# Title: Mammal Response and Extinction Risk under Ice Age Global Change

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# Proposal

The project proposal aims at identifying the biotic and abiotic changes affecting the mammalian megafauna in Western Eurasia during the 120 ka to Holocene interval. We will delineate the climatic and ecological context in which the extinction of the megafauna took place. We will proceed by calculating and mapping the environmental niches of several large mammal species, including *Homo* species. Then, by using palaeodemographic data, we will define a portfolio of population viability analyses (PVA) to identify plausible past population trajectories of each species. Once properly set, the PVAs will help to determine the ecological characteristics, such as habitat extent and connectivity, and life history traits, that drove some species to extinction while permitting others to persist, thereby allowing to size up the effects of climatic change and the ever-increasing presence of humans on their populations size and distribution. The knowledge acquired by pursuing the project goals will provide analytical, ground-truth evidence about the level of global change that megafauna species was able to survive in terms of change in global temperatures and precipitation regimes, limited spatial connectivity among populations, increased mortality by human pressure.

# Research Program

# The project unfolds through three tasks. The candidate will start collecting relevant archeological and faunal data from the late Pleistocene, building (and expanding upon) large databases which we have created over the past two decades (task 1). The candidate will participate, during the second year of the program, in the production of species distribution models and calculate habitat suitability for the megafauna, and then landscape metrics of individual species through time, to ascertain credible metapopulations structures (task 2). Distribution models will be applied to > 20 species belonging to the megafauna plus *Homo*. This task is now possible thanks to recent advances in supercomputer transient paleoclimatic modelling. We will rely on paleoclimatic and paleobiome data as generated by the P2F transient earth system model simulations. The model simulations were conducted with the Community Earth System Model, 1.2 and the off-line Biome4 model. They cover the entire climatic history of the last 3 million years and have been validated against a plethora of paleo-climate proxy data. The key environmental variables that will be used for deriving paleo species distribution models include annual and monthly temperature and precipitation values, along with annual net primary productivity, leaf-area index and biomes.

# The candidate will help evaluating the effects of climate change and human pressure on species demographics, investigating upon the ecological, climatic and anthropogenic factors that pushed some of the megafauna to extinction. To this aim, during the project years 2 and 3, the candidate will help designing realistic trajectories of change in species population size through evaluation of species fates using Population Viability Analyses (PVA) and calculating extinction rates from the fossil record with PyRate, under a reverse-engineering approach. As a post-hoc analysis, we will run a comparative machine learning extinction risk model, to identify the combination of conditions that are significantly correlated to individual species extinction.

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