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Global warming is eroding the resilience of kelp beds

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Global warming's effect on the phenology and distribution of biota threatens the preservation of biodiversity and ecosystem services worldwide. A critical element for conservation success in the future is understanding the link between physiological and ecological responses of key species to multiple concurrent environmental changes. Current evidence for how ocean temperature affects the biota in socio-economically important marine habitats is scant, correlative and provides little causal information on likely synergistic effects of multiple perturbations. Here, we use a comparative experimental approach to demonstrate that, in Australasian kelp beds, physiological adjustment to maintain abundance in a warm ocean climate reduces the ecological competency of juvenile kelp, and that this suppresses the capacity for canopy recovery from physical disturbances of increasing intensity. The implied erosion of resilience is mediated by a shift in adult-juvenile interactions from competitive under cool (benign) to facilitative under warm (adverse) conditions. This supports recent theoretical predictions that positive interactions among organisms will become increasingly important to the maintenance of ecological function in a warmer future. These results demonstrate that, rather than gradually shifting range boundaries pole-ward, the commonly predicted response to global warming, patterns of abundance may be maintained through physiological adjustment while the underlying ecological processes change. The combined effect of ocean warming and increasing disturbances from extreme events will therefore bring kelp beds closer to a threshold where persistent loss of habitat and ecological function will occur if they are subjected to additional stressors (e.g., reduced water quality).