crustaceans. The present study investigated the simultaneous effects of digestive processes and low salinity on the behavioural and physiological reactions in crabs of varying osmoregulatory ability. The species used were the slender crab, *Cancer gracilis* which is classed as a osmoconformer, the Dungeness crab, *Cancer magister* which is classed as a weak regulator and an efficient osmoregulator, the blue crab, *Callinectes sapidus*. A general pattern emerged whereby the osmoconformer and weak regulator tended to prioritize physiological responses to low salinity, whereas the regulator was able to sum responses of both digestion and low salinity. Behavioural responses in low salinity were closely linked to physiological ability. Despite the fact that feeding in low salinity could be costly for *C. magister*, this species still made forays in low salinity to feed. A decrease in salinity reduced both the likelihood of feeding and the amount of food consumed. However, an increase in starvation time overrode this effect. Once the food was consumed, low salinity caused a decrease in gut contraction rates and an increase in gastric evacuation times in *C. magister*. In the lower salinity regimes *C. gracilis* regurgitated food, which may have acted as a protective mechanism to avoid digestion and the subsequent increase in specific dynamic action. The behavioural and physiological responses are discussed in relation to the ability of each species to balance the demands of competing physiological systems.

doi:10.1016/j.cbpa.2007.01.086

A2.4
A multidisciplinary approach to evaluating physiological condition and intra-specific behaviour in the shore crab *Carcinus maenas* (Crustacea: Decapoda)

A. Dissanayake, T. Worsey, M. Jones, T. Galloway, (University of Plymouth, United Kingdom)

Male *Carcinus maenas* exhibits a characteristic and measurable agonistic behaviour during inter-individual competition for resources, such as females and food. In this study, we explored the hypothesis that experimental manipulation of Carcinus physiological condition via nutritional-deprivation (starvation) and sublethal contaminant exposure [to the hydrocarbon pyrene (PYR) (200 μg L^{-1} for 14 days)] would induce physiological changes and, subsequently, affect their competitive ability to engage in resource conflicts.

Physiological condition of male individuals was evaluated using a multidisciplinary approach, encompassing endpoints at the biochemical (post-contest glucose and lactate concentrations, urinary pyrene metabolite and protein levels and total antioxidant status) cellular (cellular integrity, cellular viability, phagocytosis), physiological (haemocyanin) and behavioural (various endpoints, including resource possession and recuperation time) level. Univariate analyses demonstrated that combined contaminant exposure and nutritional-deprivation resulted in increased proteinuria ($P<0.001$), decreased total antioxidant status ($P<0.001$) and increased cellular toxicity ($P<0.06$) between starved and fed treatment groups.

At the behavioural level, higher resource possession ($P<0.05$) and lower recuperation periods ($P<0.05$) were observed in starved PYR-exposed crabs, compared to unexposed individuals. Multivariate analyses, demonstrated that protein in urine (as a surrogate measure of hepatopancreas dysfunction), haemocyanin and cellular viability contributed most to the differences in physiological condition (between starved and fed crabs), thereby having an effect upon the competitive ability of crabs. In conclusion, this multidisciplinary study shows how Carcinus physiological condition affects competitive ability and is key in shaping intra-specific agonistic contests in this species.

doi:10.1016/j.cbpa.2007.01.087

A2.5
Diurnal activity patterns and related changes in energy metabolism in the cephalopod *Sepia officinalis*

F. Mark, (University of Cambridge, United Kingdom, Alfred Wegener Institute, Germany); G. Jaeckel, M. Gutowska, H. Pörtner, (Alfred Wegener Institute, Germany); M. Oellermann, (University of Bremen, Germany); C. Ellington, (University of Cambridge, United Kingdom)

Cuttlefish (*Sepia officinalis*) display diurnal changes in activity levels that are linked to the gas loading of the cuttlebone, which regulates buoyancy (Denton and Gilpin-Brown, 1961).

To investigate diurnal changes of standard and active metabolic rates, we analysed activity patterns of *S. officinalis* using new techniques of video tracking. We monitored *S. officinalis* activity by video continuously for 5 days. In a parallel experiment we measured their rates of oxygen consumption in order to explore whether metabolic rate changes in parallel with activity levels. Both measurements of activity and oxygen consumption indicate a strong diurnal pattern with a maximum physical activity shortly after midnight and a relatively constant minimum value during daytime.

In order to determine whether patterns of metabolic regulation go hand in hand with the diurnal rhythm of activity-dependent metabolic slowing (daytime) and stimulation (nighttime), we analysed the activities of enzymes involved in standard and digestive metabolism in mantle and hepatopancreas tissues to complete the picture. Moreover, we could show that different feeding schemes strongly affect the distinctiveness of the diurnal activity pattern.

Supported by NERC grant NERC/A/S/2002/00812.

doi:10.1016/j.cbpa.2007.01.088