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Near-future CO_2-driven hypercapnia depresses echinoderm larval metabolism by approximately one-third

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Metabolic depression, a reduction in metabolic activities, is an adaptive strategy to minimise the adverse effects of abiotic stressors and hypercapnia. We examined the metabolic response of larvae from eight echinoderm species ranging from Antarctic to tropical habitats in projected near future (year 2100) ocean conditions (0.4 pH lower than present day, pCO_2 (aq) = 1091 to 1450.8 μatm) at their ambient sea temperatures. Metabolic activity was quantified from larval respiration rates, measured in ambient and reduced pH seawater using a microrespirometer. All species exhibited a reduction in metabolic rate (12.3 to 50.9%) when exposed to hypercapnic conditions and this was significant in six species. Across all species metabolism was reduced by ca. 30% when exposed to seawater pCO_2 levels predicted for the year 2100. The data indicated that the level of metabolic depression was not closely linked with basal metabolic rate, despite the broad latitudinal range of the species and between a lecithotrophic larvae and planktotrophic developmental modes. Modelling of data suggest that sea temperature increases (due to global warming) may not be sufficient to compensate for hypercapnia-induced metabolic depression. This is the first study to show that metabolic depression, and its potential for reducing the fitness and viability of small invertebrate larvae, is an important consideration in understanding the effects of ocean acidification on marine organisms.