

# When the heat's on, fish can cope

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Australian scientists have discovered that some tropical fish have a greater capacity to cope with rising sea temperatures than previously thought – by adjusting over several generations.

The discovery, by researchers at the ARC Centre of Excellence for Coral Reef Studies, James Cook University and CSIRO sheds a ray of hope amid the rising concern over the future of coral reefs and their fish under the levels of global warming expected to occur by the end of the 21st century.

Understanding the ability of species to acclimatise to rising temperatures over longer time periods is critical for predicting the biological consequences of global warming - yet it remains one of the least understood aspects of climate science. The scientists were seeking to discover how fish would cope with the elevated [sea temperatures](#) expected by 2050 and 2100.

"When we exposed damselfish to water temperatures 1.5 degrees and 3 degrees above today's, there was a marked decline in their aerobic capacity as we'd expected," explains lead researcher Jennifer Donelson. "This affects their ability to swim fast and avoid predators."

"However when we bred the fish for several generations at higher temperatures, we found that the second generation offspring had almost completely adjusted to the higher temperatures. We were amazed... stunned, even," she says. "It shows that some species can adjust faster than the rate of climate change."

"When one generation of damselfish experiences high temperatures their whole life, the next generation is better able to cope with warmer water. We don't yet fully understand the mechanisms involved, but it doesn't seem to be simple Darwinian selection over a couple of generations," explains team leader Professor Philip Munday.

"Instead, there has been a transmission of information between the generations that enables damselfish to adjust to higher water temperatures."

The two temperatures used in the trial represent likely tropical ocean temperatures at the mid-century and by 2100, based on current trends in carbon dioxide emissions by humanity. A 3 degree increase in tropical ocean temperatures is the [temperature](#) predicted to occur if humanity's carbon dioxide emissions continue on their current trajectory.

The unusual finding suggests that some fish may have an innate ability to cope with increased sea temperatures greater than previously thought, the researchers say.

However they caution it applies so far only to a single coral reef fish species, and does not address the more complex issue of the survival of the coral habitat itself, and the effects of warming on plankton in the food chains on which fish depend.

Also, there are likely to be penalties for fish that successfully adapt to higher temperatures, Jennifer Donelson says. Initial observations suggest that the acclimatized offspring are on average smaller than their parents, and we still do not know if they are able to reproduce at the same rate as their predecessors.

Although the experiment has yet to run its full course, the researchers also say they do not expect the fishes' ability to adjust to higher

temperatures to continue past 3 degrees.

"At such a level of planetary warming there will be profound changes in Earth's ecosystems, affecting all forms of life, including humans," says Prof. Munday.

However, assuming humans manage to gradually bring [global warming](#) under control, it is important to understand how well animals and plants can cope with higher temperatures, in order to manage ecosystems for optimum survival of their species and the services they provide. This research provides an early insight into the adaptive capacity of fish, the team says.

This study reveals that transgenerational acclimation is a potentially important mechanism for coping with rapid climate change. Such acclimation could reduce the impact of warming temperatures and allow some [fish](#) populations to persist across their current range, instead of having to move away in search of cooler waters.

**More information:** Their paper "Rapid transgenerational acclimation of a tropical reef fish to climate change" by J. M. Donelson, P. L. Munday, M. I. McCormick and C. R. Pitcher, appears in the latest issue of the journal *Nature Climate Change*.

Provided by ARC Centre of Excellence in Coral Reef Studies

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