**Fast climate change drives pronounced changes in species’ genetic diversity**

Numerous species responded to past climate changes by tracking suitable environmental conditions and consequently, altered their genetic make-up 1,2. Following the projected future changes in climate, climate change velocities will likely outpace species’ dispersal abilities 3, leading to further changes in the distribution of genetic diversity 4, local extirpations (REFS, e.g. Bellard, C. et al (2012) & Parmesan, C. (2006)) and ultimately to extinctions (REFS e.g. the same as previous). Especially species in remnant, isolated populations that lack both the ability to track changes and the genetic variability to allow adaptation will appear particularly threatened 5. The pace of climate change has been proposed to affect the demography of a species and thus, its level of intraspecific genetic diversity (REFS). Species under stable climatic conditions (slow climate change velocity) are expected to reach stationary demographic conditions and stable levels of genetic diversity (REFS). In addition, simulation studies have shown that species that maintain stable ranges retain highest levels of intraspecific genetic diversity. These studies also showed that, counterintuitively, fast range contractions better preserve species levels of genetic diversity compared to slow range contractions 6. These opposite expectations hinder our ability to predict responses of genetic diversity to future changes in climate and thus, have only been investigated to a very small extent. For this reason, analyses of the differences in the response of species’ genetic diversity to the pace of climate changes are of the critical importance.

Megafaunal replacements and extinctions in the Northern Hemisphere have been linked to abrupt climate changes based on Greenlandic ice core records (Cooper). Although informative, the use of extrapolated hemispheric trends contradicts recent studies showing that species with different ecological strategies experience climate change differently (Parmesan). Furthermore, a high variance in the velocity of climate change is expected at broad spatial and temporal scales and additionally, across species (Serra-Diaz). In order to evaluate the response of intraspecific genetic diversity to past climate change variability at broad spatial, temporal and at the species level must be accounted for. With the availability of global paleoclimatic reconstructions for consecutive time bins for the last 50,000 years, the extensive fossil record and ancient DNA sequences, this can be used in conjugation to better understand species genetic dynamics during the Late Quaternary. To our knowledge, species’ genetic responses to climate change has not before been related to the pace climate change by analyzing ancient DNA and fossil record from multiple species.

Climatic fluctuations during the Late Quaternary have been characterized as occurring with different paces (Steffensen, REFS). For example, the Last Glacial Maximum was a cold but relatively stable period (Cooper – Maybe they have another reference in their article REFS). Oppositely, Younger Dryas and the Bølling-Allerød events showed substantial changes in temperature over a short period of time (Steffensen). Previous estimations of past climate change velocities have been limited to two time bins (Sandel) impeding both the comparison of periods with different velocities, and subsequently the estimation of the effect of climate velocity on species genetic diversity. Here for the first time we estimated climate change velocity for 36 time bins –from 50,000 years to present- for the Northern Hemisphere. We then used x radiocarbon-dated fossils, x ancient and x modern DNA sequences for 11 species of mammals, and tested the prediction that there is a positive correlation between the velocity of climate change and the magnitude of change in genetic diversity.

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