The NEDEMO (Neandertal Demise Modelisation) Project

Anna Degioanni[1], Christophe Bonenfant[2], Géraud Gourjon[1], Jean Philip Brugal[1], Mathieu Coulon[3], Philippe Fernandez[1], Sandrine Cabut[1] and Silvana Condemi[4]

The NEDEMO project is a network of pluridisciplinary research aiming at identifying the demographic parameters (fertility, survival, structure and variation in the size of the population) that resulted in Neandertal demise.

Three scenarios have been proposed:

• Modern humans replaced Neandertals in Europe;
• Modern humans assimilated the Neandertal population;
• Modern humans replaced and partly assimilated Neandertals.

To determine which of the three proposed scenarios is most likely, we will use an approach based on demographic modeling, which is widely employed in ecology for the study of the dynamics of animal populations.

As in all modeling work, we will simplify and interlink biological, social and environmental processes that may explain the disappearance of the Neandertals.

This approach will also enable us to test different hypotheses and, in addition, to determine the value of a priori parameters that are not measurable.
To model the past population dynamics of Neandertals, we use the Leslie matrix which requires knowledge of the survival and the fertility rates for each age group from birth to 50 years-old.

Although the Neandertal demographic parameters are not known with precision, they can be inferred through the integration of data provided by other disciplines and by comparative analyses.

What do the fossil records have to say about the Neandertal/sapiens transition in Europe? Is there a real discontinuity in the peopling of Europe? Was the demise of Neandertals in fact a disappearance brought about by hybridation?

To answer these questions, the assessment of paleobiological, morphological and genetic affinities among the Neandertals, notably late Neandertals, is of central importance for resolving issues regarding the emergence and establishment of modern human morphology and diversity in Europe.
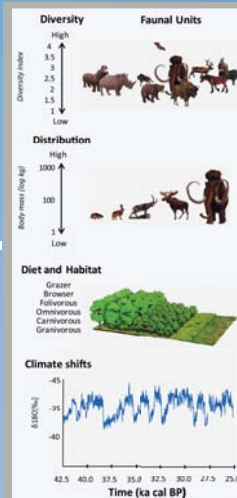
Available mammalian fossil datasets (*e.g.* Paleobiology database; pers. data) will provide a palaeological framework including structural proxies such as diversity, body size/mass, diet and habitat, in order to identify their possible interactions in the framework of Neandertal population dynamics. Starting from well documented faunal units in time and space, the main climatic shifts (*e.g.* GIPS2 pulses) will also be integrated and constitute the background of this palaeecological analysis. One of the main challenges presented by this work will be to link key environmental changes to the Neandertal population in the limited time-scale of the last part of the Upper Pleistocene.

We aim to design models of population genetics to test whether Modern humans (MHS) have assimilated the Neandertal population (HN) or not. Analysis of three models of admixture, with varying demographic parameters, will allow quantification of three possible sources of HN contribution: (i) a sole instantaneous event in Middle-East at -50Ka; (ii) an introgression in Middle-East at -100Ka, then a backward migration of admixed MHS in Africa, followed by a peopling of Europe and Asia (founder effect + possible admixture during expansion); (iii) a long term sex-biased gene flow during MSH expansion (mtDNA, which is maternally transmitted, does not support an admixture).
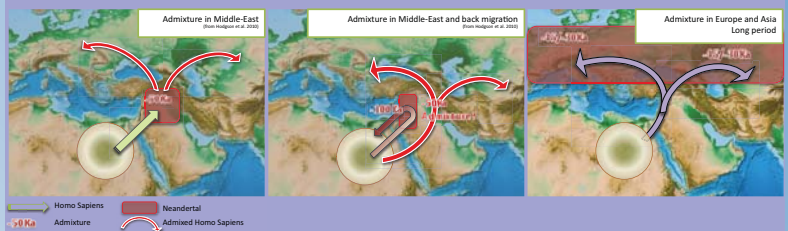
First results. It is not necessary to infer drastic demographic changes. Very small differences in fertility or in survival rates may cause enormous differences over a period of ten thousand years in total population size and they can also account for extinction.

The project's first step involves the design and implementation of a complex relational database employing quantitative and qualitative data useful for identifying relationships between different data sources. It will be easy for all the members of the consortium to use this database.

At present, researchers involved in the project come from anthropobiology, genetics, ecology, paleoanthropology, and archeozoology. We hope to stimulate interest in this project among researchers in view of presenting a broader international project.

[1] AMU, CNRS, MCC, LAMPEA UMR 7269 - 5 rue du Château de l'Horloge - BP 647, 13094 Aix-en-Provence, France
anna.degioanni@univ-amu.fr
[2] UMR5558 Laboratoire Biométrie et Biologie Évolutive - Université Claude Bernard, Lyon 1, France
[3] AMU, CNRS, MCC, LAMES UMR 7303 - 5 rue du Château de l'Horloge - BP 647, 13094 Aix-en-Provence, France
[4] AMU, CNRS, EFS, ADES UMR 7268 - Faculté de Médecine - Secteur Nord Université de la Méditerranée, CS80011, Bd Pierre Dramard 13344 MARSEILLE Cedex 15, France