

Fritillary butterflies preserve genetic diversity through interbreeding

August 19 2021



Credit: Vladimir Lukhtanov

The formation of hybrids—organisms obtained after crossing genetically

different forms—is more widespread in nature previously thought. Usually, only closely related species can hybridize. For example, hybrids occur in some populations of *Daphnia* – crustaceans from plankton. They significantly complicate the definition of the boundaries between different species. However, some cases are known when hybridisation occurred between very distant relatives: for example, between *Homo sapiens* and Neanderthals, whose common ancestor lived about 800,000 years ago.

The researchers from St Petersburg University and the Zoological Institute of the Russian Academy of Sciences have managed to detect the hybridisation of even more distant [species](#): fritillary butterflies *M. didyma* and *M. acentria*, living on the slopes of the popular Mount Hermon ski resort in northern Israel. Their [common ancestor](#) existed at least five million years ago—modern humans and chimpanzees are about as far apart on the [phylogenetic tree](#) (six million years). To obtain this result the scientists performed [whole genome sequencing](#) and analyzed 27 genomes of three species of fritillary butterflies.

It turned out that some specimens of small-numbered *M. acentria* sporadically interbreed with more common *M. didyma*, resulting in [gene flow](#) from *M. didyma* to *M. acentria*. In general, one of the reasons for the species extinction is precisely the loss of genetic diversity. The fact that *acentria* butterflies are 'fed' with genetic material through hybridisation with a distant congener could therefore be a factor of survival and further [evolution](#) for the *acentria*. Moreover, as the researchers note, introgressive hybridisation is not total in this case. Only some specimens interbreed with another species. However, this is sufficient for the emergence of a stable gene flow. The researchers even managed to catch one butterfly that turned out to be an interspecific hybrid.

"When we examined the morphology of *M. acentria*, we noticed that it

resembled *M. didyma*. This was unexpected for us, because these two species are [distant relatives](#). Such "coincidences" are mostly the result of adaptation to similar environmental conditions. However, sometimes they occur as a result of introgressive hybridisation. We have analyzed whole genomes, which showed an unidirectional gene flow from *didyma* to *acentria*," said Elena Pazhenkova, the first author of the article, a doctoral student at St Petersburg University.

Vladimir Lukhtanov is Principal Researcher at the Zoological Institute of the Russian Academy of Sciences and Professor at St Petersburg University. He says that hybridization usually leads to the fusion of two species or to the appearance of infertile offspring, that is, to the dead end of evolution. That is, the dead end of evolution. Until recently, it was therefore believed that such a scenario of 'enrichment' of a species with new genetic material was in principle impossible. However, in recent years, more and more works have appeared that encourage scientists to take a different view on the processes of evolution of living beings.

"It seems that we are at the stage of changing the scientific paradigm. Biologists have long been convinced that the evolution of living beings can be represented as a branching tree. This metaphor (Tree of Life) might not be entirely correct and might soon be discarded," said Vladimir Lukhtanov. "Introgressive hybridisation suggests that it might be more correct to represent evolution as Web of Life, in which the emerging new branches are horizontally linked to each other due to the gene exchange. Additionally, the fact that we have identified an understudied natural mechanism that makes it possible to maintain genetic diversity may be important for the development of a general strategy for the conservation of a wide variety of living organisms."

The research was published in the journal *Molecular Ecology*.

More information: Elena A. Pazhenkova et al, Genomic introgression from a distant congener in the Levant fritillary butterfly, *Melitaea acentria*, *Molecular Ecology* (2021). [DOI: 10.1111/mec.16085](https://doi.org/10.1111/mec.16085)

Provided by St. Petersburg State University

Citation: Fritillary butterflies preserve genetic diversity through interbreeding (2021, August 19) retrieved 2 May 2024 from <https://phys.org/news/2021-08-fritillary-butterflies-genetic-diversity-interbreeding.html>

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