

Coral dynamics in the deeper parts of the reefs over a decade highlight hopes and threats for the future of coral reefs.

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Coral reefs are heavily impacted by climate change worldwide. In recent years, the deeper parts of reefs, the mesophotic coral ecosystems (MCEs), have been considered a refuge for some shallow coral species in a warming ocean. Both the thermal buffer provided by the depth and the lower light stress have been shown to be critical in this context. This hypothesis, known as the Deep Reef Refugia Hypothesis (DRRH), has been challenged by the punctual observations of coral bleaching at mesophotic depths. However, long-term monitoring is necessary to understand the impact of marine heatwaves on coral communities across depths. Here, we surveyed coral reefs in Nagura Bay, Ishigaki, between shallow and upper mesophotic depths for over a decade. During our survey, two massive bleaching events occurred, providing a unique opportunity to observe their impact across depths. Our findings support the DRRH in Nagura Bay, as no significant bleaching was observed below 30 m depth. Our data suggest that while marine heatwaves are a major threat to the reefs, other factors also have a heavy impact on coral cover and diversity. Moreover, the observation of coral bleaching in 2024 at mesophotic depths in the nearby Iriomote Island prevents making generalizations on the refuge potential of deeper parts of the reefs and highlights the complexity of the environmental and biological factors affecting coral reefs and the necessity for cross-disciplinary approaches for predicting the future of coral reefs in a warming ocean and the impacts on human society.

Keywords: Coral Reefs, Marine heatwaves, Community change, Refuges