沖縄の造礁サンゴの海洋酸性化と海洋温暖化に対する反応の種間および種内変異

Form 3

Abstract

Title Inter- and intraspecific variation in responses of Okinawa reef corals to ocean acidification and ocean warming

沖縄の造礁サンゴの海洋酸性化と海洋温暖化に対する反応の 種間および種内変異

Anthropogenic emission of CO_2 into the atmosphere has been increasing exponentially, causing ocean acidification (OA) and ocean warming (OW). OA and OW may negatively affect the growth and survival of reef corals. OA increasingly reduces the calcification rate of the corals with the increasing pCO_2 of the seawater. OW has already affected the corals negatively and is also predicted to increasingly affect the corals in near future. Responses of the corals to OW may be more severe when simultaneously exposed to OA (OA+OW). The responses of the corals to OA+OW may be additive, synergistic, or antagonistic. In this dissertation, I conducted aquarium experiments to reveal the response of corals to OA, OW, and OA+OW.

First, I investigated the effect of OA (300 μatm –1200 μatm) on the calcification of 5 branching and 1 massive coral species (Chapter II). The results showed that the calcification rates of all the coral species decreased with increasing seawater pCO_2. Second, I evaluated the effect of OA (pCO_2 ~650 μatm) on the calcification of primary polyps derived from the gametes of *Acropora digitifera* (Chapter III). The results showed that the calcification of the primary polyps decreased significantly at pCO_2 higher than the ambient. Third, I separately examined the effects of OW (28 and 31 °C) and OA (400 and 1,000 μatm) on the calcification of *A. digitifera* and *M. digitata* (Chapter IV). The results showed that *A. digitifera* was more OW-sensitive than *M. digitata*, whereas the former was less sensitive to OA than the latter. Fourth, I examined the effects of OA, OW, and OA+OW on the calcification and mortality of *A. digitifera* and *M. digitata* (Chapter V). An effect size test revealed that OW was the main stressor, and OA was only the second-order stressor for increasing mortality and decreasing the calcification in both species. Fifth, I examined the intraspecific variation in the responses of the calcification and *Fv/Fm* against OA, OW, and OA+OW in *A. digitifera* (Chapter VI). Significant intraspecific variations were detected in the calcification; the calcification rate varied among colonies significantly, but *Fv/Fm* did not.

The results of the present dissertation suggest that, in *A. digitifera* and *M. digitata*, OA reduced the calcification rate by affecting the host corals, and OW reduced the density, chlorophyll content, *Fv/Fm* by affecting the endosymbionts. The effect of OA+OW was additive in these two coral species, presumably because OA and OW mainly acted on host corals and endosymbionts, respectively. When OA and OW occur simultaneously, as supposed in the high pCO_2 world in the future, corals may be generally affected more negatively by OA+OW than OA alone and OW alone. OW may be the main stressor of mortality and reduced calcification, while OA may be the second-order stressor in other coral species.

Name Cristiana Manullang