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New techniques for responding to coral bleaching in MPAs

In May 2016, the MPA News staff had an opportunity to snorkel the 306-km^2 Bar Reef Marine Sanctuary in northwest Sri Lanka. Located in a sparsely populated area of Sri Lanka and billed as having the most pristine coral reef in the country, the MPA has 156 species of coral. When we got there, it was all completely bleached.

The third global coral bleaching event, ringing the world from 2014-2016, has wreaked havoc for many coral reef MPAs (http://coralreefwatch.noaa.gov). With climate change, this is likely the new normal. Coral reef MPAs - from small sites like Sri Lanka's Bar Reef to large ones like the Great Barrier Reef in Australia - will experience bleaching more and more frequently in coming years. Some corals will recover from the bleaching events. An increasing number will not, and will die. It is a grim forecast. (For a quick primer on the distinctions between bleached and dead corals, see the box at the end of this article.)

What if anything can coral reef MPAs do about this?

Managing for bleaching

In 2006 the Great Barrier Reef Marine Park Authority published a report, *Reef Manager's Guide to Coral Bleaching* (https://oct.to/ZZe). The report walks readers through four steps of managing for bleaching: (1) protecting resistance to bleaching, (2) building tolerance to bleaching, (3) promoting recovery from a bleaching event, and (4) supporting human adaptive capacity.

Much of the report addresses the need to reduce stressors on reefs, such as overfishing and pollution - undoubtedly an important strategy. But with the third global bleaching event coming so close on the heels of the second global event in 2010, coral MPAs may be facing a larger, more severe, and more immediate threat than was envisioned when the report was written. It may not be enough simply to reduce stressors on coral reefs. Even relatively pristine reefs like the Bar Reef in Sri Lanka are being hit hard.

Active, creative management of reefs will probably be necessary. In coming issues of MPA News, we will examine ways that coral reef MPAs can face the threat of bleaching.

"In a decade or less, the water will warm again"

Here we present ideas from Austin Bowden-Kerby of Corals for Conservation, based in Fiji. His comments here are adapted from suggestions he has made this year to the Coral-List listserv, drawing from his work:

> "In Fiji we experienced our first recorded mass bleaching in 2000, with >90% mortality on Southern reefs. It was indeed tragic, but at the time I felt a bit encouraged by the few unbleached, resistant corals. However, that initial hope was quickly dashed to bits when crown-of-thorns starfish (COTS) ate virtually all of the surviving corals, quickly consuming their preferred species (*Acropora*, *Pocillopora*) before moving on to some of the less palatable ones. This happened even at sites with low COTS abundance prior to the bleaching, as the relative abundance went through the roof when most of the corals died.
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> "We are once again experiencing a mass bleaching event at some of our Fiji sites, but this time we are doing something about it:
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> 1. Predator removal (and weeding of seaweeds if needed) to save the corals that didn't bleach; and
> 2. Collecting fragments of the unbleached branching corals to ensure they don't succumb to external factors post-bleaching. We are growing these resistant corals in field nurseries to form a gene bank of the various species. The corals will be trimmed each year to prevent senescence and to create large numbers of second-generation fragments for out-planting back to the reef, within no-take MPAs where possible. The goal is to create sizable patches of bleaching-resistant corals that spawn, recombine, and spread their genetics and symbionts and thus offer some hope against future mass bleaching events.
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> "This proactive strategy to give the reef a helping hand in this time of crisis can be applied widely to help the reef adapt. If any are interested, I can send the manual of the various nursery and out-planting methods.
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> "An idea discussed on Coral-List recently by several list members was that of shading coral nurseries to prevent bleaching. My advice to that idea was: Bleaching will be back. So unless you plan to plant your nursery-reared corals to sites where the water stays cooler during future bleaching events, you may be fooling yourself that you are restoring the reef. In a decade or less the water will warm again and these corals will only bleach and die. What makes a lot more sense would be to allow nature to take its course in your nursery, and to use this mass bleaching event as an opportunity to identify corals that are bleaching-resistant. You can then re-do your nursery using these resistant corals.
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> "Whatever restoration you do with those corals will be more permanent and will help build resistance to climate change. Pockets of healthy, bleaching-resistant corals, which have enough genetic diversity within each species to ensure successful spawning, would generate coral larvae that would then spread resilience throughout the wider reef system. Isolated corals would on the other hand be unlikely to spawn successfully.
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> "A second strategy to protect the few corals that don't bleach - from predators and from algal overgrowth - could make a big difference to post-bleaching coral survival and ultimately to reef recovery, while helping build resilience in the system. What a shame if the resistant corals that are so vital to the future of reefs end up as COTS food! A COTS removal program might be in order on many reefs right now."

For more information:

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NOTE: For more thoughts from Austin on managing and responding to mass bleaching, including his current study of bleached reefs in Kiribati, go to www.mpanews.org/Bowden-Kerby.htm

BOX: A primer on bleached vs. dead corals

For readers not experienced with corals, Austin Bowden-Kerby of Corals for Conservation provides this primer on the distinctions between bleached and dead corals:

"When corals bleach, it means they have lost most or all of their symbiotic algae. As a result of this loss, they either become bright white or, if they have an underlying tissue color, they reveal that color, which is normally masked by their golden brown symbiotic algae.

"The role of the symbiotic algae is to provide food to the corals via photosynthesis. Severely bleached corals - deprived of that food for a prolonged period of time - most often end up starving to death. This

death is readily recognizable: dead corals quickly get covered with dark microbes and mats of green filamentous algae (non-symbiotic) - or, where there are lots of grazing fish, pink coralline algae (also non-symbiotic).

"Partially bleached corals that have lost some but not all of their symbiotic algae often recover, with recolonization by those symbiotic algae."
