Coral adaptation and acclimatization to global change: resilience to hotter, more acidic oceans

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Project Summary

The release of anthropogenic CO_2 to the environment is leading to climate change and ocean acidification with potentially severe repercussions for coral reefs and for society. Hawaiian reefs are valued at over $33 billion annually to the American public, and Hawai‘i annually derives an estimated $364 million directly from coral reefs in addition to other benefits, such as shoreline protection. Because corals are ecosystem engineers that directly support considerable seafood biomass and biodiversity, their health is especially important to maintaining Hawaiian coastal fisheries productivity and marine tourism. Understanding the impacts of global climate change on coral reefs is, therefore, of major scientific and societal importance.

Building on our previous research, we seek to understand the basis for coral reef resilience and to provide improved projections of how climate change and ocean acidification are likely to impact Hawaiian coral reefs. We also plan to examine the potential for corals to adapt or acclimatize to future conditions. We will generate new data and combine them with existing ecological and environmental data collected across the Hawaiian archipelago to 1) model changes in Hawaiian coral reefs under global change, 2) model potential rates of coral adaptation under global change, and 3) investigate the physiological basis for different coral calcification sensitivities to elevated temperature and reduced pH.

We will continue to use our experimental mesocosm facility to examine how the eight most abundant reef-building corals in the Hawaiian archipelago (*Montipora capitata, M. flabellatae, M. patula, Pocillopora damicornis, P. meandrina, Porites compressa, P. evermanni,* and *P. lobata)* recover from the back-to-back mass bleaching events experienced in Hawaii in 2015 and 2016. Our models show that biology trumps physics and ecosystem feedbacks in response to climate change scenarios. Likewise, we find that species-specific differences in response to temperature, pH, and the interaction between the two, suggest that corals in Kāne‘ohe Bay are the living reefs of the future because they are far more resilient to conditions predicted under future climate change than are corals from nearby Waimānalo Bay.

This study will provide much need information about the capacity for adaptation and acclimatization in Hawaiian reef-building coral species that together constitute ~97% of coral cover across the archipelago. The result will inform resource managers about effective and alternate strategies for management in the face of climate change, and help policy makers support decisions about appropriate CO_2 emissions targets and mitigation strategies. Our findings will be particularly useful to inform decisions by local managers striving to maximize coral reef resilience in times of global change. Resilient reefs will be the most likely to survive environmental pressures, maintain productive fisheries and tourism, and provide hazard resilience in coastal communities.