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?

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1. Recovery after past disturbances

Coral cover increased rapidly after a cyclone due to high rates of coral recruitment

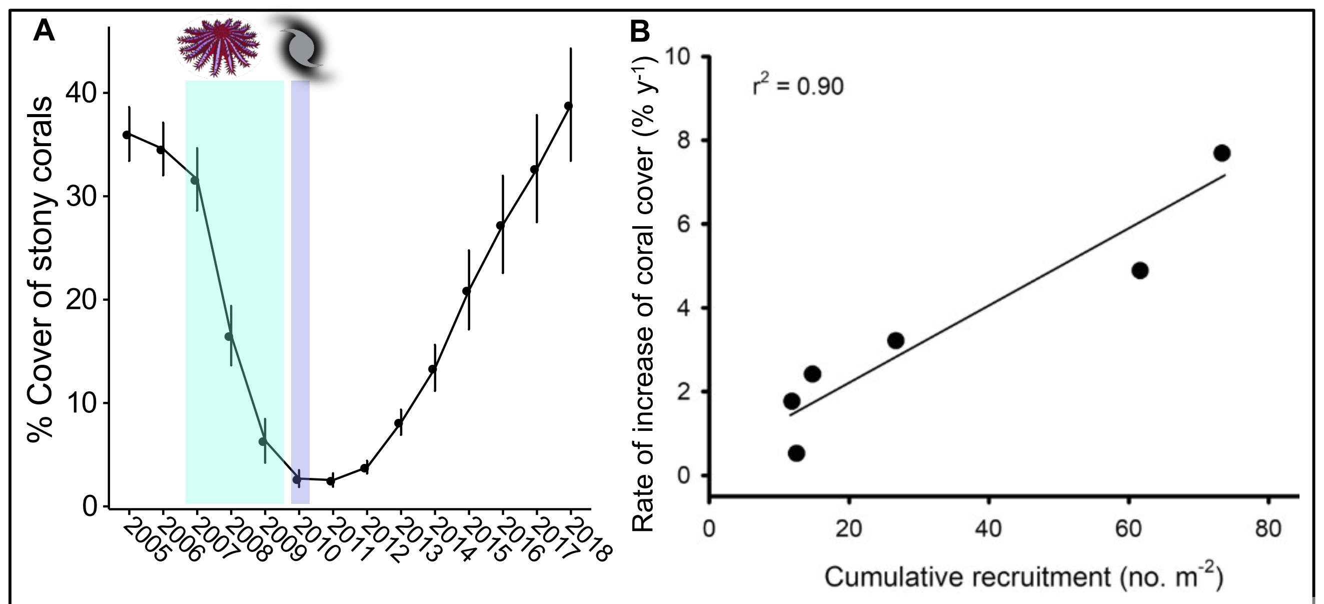

Fig. 1 A) Mean percent cover of stony corals on the outer reef. Colored bars show the timing of past disturbances. **B)** The rate of increase of coral cover was strongly correlated with the density of coral recruits. Figure modified from Holbrook *et al.* 2018 *Scientific Reports*

