

Climate change influences on coral growth tested by a culture experiment of temperate species

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Recently, it has been reported that rising temperature of sea surface by global warming causes quick poleward range shift and/or expansion of some coral species around Japan. This is probably because the influences from not only rising temperature by global warming but also ocean acidification. The ocean acidification has been decreasing pH and Omega (saturation state of CaCO₃) in seawater, which would cause negative impact on calcification in coral skeleton composed of CaCO₃ (aragonite). However, the influences of climate changes on "expanded" corals and corals, which are distributed in northern limited, have not yet been tested in detail. In this study, we focus on the corals distributed in the temperature zone and conducted culture experiment on these corals in order to reveal the impacts of global warming and ocean acidification on coral growth.

To evaluate coral growth by enhanced global warming and ocean acidification followed by continuous CO₂ emission, two culture experiments, "Temperature experiments with large Omega gradient" and "Temperature experiments with normal Omega gradient", both of which have 5 temperature settings, were conducted. "Temperature experiments with large Omega gradient" had Omega of 3.1 - 1.8, which were from high to low temperature, as a result of adjusting partial pressure of carbon dioxide (pCO₂) to achieve constant pCO₂ concentration throughout all temperature settings. In contrast, "Temperature experiments with normal Omega gradient" had Omega of 2.4 - 2.1, which were little change with temperature because of no addition of CO₂ in all temperature settings.

The results of both two culture experiments showed that all coral species were bleached and died at 13 deg C treatment, suggesting that low temperature of seawater during the winter season could be a limited factor of northern distribution of temperate corals. On the other hand, suppression of coral growth according with the decreasing of carbonate saturation state indicated that ocean acidification effect could also be negative influence on calcification of corals. Recent modeling study provided a prediction in which the distribution of temperate coral around Japan might be limited by ongoing ocean acidification rather than increasing seawater temperature. Our experimental study suggests that the growth rate of temperate corals are potentially affected by decreasing Omega and that expansion of temperate corals towards the north accompanying with global warming would be suppressed by ocean acidification in the near future.

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