

# Study shows competition, not climate change, led to Neanderthal extinction

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In a recently conducted study, a multidisciplinary French-American research team with expertise in archaeology, past climates, and ecology reported that Neanderthal extinction was principally a result of competition with Cro-Magnon populations, rather than the consequences of climate change.

The study, reported in the online, open-access journal *PLoS ONE* on December 24, figures in the ongoing debate on the reasons behind the eventual disappearance of Neanderthal populations, which occupied Europe prior to the arrival of human populations like us around 40,000 years ago. Led by Dr William E. Banks, the authors, who belong to the French Centre National de la Recherche Scientifique, l'Ecole Pratique d'Hautes Etudes, and the University of Kansas, reached their conclusion by reconstructing climatic conditions during this period and analyzing the distribution of archaeological sites associated with the last Neanderthals and the first modern human populations with an approach typically used to study the impact of climate change on biodiversity.

This method uses geographic locations of archaeological sites dated by radiocarbon, in conjunction with high-resolution simulations of past climates for specific periods, and employs an algorithm to analyze relationships between the two datasets to reconstruct potential areas occupied by each human population and to determine if and how climatic conditions played a role in shaping these areas. In other words, by integrating archaeological and paleoenvironmental datasets, this predictive method can reconstruct the regions that a past population

could potentially have occupied. By repeating the modeling process hundreds of times and evaluating where the errors occur, this machine-learning algorithm is able to provide robust predictions of regions that could have been occupied by specific human cultures.

This modeling approach also allows the projection of the ecological footprint of one culture onto the environmental conditions of a later climatic phase—by comparing this projected prediction to the known archaeological sites dated to this later period, it is possible to determine if the ecological niche exploited by this human population remained the same, or if it contracted or expanded during that period of time.

Comparing these reconstructed areas for Neanderthals and anatomically modern humans during each of the climatic phases concerned, and by projecting each niche onto the subsequent climatic phases, Banks and colleagues determined that Neanderthals had the possibility to maintain their range across Europe during a period of less severe climatic conditions called Greenland Interstadial 8 (GI8).

However, the archaeological record shows that this did not occur, and Neanderthal disappearance occurs at a point when we see the geographic expansion of the ecological niche occupied by modern humans during GI8. The researchers' models predict the southern limit of the modern human territory to be near the Ebro River Valley in northern Spain during the preceding cold period called Heinrich Event 4 (H4), and that this southern boundary moved to the south during the more temperate phase GI8.

The researchers conclude that the Neanderthal populations that occupied what is now southern Spain were the last to survive because they were able to avoid direct competition with modern humans since the two populations exploited distinct territories during the cold climatic conditions of H4. They also point out that during this population event

contact between Neanderthals and modern humans may have permitted cultural and genetic exchanges.

Citation: Banks WE, d'Errico F, Peterson AT, Kageyama M, Sima A, et al. (2008) Neanderthal Extinction by Competitive Exclusion. PLoS ONE 3(12): e3972. doi:10.1371/journal.pone.0003972  
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