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# Adjustments in fatty acid composition is a mechanism that can explain resilience to marine heatwaves and future ocean conditions in the habitat-forming seaweed *Phyllospora comosa* (Labillardière) C. Agardh

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**Abstract:**

Marine heatwaves are extreme events that can have profound and lasting impacts on marine species. Field observations have shown seaweeds to be highly susceptible to marine heatwaves, but the physiological drivers of this susceptibility are poorly understood. Furthermore, the effects of marine heatwaves in conjunction with ocean warming and acidification are yet to be investigated. To address this knowledge gap, we conducted a laboratory culture experiment in which we tested the growth and physiological responses of *Phyllospora comosa* juveniles from the southern extent of its range (43 – 31 °S) to marine heatwaves, ocean warming and acidification. We used a 'collapsed factorial design' in which marine heatwaves were superimposed on current (today's pH and temperature) and future (pH and temperature projected by 2100) ocean conditions. Responses were tested both during the heatwaves, and after a 7-day recovery period. Heatwaves reduced net photosynthetic rates in both current and future conditions, while respiration rates were elevated under heatwaves in the current conditions only. Following the recovery period, there was little evidence of heatwaves having lasting negative effects on growth, photosynthesis or respiration. Exposure to heatwaves, future ocean conditions or both caused an increase in the degree of saturation of fatty acids. This adjustment may have counteracted negative effects of elevated temperatures by decreasing membrane fluidity, which increases at higher temperatures. Furthermore, *P. comosa* appeared to down-regulate the energetically expensive carbon dioxide concentration mechanism in the future conditions with a reduction in $\delta^{13}$ C values detected in these treatments. Any saved energy arising from this down-regulation was not invested in growth and was likely invested in the adjustment of fatty acid composition. This adjustment is a mechanism by which *P. comosa* and other seaweeds may tolerate the negative effects of ocean warming and marine heatwaves through benefits arising from ocean acidification.

Keywords: fatty acids, global ocean change, habitat-forming, macroalgae, marine heatwaves, ocean acidification, ocean warming, physiology, seaweed