Researchers show nature conserves its most vital DNA by multitasking

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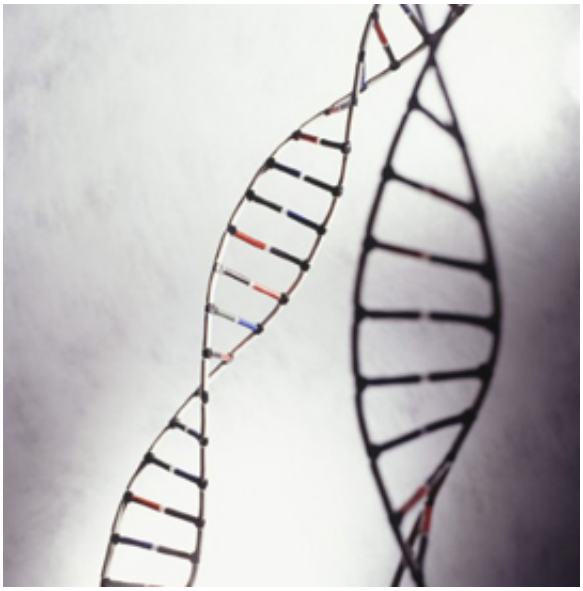

Credit: NIH

In evolutionary biology, the most vital genomic elements necessary for survival are typically those that are held on most dearly throughout the history of life on Earth.

In a study published in the advanced online edition of *Molecular Biology and Evolution*, Professor Claudio Alonso and colleagues at the University of Sussex (UK) investigated these treasured genomic keepsakes, called ultraconserved elements (UCEs), which have been found to span the tree of life, from plants to yeast to mice to humans. They used the trusted

fruit fly model *Drosophila melanogaster* together with other species where they applied a variety of bioinformatics tools to get at the heart of this poorly understood phenomenon.

In the new paper, the authors describe and define 'ultraconserved' as 50 base pairs long DNA elements found in all 12 *Drosophila* species they studied—-a comparison that is greater than the evolutionary distance between humans and reptiles. Most importantly, the authors show that UCEs are the "multitaskers" of the genome, involved in numerous biological processes simultaneously, and this multi-layered function may be responsible for the extreme DNA sequence conservation observed.

Overall, they identified more than 1,500 UCEs in the fruit fly genome. These UCEs where found next to genes critical to animal development, suggesting that they act like hubs to allow genome access for an array of proteins. And similar to the real estate market, location is everything. They showed that the exact roles of UCEs vary depending on whether a UCE is found within a gene, between genes or controlling a gene from a vast distance.

For one protein, called Cad, the authors demonstrated dynamic binding with UCEs during development. This analysis showed that in young embryos, Cad binding was significantly enriched within a gene, while in adult flies there was a depletion of Cad binding. These results suggest that Drosophila UCEs might be implicated in the establishment and maintenance of genome packaging that is necessary for the precise control of gene expression throughout development.

Professor Alonso says "As a molecular biologist these elements always intrigued me because no single known molecular mechanism can explain the retention of exact DNA sequences of this length for such long evolutionary periods". And he also adds "Our computational work led by my colleague Dr Maria Warnefors strongly suggests that UCEs achieve

their invariance due to their multi-tasking roles in several molecular mechanisms involved in gene control".

Their work contributes to the understanding of the mechanisms that lead to the existence of UCEs and suggests that the constraints of their "multitasking" genomic role can help explain the high level of evolutionary conservation of UCEs, and why nature prizes these DNA elements above all others.

More information: *Molecular Biology and Evolution*, DOI: 10.1093/molbev/msw101

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