Why The Amazon Rainforest Is So Rich In Species

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Tropical areas of south and central America such as the Amazon rainforest are home to some 7500 species of butterfly compared with only around 65 species in Britain. UCL scientists have ruled out the common theory that attributed this richness of wildlife to climate change, in a paper published on 7th December by the journal Proceedings of the Royal Society B (Biological Sciences).

Instead, scientists believe that biology played a far greater role in the evolution of species than external factors like prehistoric climate change. After conducting "DNA-clock" studies, which revealed that new species evolved at very variable rates, the scientists were able to conclude that external factors can only have had a limited impact on evolution.

This study's remit was not to put forward new theories, but Professor Jim Mallet, UCL Department of Biology, argues that his team's work shows that factors other than climate change play the greatest role in species evolution.

He said: "Different types of rainforest butterflies in the Amazon basin are evolving at very different rates, not at all the pattern expected if forest refuges during the ice ages were causing the origin of new species – the reason normally given. Instead, we think that idiosyncratic features of the biology of each species, such as competition for food and their individual reactions to the environment dictate the pattern of evolution in each group."

Professor Mallet and PhD student Alaine Whinnett tested the "DNA clock" using the mitochondrial DNA of nine different butterfly species groups [genera] on the eastern side of the Andes in Eastern Peru. By using a "DNA clock" the scientists were able to calculate the age of the species within each group of species. If the DNA is similar between any pair of species, they must have split recently. If the DNA has diverged a great deal between species, the species are probably ancient.

Some groups contain very young and rapidly evolving species, such as the Amazonian tiger-stripe butterflies [the genus Melinaea], many of whose species are only a few hundred thousand years old. Other groups were very ancient and hadn't produced many species over tens of millions of years, such as the clear-winged butterflies [the genus Oleria]. There was also a wide spectrum of ages in the other species they studied.

Because tests revealed that the species were of varying ages in the same geographical area, these scientists have concluded that external factors like climate change are unlikely to have had much impact on their evolution. Instead, the biology of each genus is thought to be more important.

Professor Mallet said: "It was a very simple molecular test but it rules out geographic isolation caused by past climate change as the main cause of species evolution. Instead the evolution of species must largely be caused by intrinsic biological features of each group of species."

He added: "This research is helping us understand the reasons behind the large number of species in the Amazon rainforest – it's another piece of the biodiversity puzzle in place. Species split at very different rates, and their extinction or transformation is mostly determined by the ecology and biology of each species. We want to discover more about why some species survive and multiply, while others remain static or become extinct."

Around 40% of the world's species can be found in the tropical areas of south and central America. Scientists have long believed that the wealth of species in tropical climes was caused by external forces such as climate change which split the rainforest up: leading to separate evolution in separate forest 'refuges'. In each refuge, it was thought that the isolated populations eventually developed into new species. In the Amazon basin, these changes were thought to have taken place during the Pleistocene geological age which started 1.6 million years ago.

In this theory, the Pleistocene ice ages trapped water near the poles, leading to reduced sea levels and supposedly to periods of profound drought in the tropics generally, and in the Amazon basin particularly. Forty years ago, evolutionary biologists proposed that such periods of drought led to rainforest refuges in which many new species of birds, butterflies, and plants arose.

Recent geological work, however, has failed to find much evidence of such forest refuges in the Amazon basin, and the Pleistocene refuge theory is now under question.

He said: "Although I do not believe that ice ages had much to do with the rapid evolution of species in the Amazon basin, the difference in numbers of species between the temperate zone and tropical South America can be explained by mass extinctions caused by the glaciations. Most species living in North America and Europe are relatively recent arrivals because the original inhabitants were wiped out by those ice ages.

"They haven't had time to evolve into multiple species yet, whereas in the tropics the climate changes were less severe and so older species survived, and rapidly evolving groups were able to diversify without interruption."

Mallet's team is now investigating particular groups of species to home in on the exact reason why some species evolve so rapidly, while others in the same rainforest do not split into new species for tens of millions of years.