Corals & Carbonate: Physiological response of a protected deep-sea coral to ocean acidification

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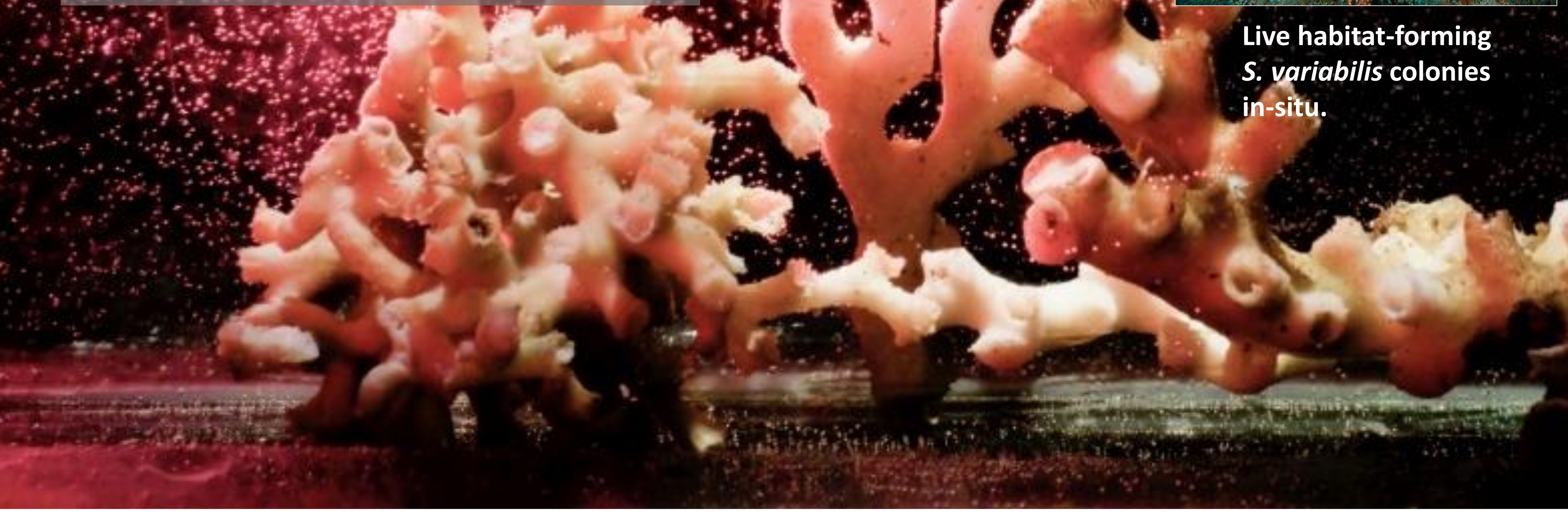
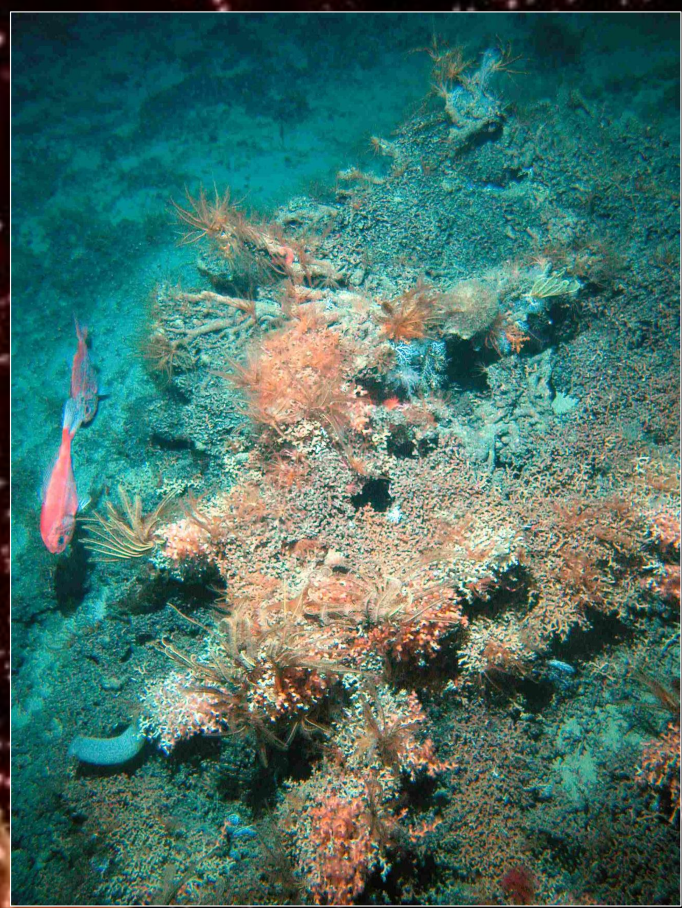
Deep-sea stony corals provide an important ecosystem role and are potentially under threat. Structures of the deep-sea scleractinian corals, commonly found in the New Zealand region, provide habitat complexity in the deep for fish and many invertebrates. These frame-building 3-D-like coral structures comprised of calcium carbonate (aragonitic form), are fragile and often impacted by human activities such as bottom trawling. Ocean acidification (OA) is recognised as another impact to corals and other calcifying organisms due to the rapid shoaling of the aragonite saturation horizon (ASH) in the ocean. A reduced pH will affect the availability of carbonate ions in seawater; an ion with which the stony corals construct their skeletons.

