Marine food webs under increasing stress

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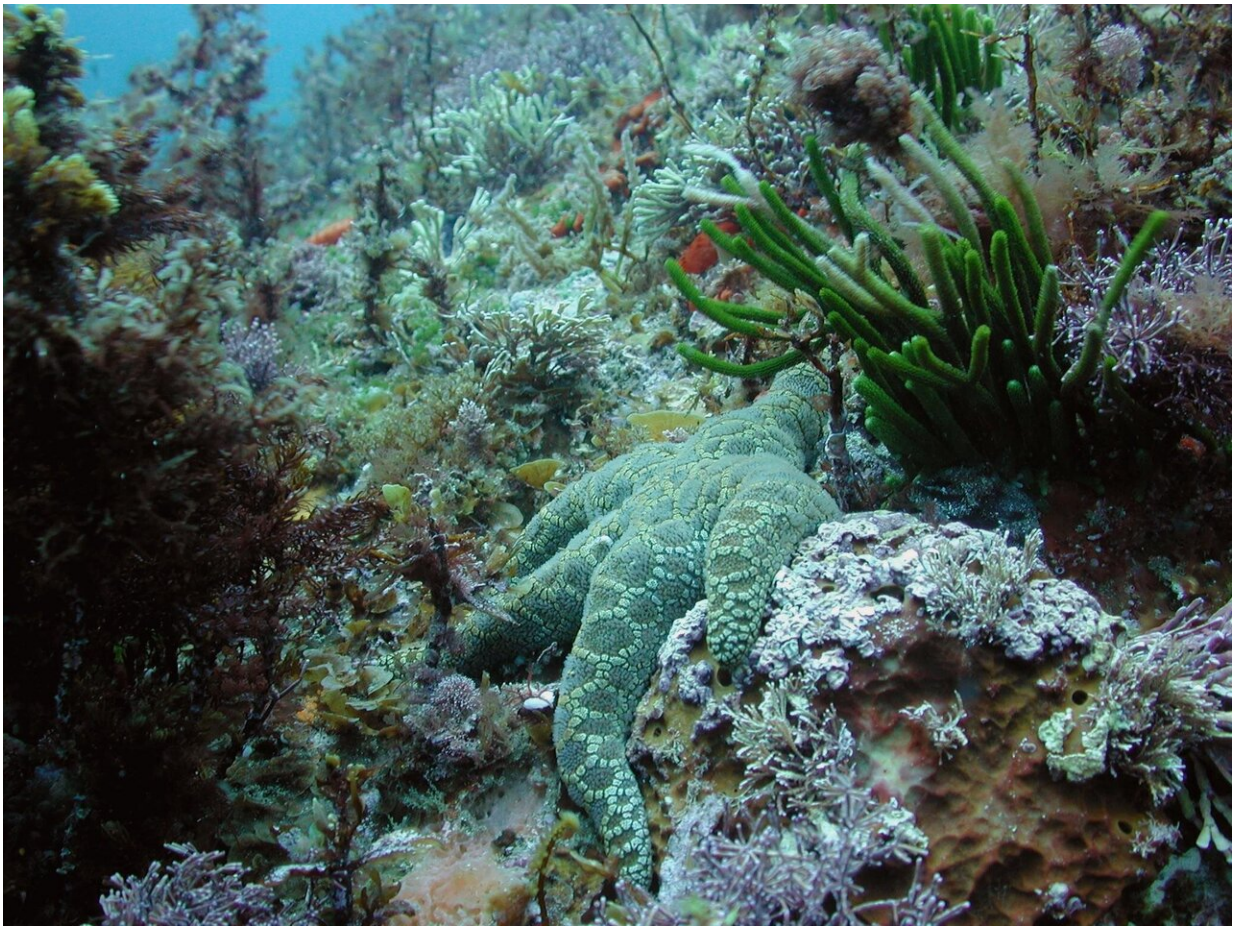

Marine ecosystem, Whakaari Island, New Zealand. Credit: Sean D. Connell

Scientists at the University of Adelaide have found growing evidence that marine ecosystems will not cope well with rising sea temperatures caused by climate change.

"Healthy food webs are critical for ecosystems so that the world's oceans can continue to provide an important source of food for humans," says lead author Professor Ivan Nagelkerken, from the University of Adelaide's Environment Institute.

"Greenhouse gas emissions are affecting the health and persistence of many marine species because of increasing seawater temperatures and CO_2 levels. Revealing the response of marine food webs to climate change is a critical step towards understanding ecosystem vulnerability to human impacts. Our research shows that ocean warming reshuffles species communities; the abundance of weedy plant species increases but the abundance of other species, especially invertebrates, collapses."

The team, which published their study in the journal *Science* , recreated a coastal ecosystem of three predominant habitats found in the Gulf St. Vincent, at the South Australian Research and Development Institute (SARDI) site at West Beach in Adelaide. This recreated ecosystem was then exposed to simulated ocean acidification and warming.

"Our research identified a future trophic pyramid which showed that the biomass expanded at the base and the top, but contracted in the center," says Professor Nagelkerken.

"This unusual profile may characterize a transitionary state before a marine ecosystem collapses into shortened, bottom-heavy food webs with increasing sea temperatures."

Trophic pyramids are graphical illustrations that show the species biomass at each trophic level. Healthy trophic pyramids are normally triangular with most energy contained in the lowest trophic level. Energy passes between successive trophic levels as species feed on the level below.

"Where food web architecture lacks adjustability, ecosystems lack the capacity to adapt to global change and ecosystem degradation is likely," says collaborator and co-author Professor Sean Connell from the University of Adelaide's Environment Institute.

"Marine food webs that are not able to adapt to global change show all the signs of being transformed into a food web dominated by weedy algae. Even though there were more plants at the bottom of the food web, this increased energy does not flow upwards towards the top of the food web."

Further warming and acidification of the oceans in the near future is likely to exacerbate these effects consequently reduce species at the top of food webs, such as fish.

"An ecological tipping point may be passed beyond which the top of the food web can no longer be supported, with an ensuing collapse into shorter, bottom-heavy trophic pyramids." says Professor Nagelkerken.

"This will weaken the health and sustainability of ocean ecosystems unless species are capable of genetic adaptation to climate stressors in the near future."

More information: I. Nagelkerken el al., "Trophic pyramids reorganize when food web architecture fails to adjust to ocean change," *Science* (2020). science.sciencemag.org/cgi/doi … 1126/science.aax0621

"Marine food webs destabilized," *Science* (2020). science.sciencemag.org/cgi/doi … 1126/science.abd5739

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