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

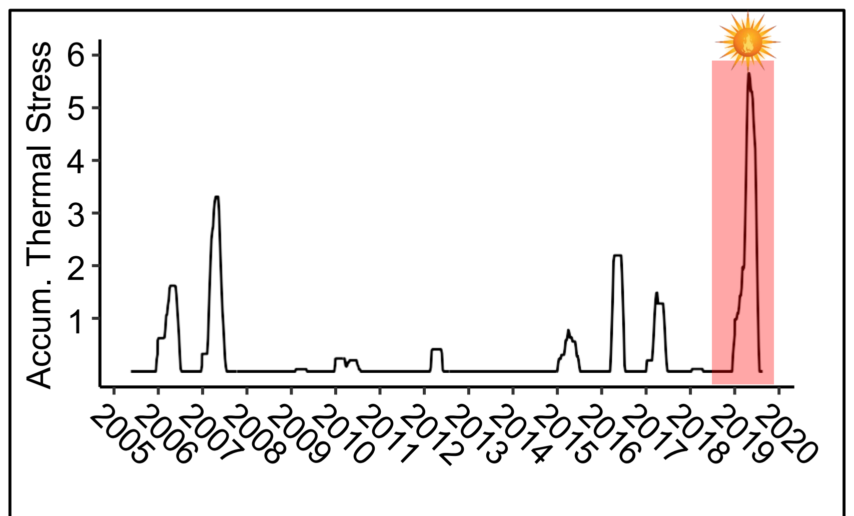

Fig. 2 A history of thermal stress events since the start of the MCR LTER. Accumulated thermal stress is a metric that quantifies heat stress that corals experience as function of the intensity and duration of a marine heatwave.

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).