Several live colonies of the deep-sea coral *Solenosmilia variabilis* were collected from the Louisville Seamount chain in 1200m -1250 metres.

This research investigated the response of *S. variabilis* to OA. Colonies were fragmented and kept in an aquarium replicating their natural environment (dark, cold (3.5°C) and with a high flow-rate). Colonies were held in a pH of either 7.88 or 7.65, designed to reflect current pH condiions and end-of-century predictions, respectively.



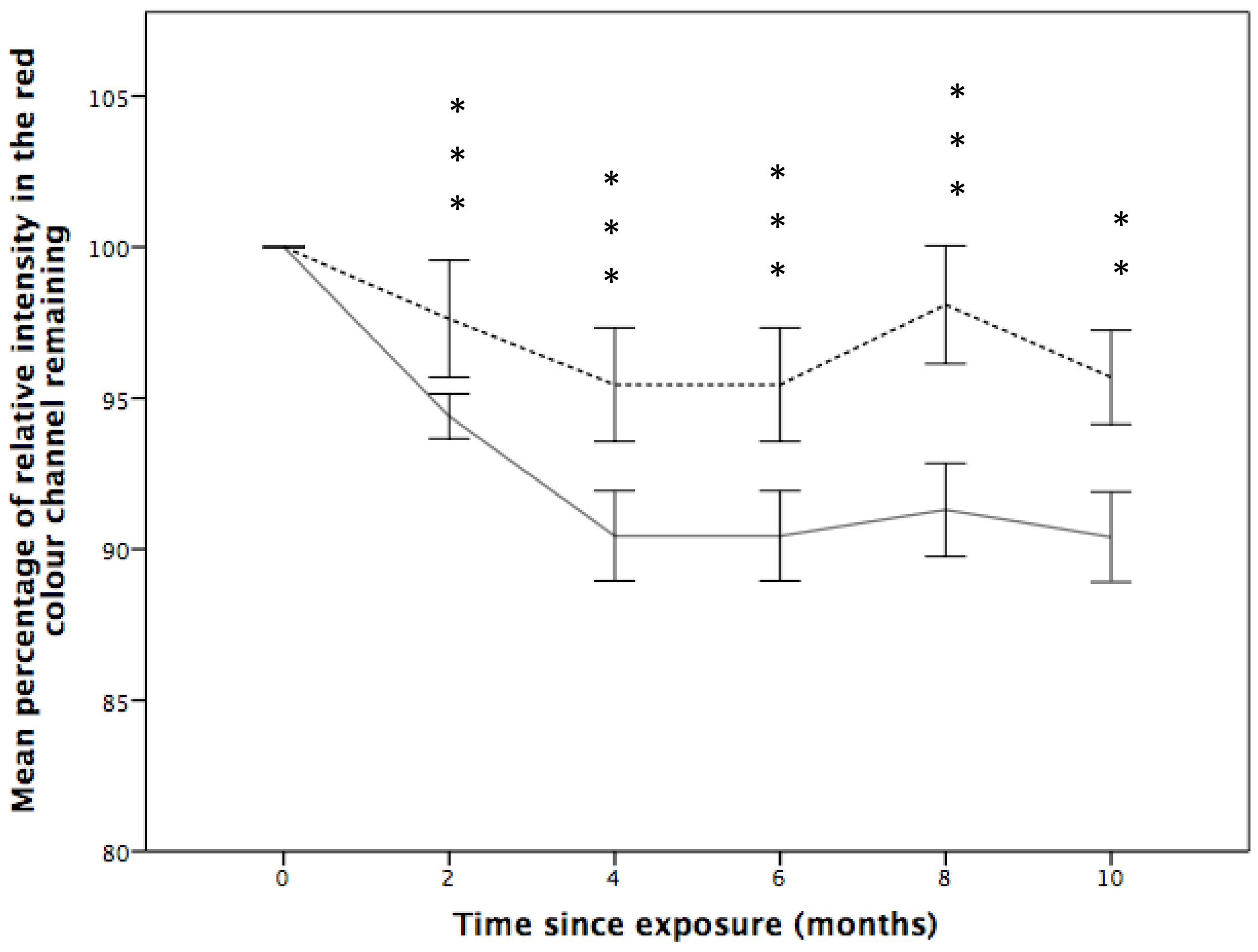


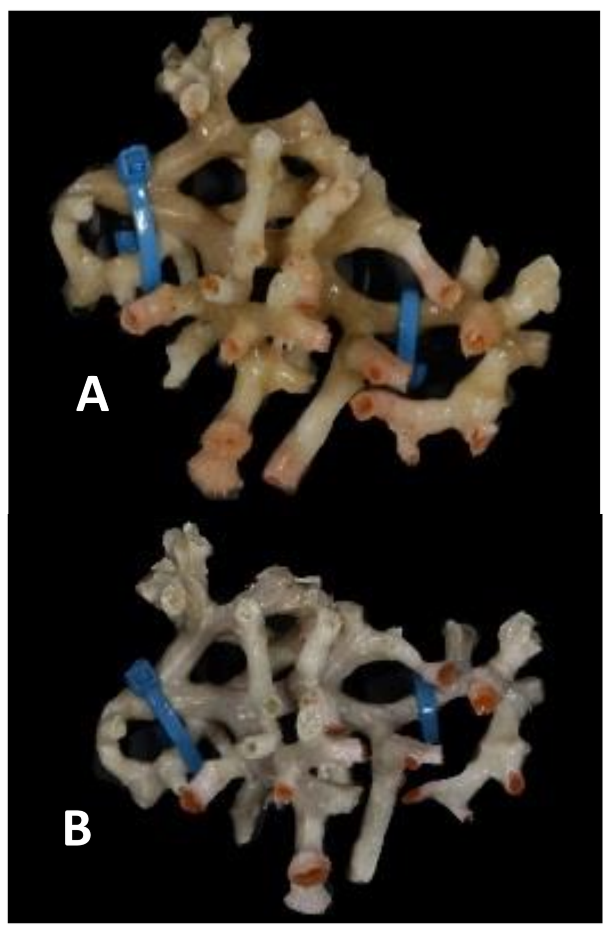
Live habitat-forming *S. variabilis* colonies in-situ.

There was no treatment effect on respiration rates, growth and intracellular pH (pHi). Respiration rates were highly variable, ranging from 0.065 to 1.756 µg O^2 g^{-1} protein h^{-1} and pHi ranged from 7.67 – 8.30. Yearly growth rates were also variable, ranging from 0.53 to 3.068 mm year $^{-1}$ and again showed no detectable difference between the treatment and control colonies.

An unexpected discovery. A loss in the colouration of coral skeletons was observed in the treatment colonies after several months exposure to the reduced pH treatment. This was attributed to a loss of tissue. Photos were taken of each coral bi-monthly for the purpose of measuring growth. The loss of skeleton colouration was quantified by measuring the change in the relative percentage of intensity in the red colour channel of these images.

The observed loss of tissue in the treatment group could indicate a re-allocation of energy, allowing for the maintenance of other physiological parameters such as those measured here (e.g. growth and respiration rates). Deep-sea corals feed on nutrients in the water column that originate from primary production in surface waters. This makes maintenance of linear extension important as they need to be able to filter nutrients from overlaying water.





The effect of seawater pH on the loss of coenosarc tissue in *S. variabilis*. Images A-B are of the same colony at the treatment pH (pH 7.65). Images were taken before the experiment began (A) and after three months into the experiment (B). The mean percentage remaining (±1 SE) of the initial relative intensity is presented (treatment group = solid line, control group = broken line). Significant differences from the control are shown by ** $p < 0.01$ and *** $p < 0.001$ (Wilcoxon-signed rank analysis) (n = 17 *per* time-point *per* treatment).

Always more work to be done! This research is an important first step towards understanding the senstivity of deep-sea corals in the New Zealand region to OA and their potential acclimation. In many respects, this research suggests that *S. variabilis* might not be susceptible to end-of-century projections of OA. Nevertheless, the observed tissue loss is interesting and warrants further investigation to assess its long-term implications.

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