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Coping with ocean acidification during long-term exposure in the cold-water coral *Lophelia pertusa*

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Ocean acidification due to the uptake of anthropogenic CO_2 is expected to become a major threat to calcifying organisms in the coming decades. Calcifiers in the high latitudes and in deeper waters are considered particularly vulnerable to ocean acidification because these waters are already low in carbonate saturation state and the dissolution of CO_2 is highest at low temperatures. One of the most prominent benthic calcifiers in these waters is the scleractinian cold-water coral *Lophelia pertusa*, which builds extensive reefs along the continental shelves, which in the Atlantic Ocean extend from northern Norway to the west of Africa. The reefs are biodiversity hotspots of the deep sea and provide habitat and nursery grounds for a variety of organisms, including many commercially important fish species. Ocean acidification is projected to expose 70 % of the presently known reefs to waters corrosive for their carbonate structures by 2100 in case of unabated CO_2 emissions. Despite their wide-spread abundance and crucial role as ecosystem engineers very little is known about the sensitivity of cold-water corals to ocean acidification. Here we present results from the first long-term CO_2 perturbation study on *L. pertusa* and relate them to results from a short-term study to compare the effect of exposure time on the coral's responses. Whereas short-term (1 week) high CO_2 exposure resulted in a decline of calcification by 26-29 % for a pH decrease of 0.1 units and net dissolution of calcium carbonate, *L. pertusa* was capable to acclimate to acidified conditions in long-term (6 months) incubations, leading to even slightly enhanced rates of calcification. Respiration rates, measured across a pCO_2 gradient from 410 to 1200 µatm decreased significantly and revealed that enhanced calcification due to higher CO_2 concentrations did not entail enhanced metabolic costs with respect to oxygen consumption. Furthermore, the relationship between metabolic activity and calcification performance appeared to be complex and dependent on several aspects of the animals energy budget (e.g. fitness, feeding state, tissue growth, reproduction). The present results provide the first evidence of a successful acclimation to ocean acidification in a coral species and emphasize the need for long-term incubations in ocean acidification research. Finally, net growth occurred in sub-saturated waters, i.e. in waters considered corrosive to calcium carbonate. This implies that the projected shoaling of the carbonate saturation horizon by up to 2000 metres in the North Atlantic before the end of this century may not necessarily cause the destruction of cold-water coral reefs exposed to these corrosive waters as previously projected.