Marine heatwaves have size-, species-, and habitat-specific impacts on coral communities.

How will these context-dependent impacts shape coral reef community trajectories following disturbances?

1. Recovery after past disturbances
   Coral cover increased rapidly after a cyclone due to high rates of coral recruitment

Starting in 2007 an outbreak of a predatory sea star, Acanthaster planci, started driving coral decline on the outer reef and by 2010 coral cover was <1%. In 2010 Moorea was hit by a category 4 cyclone that removed the dead coral skeletons left behind after the A. planci outbreak. Following these two disturbances, coral cover increased rapidly on the outer reef, and past work has shown that the rate of increase of coral cover was driven by the density of new corals that recruited on the benthos.

2. Recent Disturbance: Coral Bleaching

This was the most extreme marine heatwave in Moorea in the last 15 years (left) which resulted in landscape-scale coral bleaching and mortality (below).

The marine heatwave drove island-wide mass coral bleaching that killed up to 76% and 65% of the largest individuals of the two dominant coral genera, Pocillopora and Acropora, respectively. Colonies of Pocillopora and Acropora ≥30 cm diameter were ~3.5× and ~1.3×, respectively, more likely to die than colonies <30-cm diameter.

3. Coral bleaching and mortality was size-dependent
   Larger corals were more likely to die than smaller corals

4. Coral bleaching susceptibility differed among morphologically indistinguishable cryptic species
   Larger corals were disproportionately represented by thermally sensitive cryptic species

Fig. 3 Coral bleaching resulted in widespread coral mortality, but the probability of mortality was size dependent, where larger corals of the two dominant genera, Pocillopora and Acropora, were more likely to die than smaller conspecifics. Speare et al. 2022 Global Change Biology

5. Coral mortality differed across depths
   Bleaching and mortality was less severe on deep reefs compared to shallow reefs

The severity of coral bleaching and mortality declined with depth on the outer reef, resulting in greater declines in coral cover on shallower reefs compared to deeper reefs.

6. Coral mortality varied spatially around the island

The north shore of Moorea (LTER 1) experienced the greatest coral mortality, followed by reefs on the west and east shores (LTER 4). Differences in coral mortality resulted in heterogeneity in the change of coral cover on the three sides of the island following the bleaching event. The north shore saw steep declines in coral cover whereas the east shore saw moderate declines in coral cover.

7. Heterogeneity in coral mortality and physical forcing creates different material legacies around the island

Material legacies (dead coral skeletons) may facilitate colonization of macroalgae by suppressing herbivory and coral recruitment.

Question: How will the trajectories of communities following this marine heatwave differ from community trajectories following previous disturbances?