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JUST THE TIP OF THE ICEBERG?

An in-depth investigation of lithic projectile morphology during the Upper Palaeolithic in Europe

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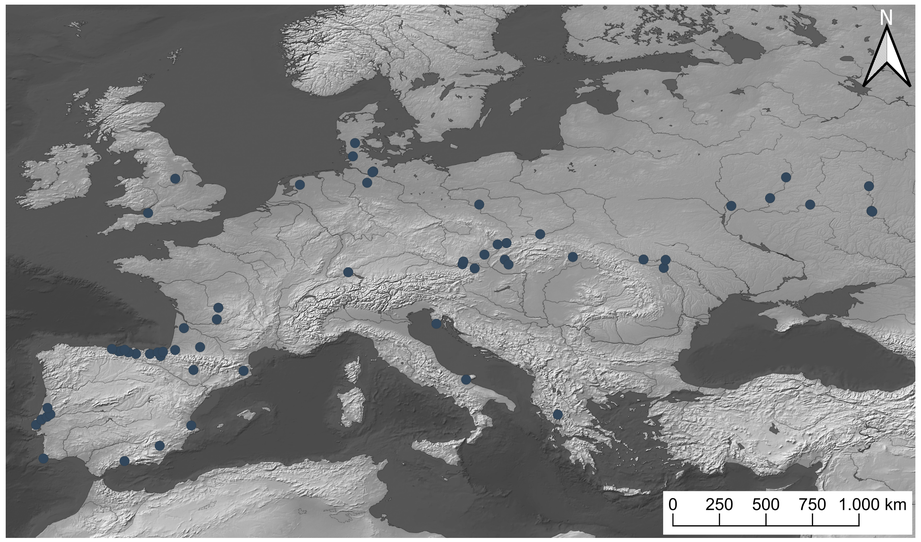

Fig. 1: Map of the current state of the data collection (sites processed so far n=63). Map basis: https://www.naturalearthdata.com/downloads/10m-gray-earth/gray-earth-with-shaded-relief-ocean-bottom-and-drainages/

Introduction

Human culture changes over time. Archaeologically, the process of culture change is most visible in material items and exhibits aspects that mark it as evolutionary in nature. Quantitative analysis of material culture under a diachronic, evolutionary paradigm is recently gaining renewed interest and has considerably advanced our understanding of past processes (e.g., O'Brien and Lyman 2000). The applicability of cultural evolution as an analytical and explanatory framework for the archaeological record, however, is facing problems not only from the patchy nature and sometimes poor chronological control, but also from the way archaeological data is traditionally recorded.

The aim of my PhD-project conducted at the University of Cologne and funded by the Helga-Raddatz-Scholarship of the Neanderthal Museum (in cooperation with the NRW-Stiftung) is to contribute to the quantitative analysis of cultural evolution and can be summarised within five key points:

- develop new kinds of quantitative archaeological data compatible with data from other research areas, such as environmental science or palaeogenetics
- provide replicable and case-transferable methods and code scripts to automate and standardize data recording
- generate functions for the search of temporal and spatial trends and countertrends as well as recurring patterns
- quantify cultural evolution along the lines of evolutionary biology (Haldane 1949; Gingerich 2001)
- build up a standardised and expandable online-database containing visual catalogues of artefact depictions and morphological data

Case study

Artefacts, typological classified as "shouldered points" are especially well suited for the investigation of evolutionary processes during the Upper Palaeolithic, as they:

- are – as projectiles in hunting weapons – directly linked to subsistence success and therefore likely to show a high sensitivity to social or ecological changes;
- represent a group that can be morphologically distinguished from other types of projectiles;
- have a relatively long lifespan of around 18.000 years and a wide distribution.

