Butterflies and moths share ancient 'blocks' of DNA

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A male and female African monarch mating. Credit: University of Exeter

Butterflies and moths share "blocks" of DNA dating back more than 200 million years, new research shows.

Scientists from the Universities of Exeter (UK), Lübeck (Germany) and Iwate (Japan) devised a tool to compare the chromosomes (DNA molecules) of different butterflies and moths.

They found blocks of chromosomes that exist in all moth and butterfly species, and also in Trichoptera—aquatic caddisflies that shared a common ancestor with moths and butterflies some 230 million years ago.

Moths and butterflies (collectively called Lepidoptera) have widely varying numbers of chromosomes—from 30 to 300—but the study's findings show remarkable evidence of shared blocks of homology (similar structure) going back through time.

"DNA is compacted into individual particles or chromosomes that form the basic units of inheritance," said Professor Richard ffrench-Constant, from the Centre for Ecology and Conservation on Exeter's Penryn Campus in Cornwall.

"If genes are on the same 'string', or chromosome, they tend to be inherited together and are therefore 'linked'."

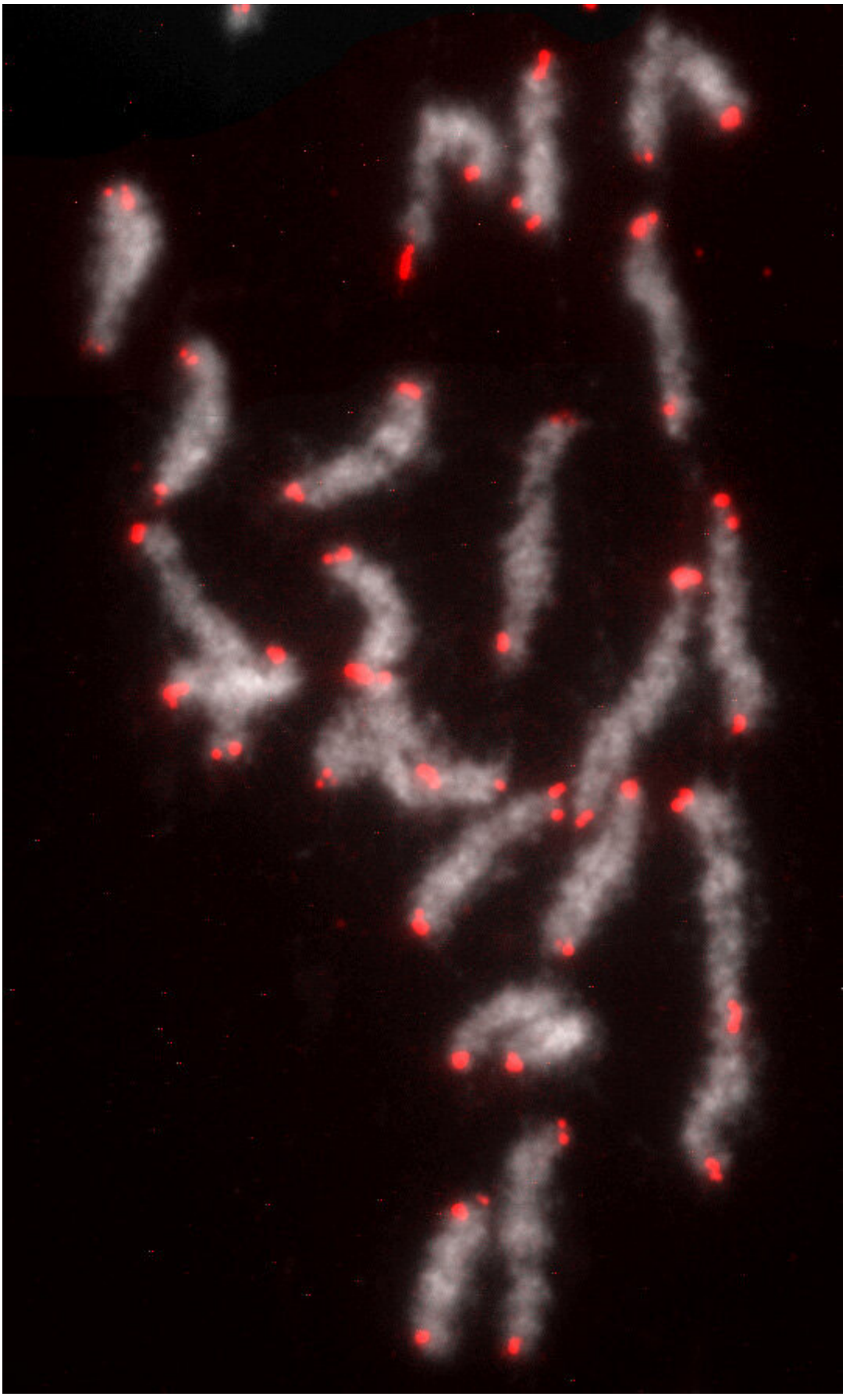
"However, different animals and plants have widely different numbers of chromosomes, so we cannot easily tell which chromosomes are related to which."

"This becomes a major problem when chromosome numbers vary widely—as they do in the Lepidoptera."

"We developed a simple technique that looks at the similarity of blocks of genes on each chromosome and thus gives us a true picture of how they change as different species evolve."

"We found 30 basic units of 'synteny' (literally meaning 'on the same

string' where the string is DNA) that exist in all butterflies and moths, and go back all the way to their sister group the caddisflies or Trichoptera."



The chromosomes of the African Monarch butterfly. The red dots highlight the ends of each chromosome using a DNA probe linked to a fluorescent reporter. Credit: University of Exeter

Butterflies are often seen as key indicators of conservation, and many species worldwide are declining due to human activity.

However, this study shows that they are also useful models for the study of chromosome evolution.

The study improves scientific understanding of how moth and butterfly genes have evolved and, importantly, similar techniques may also provide insights about the evolution of chromosomes in other groups of animals or plants.

The study is published in the journal *G3: Genes, Genomes, Genetics*.

More information: Walther Traut et al, Lepidopteran Synteny Units reveal deep chromosomal conservation in butterflies and moths, *G3: Genes, Genomes, Genetics* (2023). DOI: 10.1093/g3journal/jkad134

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