Nemo Seems to Thrive in Waters Warmed by Climate Change
Article questions

1. What are fish likely to do in the face of increasing temperatures from climate change?
2. What is an epigenetic adaptation?
3. Describe a potential cost of such an adaptation.
4. Describe the changes seen in studies by Jennifer Donelson from the University of Technology in Sydney, Australia.
5. Ocean acidification is another byproduct of climate change. How have fish reacted to more acidic waters?

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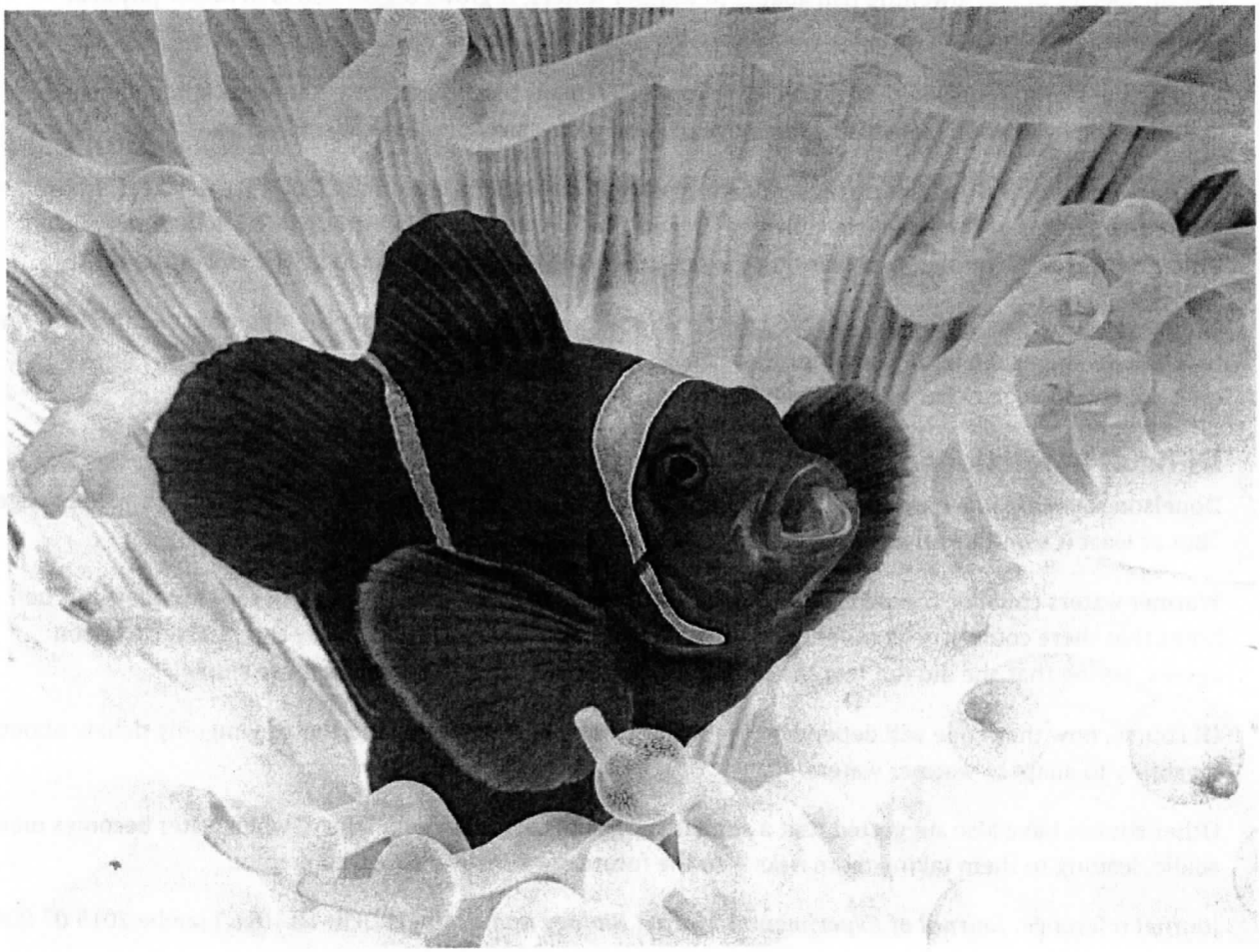

Good news for Nemo: some clownfish could thrive in warmer waters (Image: F1 Online/REX)

Some fish seem to be capable of adapting rapidly to climate change. In fact, they might even thrive in the warmer oceans of the future, growing bigger and healthier than they can at present-day temperatures.

Evidence gathered over the past decade has suggested that climate change will force fish to migrate to cooler waters, or else face extinction. Signs of such migration have already even been seen.

But recent studies have shown that some fish are able to adapt to warmer waters over a few generations.

Earlier this month, Philip Munday of James Cook University in Townsville, Australia, and his colleagues showed that one key tropical fish species did this by switching some of its genes on and off – an epigenetic adaptation.

Yet there are questions over the potential cost of such an adaptation. The fish's ability to swim seems to be unimpaired but, as Munday noted: "Maybe we'll see trade-offs with growth rates. There are no free lunches in this world."

However, for some fish at least, climate change may well carry the prospect of just such a free lunch.

Bigger and better

Work by Jennifer Donelson from the University of Technology in Sydney, Australia, suggests that when a certain species of reef-dwelling fish adapts to warmer waters, it grows bigger and is in better physical condition.

In her laboratory, Donelson reared several groups of *Premnas biaculeatus*, also known as spine-cheeked anemonefish or maroon clownfish, which live in coral reefs throughout the West Pacific.

She kept one group at temperatures replicating present-day conditions on the Great Barrier Reef, from where the parents of the fish were collected. In addition, she kept another group at 1.5 °C warmer and a third group at 3 °C warmer, representing the ocean temperature rise expected by the end of the century.

After a year of growing, the fish adapted to the warmer temperatures, upping their aerobic metabolism. And that enhancement seemed to bestow other benefits: those reared at temperatures 3 °C warmer grew 8 per cent larger and 29 per cent heavier than fish reared at lower temperatures.

Difficult predictions

Donelson says that it is hard to make predictions about how different species will cope with climate change. "But at least it won't be all negative news for all species," she says.

Warmer waters could be a good thing for fish that are able to adapt quickly enough, says Munday. But he notes that there could still be other costs of adaptation that were not revealed by this study. Donelson agrees, saying that she did not test the reproduction rates of the anemonefish, for example.

Of course, how they cope will depend on the wider coral reef ecosystem, and there is ongoing debate about its ability to adapt to warmer waters.

Other studies have also suggested that a similar species of clownfish gets "tipsy" when water becomes more acidic, leading to them taking more risks – so the future of Nemo is difficult to predict.

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22