

Postdoc in engineering of coral-associated prokaryotes to increase coral climate resilience

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This program aims to engineer coral-associated microbes to enhance coral climate resilience and increase the likelihood of coral reef persistence within this century. Coral reefs are home to about a quarter of all marine species, and their economic value (per unit surface area) far exceeds that of any other ecosystem in the world, including estuaries, tropical rain forests and wetlands. Alarmingly, coral reefs are in rapid decline due to a multitude of anthropogenic activities causing mechanical damage, deteriorating water quality, and ocean acidification and warming. Climate models based on unmitigated greenhouse gas emissions predict heat-induced mass bleaching will occur on most coral reefs every summer within this century, and even under the best-case CO₂ emission scenarios oceans will continue to warm and corals will decline further. Coral bleaching is a stress response manifested as the loss of endosymbiotic microalgae (*Symbiodinium* spp.) from the coral tissues, and can lead to extensive coral mortality because the algae provide up to 95% of the coral's nutrition through translocation of photosynthate. For instance, the 2016 and 2017 temperature anomalies on the Great Barrier Reef (GBR) caused back-to-back mass bleaching events that resulted in the die-off of ~49% of the coral present; this occurred despite the GBR being the best managed reef in the world. Given that coral cover on the GBR had already declined by half over the period 1985-2012, human interventions that increase coral climate resilience are urgently required. Such interventions are not proposed as replacements for conventional management and reductions in greenhouse gas emissions, but should be integrated with these actions.

Innovative biological engineering principles that are successfully being applied to improve human health and food production, but still in their infancy in biodiversity conservation initiatives, will be implemented. Two bioengineering approaches for reef restoration will be adopted: (1) assisted evolution [AE]: the acceleration of naturally occurring evolutionary processes to enhance certain traits; and (2) genetic engineering [GE]: the deliberate modification of the characteristics of an organism by manipulating its genetic material.

*Skills/tasks may include: bacterial pure culturing; bacterial genome sequencing and analysis; development and testing of bacterial probiotics that enhance thermal tolerance of coral and the coral model, the anemone *Exaiptasia pallida* (i.e., phenotypic analyses); microscopy including FISH; metabarcoding; gene knock-out/knock-down; metagenomics; bioinformatics; statistical analysis of data.*