Warming waters spark 'evolution at super speed' in marine sponges, study finds

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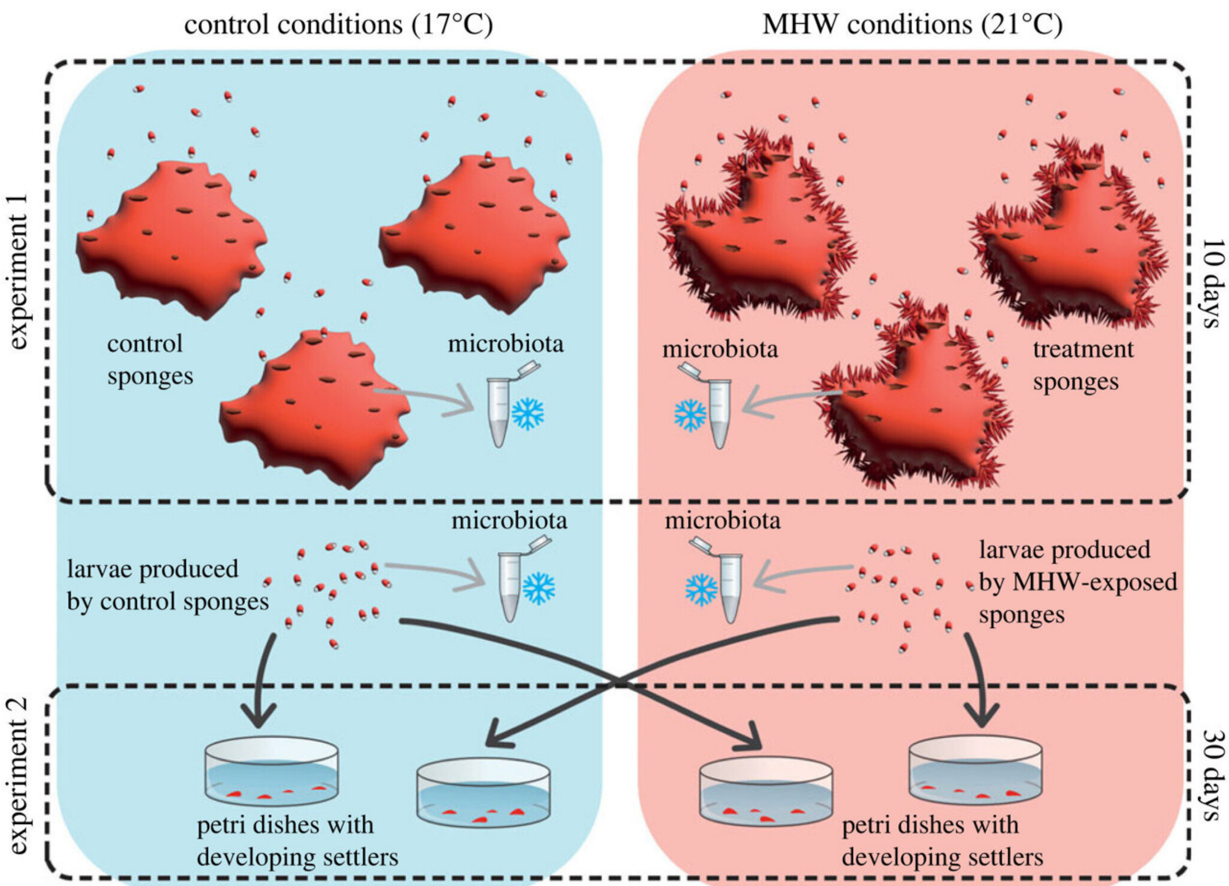

Schematic representation of the experiments and sampling design. Sponge larvae were randomly sampled from adult sponges in control or MHW conditions, either preserved for microbial community analyses or exposed to further control or prolonged MHW conditions. Credit: *Proceedings of the Royal Society B: Biological Sciences* (2023). DOI: 10.1098/rspb.2022.2539

Marine heat waves caused by the warming climate are capable of sparking rapid changes in sea sponges with scientists describing the pace of change as "evolution at super speed."

Research by marine biologists at Te Herenga Waka—Victoria University of Wellington found sponges that survive marine heat wave conditions can undergo significant changes in their microbial make-up within one generation.

These changes may be a way for the sponges to cope with increasing environmental stress, says Ph.D. candidate Francesca Strano who carried out the research with Professor James Bell from the University's Te Kura Mātauranga Koiora—School of Biological Sciences.

In their study, the researchers exposed the common sea sponge Crella incrustans to marine heat wave conditions in the lab.

"Our experiments found just over a third of adult sponges died after only 10 days spent at 21°C—conditions similar to those in Wellington harbor during the marine heat wave in January 2018," Professor Bell said.

The study also found sponges exposed to heat wave conditions had a marked relative increase in harmful pathogenic and stress-associated bacteria and a decrease in their normal symbiotic bacteria—tiny organisms that live inside the sponges.

However, the offspring of these sponges fared better, an indication they may be able to adapt to warming waters.

"Importantly, the baby sponges didn't show an increase in pathogenic bacteria when exposed to heat wave conditions. Instead, they showed an increase in a symbiotic bacteria called Rubritalea marina.

"There's a potential upside to this. We think this bacteria may provide the baby sponges with a better ability to deal with future heat stress—it's a bit like natural selection in action," Professor Bell said.

Baby sponges with increased Rubritalea marina grew faster than offspring of "control" sponges that weren't exposed to heat wave conditions. However, there was a significant delay in the time it took for the baby sponges to reach their juvenile stage.

"This delay could be caused by the sponges temporarily going into a dormant state in order to survive periods of environmental stress, something that's been seen in other marine species when they're exposed to high temperatures."

Strano said more research was needed on the role of Rubritalea marina and the long-term effects on sponges of losing some of their symbiotic bacteria.

"It's possible sponges losing some of their microbes could be a good thing, enabling them to 'shuffle' or 'switch' the microbes they contain to get new ones and provide the potential for them to survive in new or different conditions. However, during this process they could also lose some microbes that are important for other functions—for example, detoxification."

Sponges are among the most abundant species on the ocean floor and play a major role in nutrient recycling and removing pollutants from the water.

"They're a really key part of the marine environment and changes to sponge communities have the potential to cause flow-on effects for other species. That's why it's so important to find out how they'll be affected by the rapidly warming waters associated with marine heat waves. It's possible some sponges may be able to adapt," Professor Bell said.

The research is published in the journal *Proceedings of the Royal Society B: Biological Sciences*.

More information: Francesca Strano et al, Marine heatwave conditions drive carryover effects in a temperate sponge microbiome and developmental performance, *Proceedings of the Royal Society B: Biological Sciences* (2023). DOI: 10.1098/rspb.2022.2539

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