Media Release

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Insects show it is possible to adapt to climate change, but not if you're fussy.

The extent to which species a can survive climate change may ultimately depend on their ability to evolve and cope with drier and hotter conditions.

Using the Australian vinegar fly as a model, scientists at the University of Melbourne have found that the common species is able to evolve and adapt to climate change but their cousins - who only inhabit tropical rainforest - were not able to.

"The danger that species in threatened environments, like tropical rainforests, may not survive climate change now appears more acute than previously thought" said Professor Prof Ary Hoffman Director of the Centre for Environmental Stress and Adaptation Research (CESAR) at the University of Melbourne.

Researchers first looked at the gene alcohol dehydrogenase (Adh) in the vinegar fly- which in humans enables us to metabolise alcohol- but in flies the gene responds to temperature-related factors. The version of the gene is also known to change with the latitudinal location of the fly species. The 'S' version appears to enable survival in hot, dry conditions with flies in the tropical north more likely than their southern counterparts to carry a version called AdhS.

Hoffman's team sampled the flies in 2002 and 2004, and found that the distribution of AdhS had shifted some 400 kilometres south from where it was two decades earlier.

"Warming over the past two decades has encouraged genes to spread from flies at tropical latitudes into flies in more temperate areas" said Prof Hoffmann.

"We were surprised at the speed of the change. Twenty years is not long on an evolutionary time scale," Hoffmann says. Hoffmann's team says the geographical shift of AdhS is probably due to climate change with temperatures along Australia's east coast are rising by around 0.2 ºC every ten years, and annual rainfall is decreasing by 10-70 millimetres per year.

The discovery also shows the ability of specific genes (such as these linked to latitude) to reveal the effects of climate change on living populations.

A second study by Prof Hoffmann and colleagues found that Drosophila birchii and Drosphila bunnanda- other species of Australian vinegar fly which inhabit Queensland rainforests do not have the ability to evolve and adapt to drier environments.

Using the generally-accepted assumption that climate change will result in hotter and drier conditions for rain forests, the study used artificial selection to rapidly evolve the flies. The flies were exposed to a climate drier than that of the rainforest- desiccating conditions- until they started to die off. The flies which survived the longest were selected to breed.

“For three years we looked for signs that this intense selection would increase climatic stress resistance - but it simply did not happen”, Professor Hoffmann said. “Such a lack of adaptive response has never been found and it caught us completely by surprise.”

“When you look at a species in a threatened habitat like a rainforest, all of a sudden the chances of extinction occurring are a lot higher, because we had assumed previously that you could avoid extinction at least to some extent by adapting.

“Now it looks like that if this is a general result - and we have to repeat this on species other than Drosophila - it may be a case that if you don’t have the genes to adapt then you’re not going to have much chance of avoiding extinction once the change occurs”.

Drosophila birchii were able to pass on other characteristics such as wing size and shape - but not the ability to survive in a drier, warmer climate. “So on the whole the species has plenty of genetic variation to adapt to changing conditions, but parents with some stress resistance did not reproduce offspring that were resistant. “

The research has important implications for conservation and extinction. If species cannot adapt to changing conditions, the risk of extinction will be much greater than previously assumed.

“This low ability to evolve highlights the importance of assessing evolutionary potential using specific genes for targeted ecological traits,” Professor Hoffmann said.

“It seems using overall levels of variation for the common genes normally used by conservation managers to identify adaptive potential may not actually tell you much about the likelihood of adapting.”

“The question now arises: how common is this, not only for other species in rainforests but for other species in threatened environments?”

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