Symbiont distribution along a light gradient within an intertidal cave

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ABSTRACT: The potentially lethal bleaching of invertebrates through loss of their algal symbionts is a major global conservation issue; cnidarians in such interactions could potentially withstand environmental change by having multiple symbiotic partners whose physiologies vary with critical field parameters such as temperature and light. Spatial variation in symbiont distributions in the field is a strong indicator of such potential. We show that, in an association between an abundant temperate sea anemone and its two endosymbionts, the dinophyte *Symbiodinium muscatinei* (zooxanthellae) and an unidentified green alga (zoochlorellae), densities and ratios of anemones[] symbionts change along a light gradient generated by intertidal caves in Washington state. In the laboratory, the photosynthetic performance of zooxanthellate anemones exceeded that of zoochlorellate anemones under high irradiance levels (>100 µmol quanta m^{-2} s^{-1}). Further, field sampling revealed that caves are divided into three distinct regions based on anemones[] algal complements: a brown region of zooxanthellate anemones near the mouth of the cave, a green region of zoochlorellate anemones in the middle of the cave, and a white region of algae-free anemones near the back of the cave. These data, together with field reciprocal transplant experiments showing algae-free anemones[] ability to regrow algae consistent with local physical conditions, suggest that algal performance (vs. host selection) determines observed variation in these symbioses. Our results support the idea that temperate, as well as tropical, host-symbiont associations can respond plastically to environmental change. Our data also suggest that intact symbioses in adult hosts are surprisingly stable; bleaching may be required in rearranging host-symbiont associations.

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