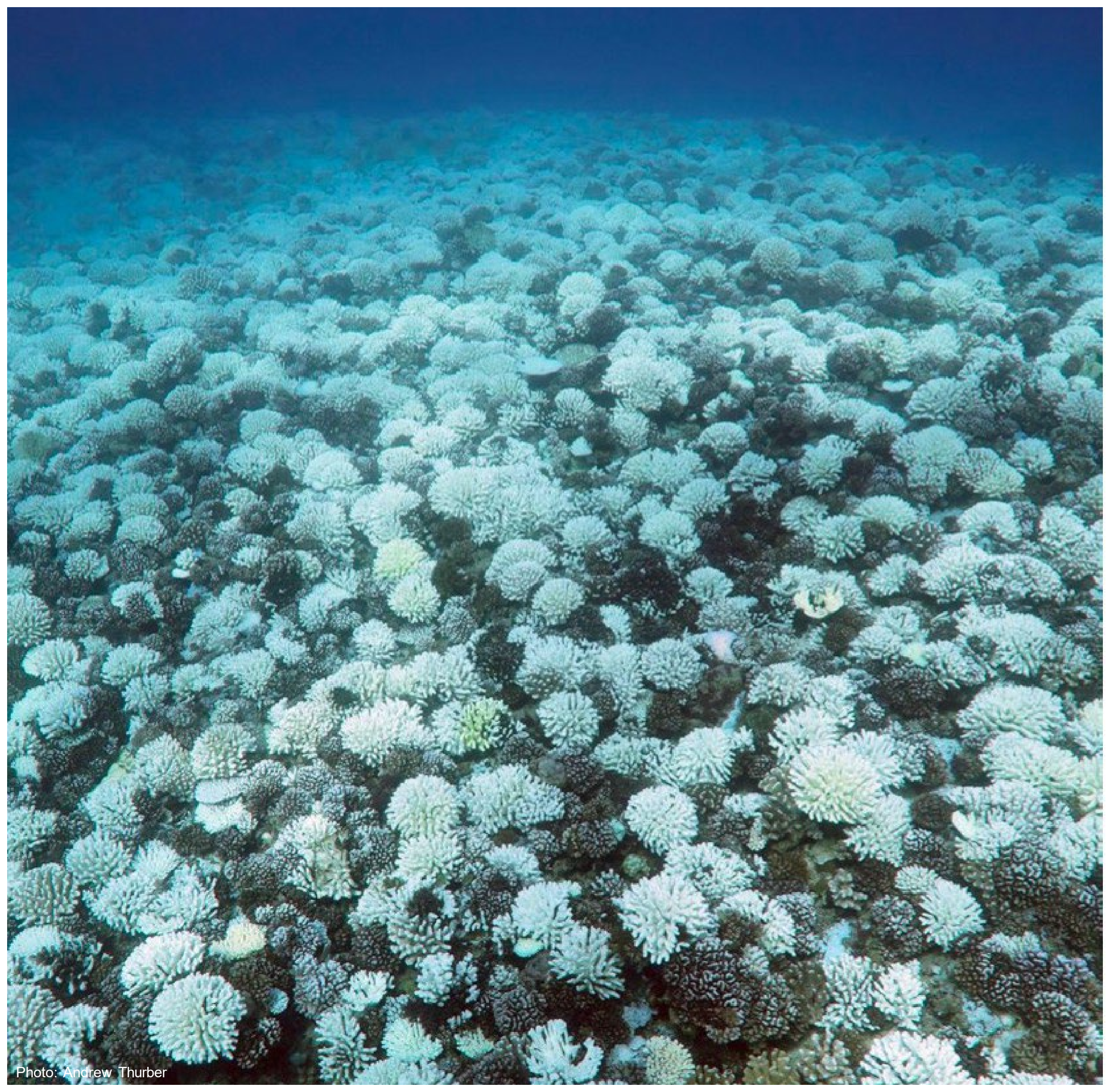

Photo: Andrew Thurber

Unlike the previous disturbance, which had relatively uniform impacts across the reefscape, this bleaching event had different impacts across habitats and members of the coral community.

3. Coral bleaching and mortality was size-dependent

Larger corals were more likely to die than smaller corals

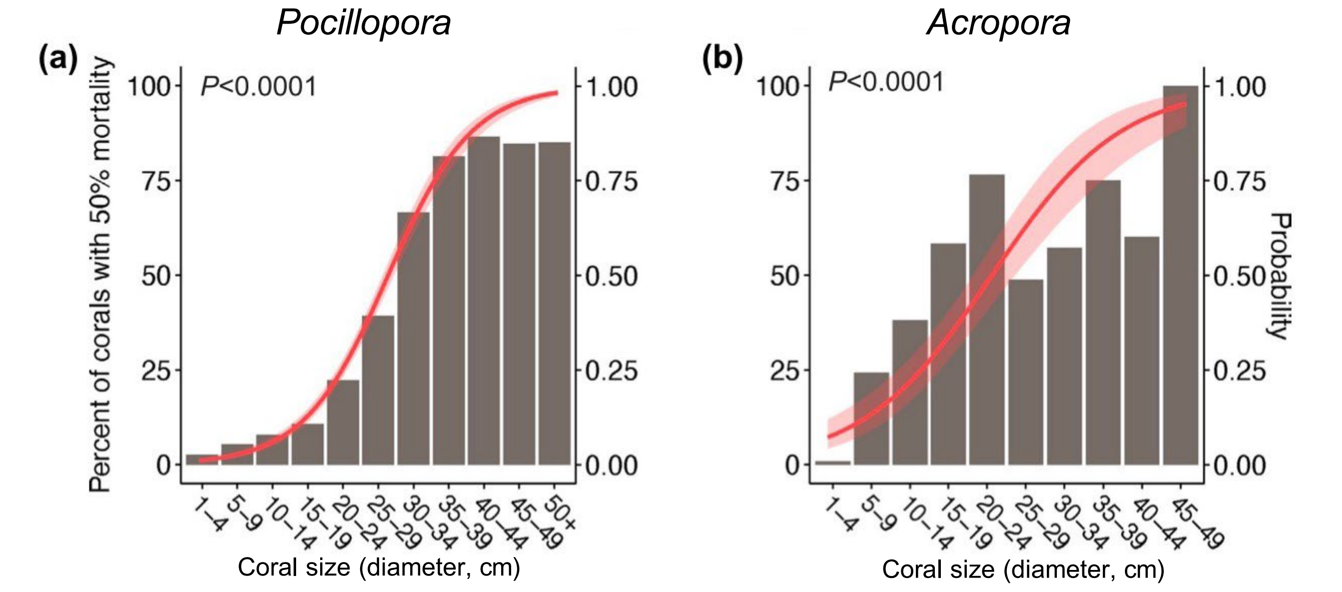

Fig. 3 Coral bleaching resulted in widespread coral mortality, but the probability of mortality was size dependent, where larger corals of the two dominant genera, *Pocillopora* and *Acropora*, were more likely to die than smaller conspecifics. Speare *et al.* 2022 *Global Change Biology*

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.