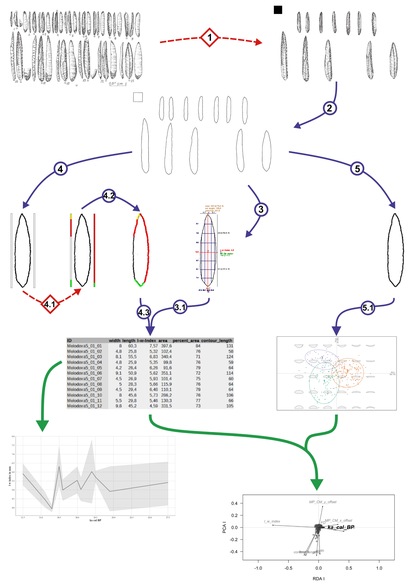

Fig. 2: Workflow in PyREnArA. Red dashed lines: steps to do by hand; blue solid lines: automated steps producing data; green solid lines: selectable automated functions for multivariate statistical methods (left: plot of l-w-index against ka cal BP with error bars representing standard deviation; right: Triplot of Redundancy Analysis (RDA) (see Fig. 3)). Step 1: drawing of reference object and deletion of unused depictions (lateral/ventral views, scale, etc.); Step 2: standardisation of orientation of artefacts and outline detection; Step 3: calculation of metrics; Step 3.1: export of metrical data to .csv-datafile; 4: production of figure for retouch recording; Step 4.1: recording of retouches by colour-coding; Step 4.2: calculation of retouch length and position depending on retouch style; Step 4.3: export of retouch data to .csv-datafile; Step 5: export of single artefact outlines; Step 5.1: execution of Geometric Morphometric (GMM) functions.

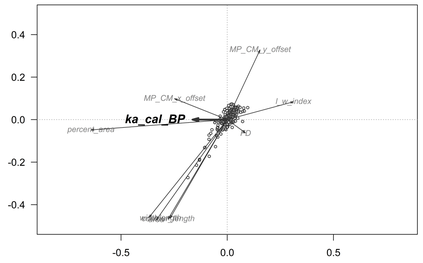

Fig. 3: Example of RDA triplot (Maier et al. in review). X-axis: RDA, y-axis: first PCA-axis. Time is getting younger from left to right. Arrows indicating the nature of change through time in the respective morphological feature (pointing left: feature decreases with time; pointing right: feature increases with time; tilt in y direction indicating importance for overall variance). Objects in this graph thus become pointier, shorter and slenderer while getting younger. The amount of variance explained by the RDA is 2.6%, while other factors, rather unrelated to the passing of time, account for 46%.

Their earliest evidence marks the beginning of the Willendorf-Kostenkian (Upper Gravettian), around 29 ka cal BP in Central and Eastern Europe. With the beginning of the subsequent Epigravettian or Solutrean around ca. 25 ka cal BP, a morphological diversification can be observed in different parts of Europe. From 22 ka cal BP, shouldered points seem to stay a part of the hunting equipment up to about 11 ka cal BP (Maier et al. 2021), when they are particularly numerous in northern Germany, Poland, the Netherlands, and Denmark.

Method

Sites across Europe yielding shouldered points are collected through literature research. Available radiometric dates are examined for their quality, since only well dated sites are considered. Artefact depictions are scanned, processed and fed into the semi-automated code PyREnArA (Python-R-Environment for Artefact Analysis; Fig. 2; John et al. 2023). PyREnArA provides traditional and new information on artefact morphology, customised for the implemented statistical methods, e.g., Redundancy Analysis (RDA; Legendre and Legendre 1983), which allow for quantitative analyses of morphological change and to statistically determine the amount of variation that correlates with the progress of time as well as how morphological features are affected (Fig. 3; Maier et al. in review). In doing so, it allows for new insights into material culture evolution. The thus-obtained quantitative data on material culture change shall be compared to climatic and environmental changes as well as data from palaeogenetics.

Research Questions

- Are there recognisable changes (trends) in the morphology of shouldered points?
- What are the characteristics of these trends?
- Are these trends continuous or intermittent, gradually or punctuated?
- What is the tempo of these trends?
- Can these trends be paralleled with environmental data or data from palaeogenetics?

With its new approach, this project aims at contributing to the quantitative study of cultural evolution to advance our understanding of diachronic processes. The quantitative basis will strengthen the argumentative capacity of the results and thus provide a counterweight and interface to other disciplines such as palaeogenetics and environmental science in the discussion about human evolution.

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