with fewer males crawling towards female odour. The results indicate that medetomidine may impair the reproductive fitness of non-target crustaceans, an aspect that needs to be considered before further commercialisation.

Another problem with heavy boat traffic is the discharge of high concentrations of fuel into the water and sediment. Naphthalene is a polycyclic aromatic hydrocarbon abundant in motor fuels. It was found that *C. volutator* males exposed to naphthalene treated sediment (0.5 and 5 mg kg^{-1} dw for 3 days) have a 27-45% reduced mate search activity and can no longer find females by the use of the olfactory sense. The ability of females to produce and release pheromones is, however, unaffected by naphthalene exposure. In natural populations, impaired pheromone perception and decreased mate search behaviour may have implications for mate selection and males' access to females during the few days mating can occur following the female moult.

In conclusion, this thesis shows that several mating and foraging behaviours in benthic crustaceans are disturbed by pollutants, likely due to impaired chemosensory ability. Behavioural changes identified are delayed reactions to odour, decreased and less directed behaviours, or that animals make inappropriate choices. Even minor behavioural changes could have strong consequences for an individual's competitive ability over food or mates under natural conditions, affecting their fitness and thereby having profound ecological implications for populations in polluted environments.