4. Coral bleaching susceptibility differed among morphologically indistinguishable cryptic species

Larger corals were disproportionately represented by thermally sensitive cryptic species

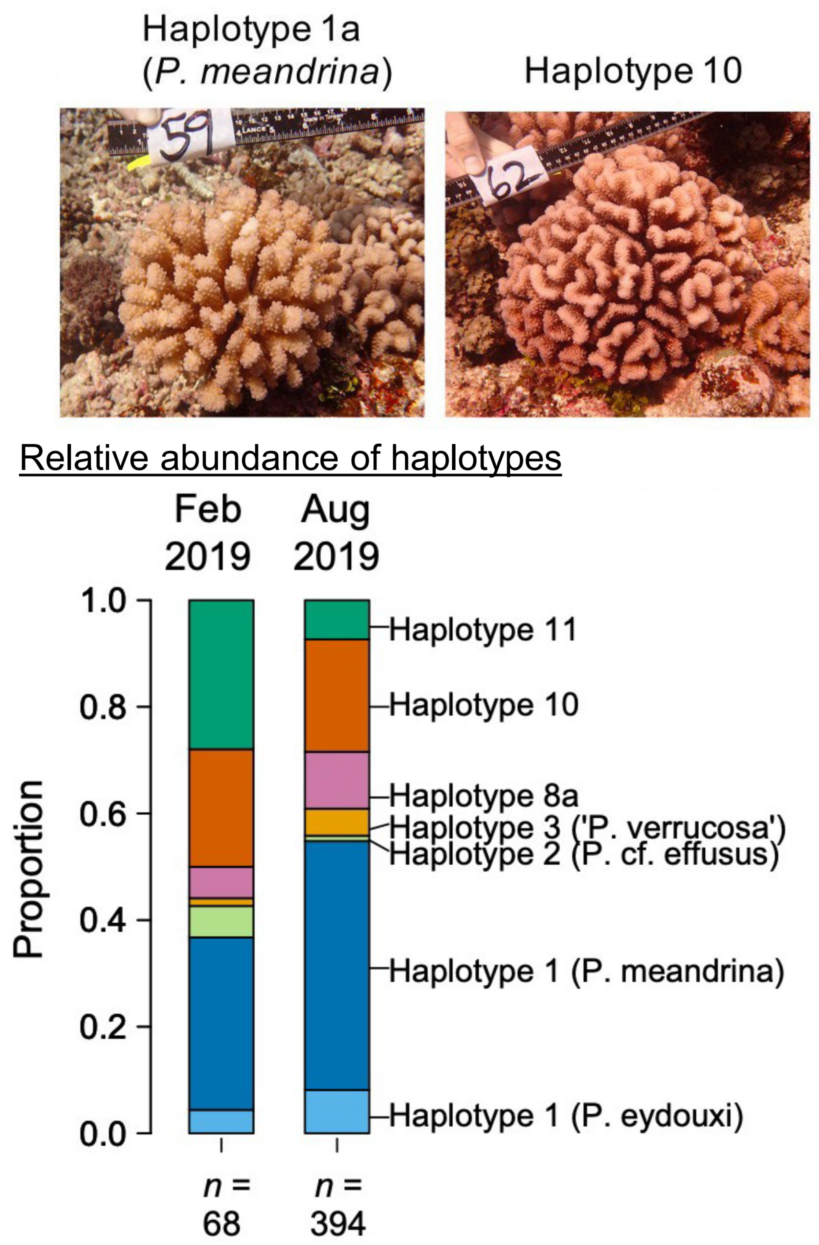

Fig. 4. There are at least 12 different haplotypes (representing at least 5 species) of *Pocillopora* corals in Moorea. *Pocillopora* haplotypes are morphologically similar (above) and cannot be reliably identified by morphology alone. Tissue samples collected before and after bleaching, followed by genetic analysis to identify haplotypes, showed that the relative abundance of common haplotypes shifted following the bleaching event (left). Of the corals that were sampled prior to the bleaching, most corals that died belonged to a single haplotype (Haplotype 11). Further, Haplotype 11 corals tended to be large colonies. See Burgess *et al*. 2021 *Ecology*

Large colonies were disproportionately represented by thermally sensitive cryptic species prior to the bleaching event. High susceptibility of these cryptic species contributed to the size-dependent patterns of coral bleaching and mortality. Disproportionate mortality of thermally-sensitive cryptic species is an important mechanism that drove size-dependent mortality of *Pocillopora* corals.

