Genome sequencing reveals ancient interbreeding between chimpanzees and bonobos

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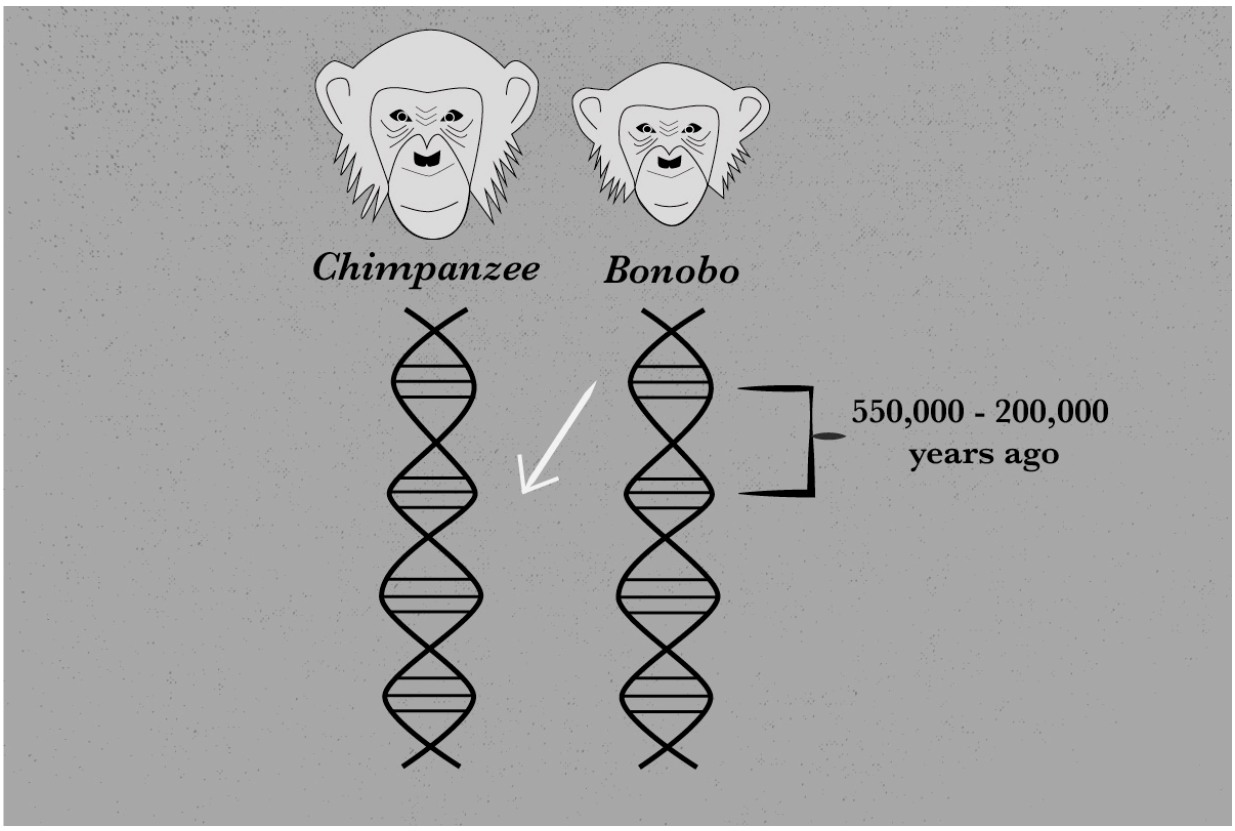

An analysis by de Manuel Montero et al. suggests that bonobos mated with chimpanzees between 550,000 and 200,000 years ago, resulting in genetic admixture between the two species. Credit: Carla Schaffer / *Science*

For the first time, scientists have revealed ancient gene mixing between chimpanzees and bonobos, mankind's closest relatives, showing parallels with Neanderthal mixing in human ancestry. Published today in the journal *Science*, the study from scientists at the Wellcome Trust Sanger Institute and their international collaborators showed that 1% of chimpanzee genomes are derived from bonobos.

The study also showed that genomics could help reveal the country of origin of individual chimpanzees, which has strong implications for chimpanzee conservation.

Chimpanzees and bonobos are great apes found only in tropical Africa. They are endangered species and are supposedly fully protected by law, yet many chimpanzees and bonobos are captured and held illegally.

To aid the conservation effort, researchers analysed the whole genome sequences of 75 chimpanzees and bonobos, from 10 African countries, and crucially included 40 new wild-born chimpanzees from known geographic locations. They discovered that there was a strong link between the genetic sequence of a chimpanzee, and their geographic origin.

Dr Chris Tyler Smith, from the Wellcome Trust Sanger Institute, said: "This is the largest analysis of chimpanzee genomes to date and shows that genetics can be used to locate quite precisely where in the wild a chimpanzee comes from. This can aid the release of illegally captured chimpanzees back into the right place in the wild and provide key evidence for action against the captors."

Chimpanzees and bonobos are the closest living relatives of human beings. They diverged from a common ancestor between 1.5 and 2 million years ago and live in different areas of tropical Africa. Until now, it was thought that gene flow between the species would have been

impossible, as they were physically separated by the Congo River.

The study confirmed a main separation between chimpanzees and bonobos approximately 1.5 million years ago, and the presence of four chimpanzee subspecies in different regions. However, the researchers also found there were two additional gene flow events between the chimpanzee and bonobo populations, indicating that at least some individuals found their way across the river.

Dr Yali Xue, from the Sanger Institute, said: "We found that central and eastern chimpanzees share significantly more genetic material with bonobos than the other chimpanzee subspecies. These chimpanzees have at least 1% of their genomes derived from bonobos. This shows that there wasn't a clean separation, but that the initial divergence was followed by occasional episodes of mixing between the species.

The study also included researchers from Spain, Copenhagen Zoo and the University of Cambridge and showed that there have been at least two phases of secondary contact, 200-550 thousand years ago and around 150 thousand years ago, mirroring what is believed to have happened during the last 100 thousand years of the evolution of humans.

Dr Tomàs Marquès-Bonet, leader of the study from the Institute of Biological Evolution (University Pompeu Fabra and CSIC), Barcelona, said: "This is the first study to reveal that ancient gene flow events happened amongst the living species closest to humans - the bonobos and chimpanzees. It implies that successful breeding between close species might have been actually widespread in the ancestors of humans and living apes."

More information: "Chimpanzee genomic diversity reveals ancient admixture with bonobos," *Science*, DOI: 10.1126/science.aag2602

Provided by Wellcome Trust Sanger Institute

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