5. Coral mortality differed across depths

Bleaching and mortality was less severe on deep reefs compared to shallow reefs

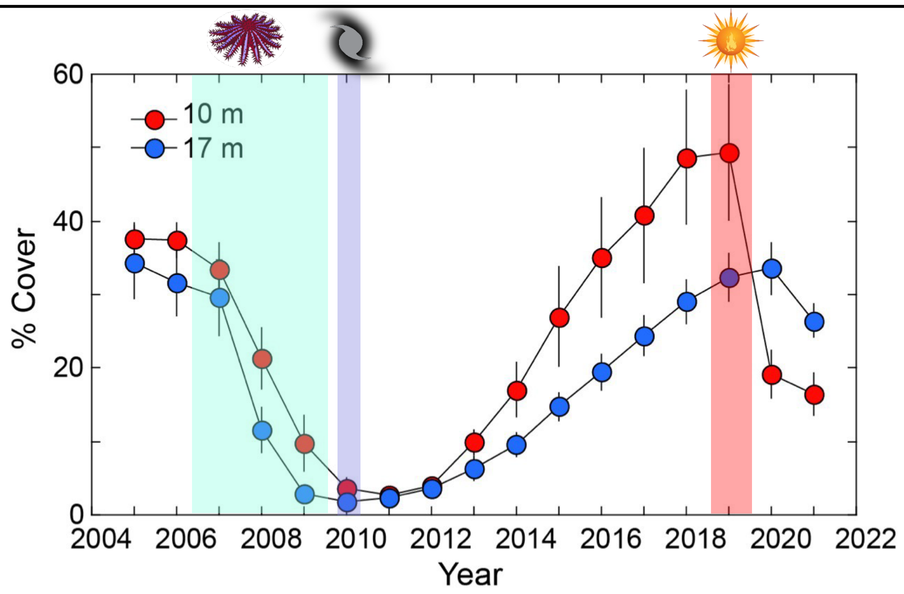

Fig. 5 Deep (17m water depth, blue) and shallow (10m, red) reefs experienced similar declines in coral cover following past disturbances, but coral cover increased more rapidly on reefs at 10m compared to 17m. Following the recent bleaching event, coral mortality was higher at 10m than at 17m.

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

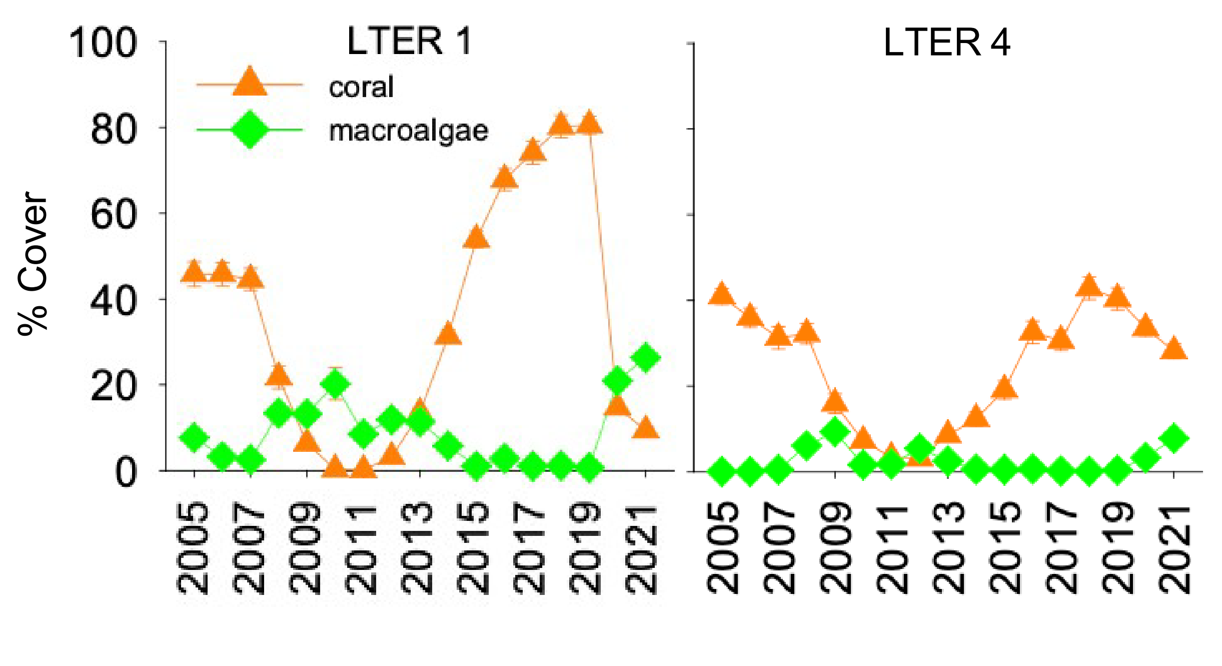

Fig. 6 Reefs on the north shore of Moorea (LTER 1) experienced the greatest coral mortality, followed by reefs on the west and east shores (LTER 4). Differences in coral mortality resulted in heterogeneity in the change of coral cover on the three sides of the island following the bleaching event. The 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

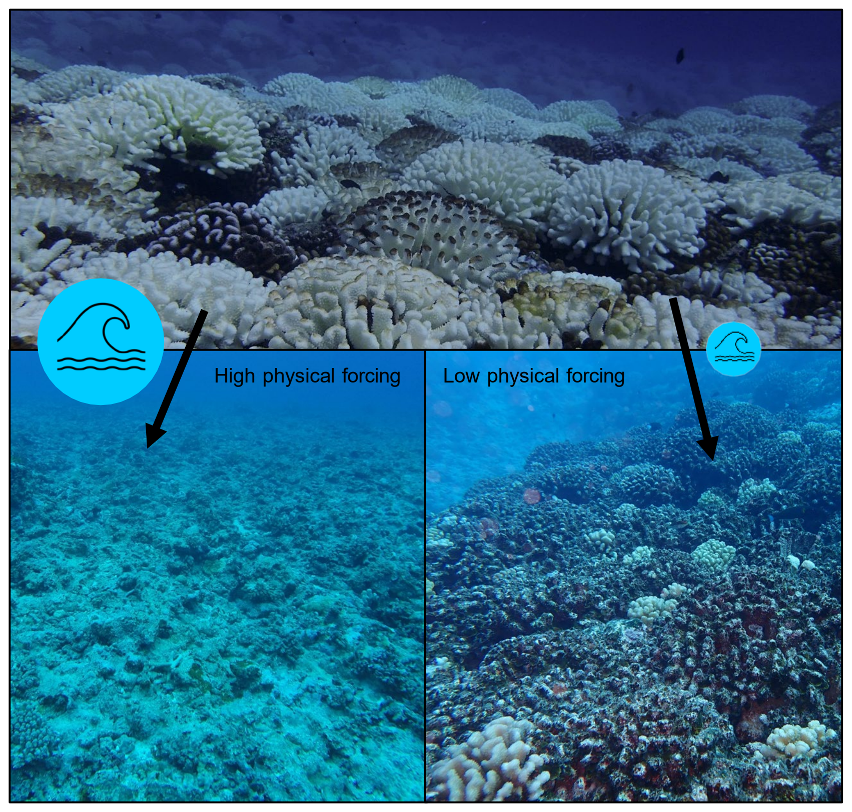

Fig. 7 On the north shore (lower right) high coral mortality left a seascape of dead coral skeletons that were rapidly colonized by macroalgae. The north shore experiences relatively low levels of physical forcing and these skeletons have persisted for >3 years. In contrast, the west side of the island (lower left) experienced lower coral mortality but greater physical forcing. A recent major swell event removed remnant dead coral skeletons and many live corals.

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?

See related poster on material legacies

This Poster

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