THE FIFTH ANNUAL ZOOLOGICAL
CONGRESS OF "GRIGORE ANTIPA" MUSEUM, BUCHAREST, ROMANIA
20-23 NOVEMBER 2013

# Phenotypic variability in dentition of suines in the Chalcolithic period in Romania

**Mariana POPOVICI[1], Thomas CUCCHI[2, 3], Adrian BĂLĂŞESCU[4], Simina STANC[1]**

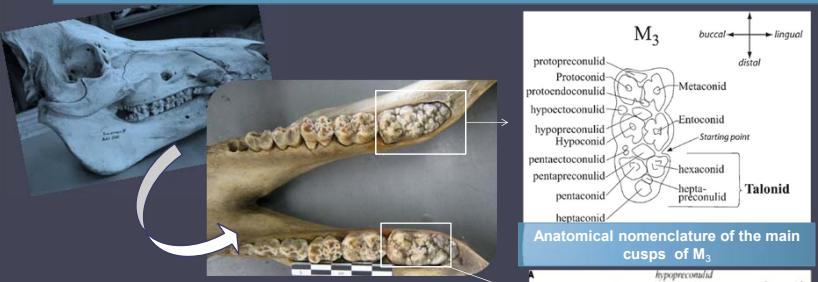
[1]Alexandru Ioan Cuza University, Faculty of Biology, Bd. Carol I 20A, 700505, Iaşi, Romania, sorexmin@yahoo.com, simina_stanc@yahoo.com
[2] University of Durham, Department of Archaeology, South Road, Durham DH1 3LE, UK
[3] Museum National d'Histoire Naturelle, UMR 5197, Departement Ecologie et Gestion de la Biodiversite, 55 rue Buffon, 75231 Paris Cedex 05, France, cucchi@mnhn.fr
[4]National Museum of Romanian History, Bucharest, Romania, abalasescu2005@yahoo.fr

The distinction between domestic and wild forms of *Sus scrofa* is often difficult due to the coexistence of these two forms in Neolithic period and it is possible that in archaeological samples occur hybrid forms which make complicated the identification. The morphological variation seen in the molar of swine was described by the two-dimensional projection of the tooth viewed from its occlusal surface. The geometric morphometric approaches on molar tooth was used in this goal. The advantages of geometric morphometric are the visualization and the possibility to use mathematical data for multivariate statistics.

The osteological material used in analysis (the lower second and third molars of pig and wild boar) (Figure 1) came from archaeological sites of Romania territory dating form Chalcolithic period (4500 - 3000/2500 B.C.) (Cucuteni Culture and Gumelnita Culture). For comparison, material from Precucuteni Culture, Boian Culture and Mesolitic period were added (Figure 2).

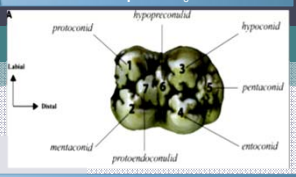
Among the three permanent molars, the lower second molar ($M_2$) and lower third molar ($M_3$) represent key phenotypic markers to examine phenotypic diversity and the domestication process in pigs for the following main reasons :

- $M_2$ displays less crown deformation due to mesio-distal abrasion than the $M_1$.
- $M_2$ should be more genetically controlled than the $M_3$ which could provide an advantage in our attempt to highlight genetic determinism of the phenotypic response at the intra-specific level.
- The M3 (being the final permanent tooth to develop and erupt) retains its morphological integrity for longer and suffers less from interproximal and occlusal abrasion than the other permanent molars (Cucchi at al., 2009; 2011)




Anatomical nomenclature of the main cusps of $M_3$

Figure 1. Occlusal view of mandible and anatomical nomenclature of the main cusps of the molars




Anatomical nomenclature of the main cusps of $M_2$

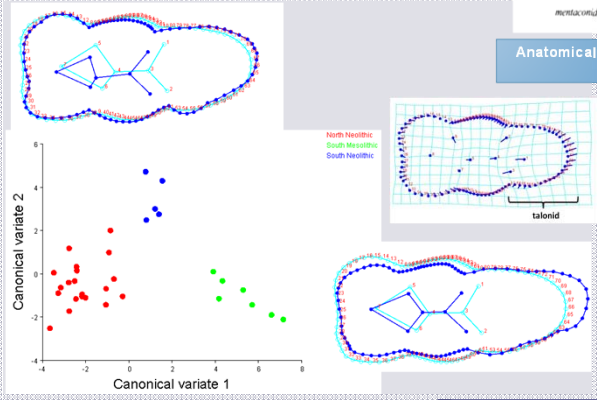



Figure 3. Discriminant Analysis excluding Allometry and Corect Size - characteristic patterns of $M_3$-

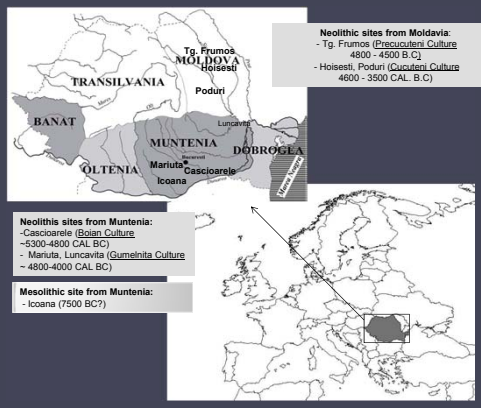



Figure 2. Location of the archaeological sites

Form analysis was performed using Geometric Morphometrics (GM) methods based on the Kendall theory of shape: defined as "all the geometric information that remains when location, scale and rotational effect are filtered out from an object" (Kendall, 1977). The shape can then be described by a configuration of Cartesian coordinates of landmarks which are discrete anatomical loci and homologous from one organism to another . GM compared the shape configurations using Generalized Procrustes Analysis (GPA);

Size and shape components of this configuration are separately computed. The size of the molars was measured as the Centroid Size (CS). The CS is a geometric scale which is mathematically defined by the square root of the sum of squared distances between all landmarks and their Centroid (the centre of gravity of the form).

To describe the phenetic relationships of shapes within sample Principal Components Analysis (PCA) using variance-covariance matrix and the representation of the shapes differences was made with Thin-plate spline deformation grids.

Canonical variates analysis (CVA) was used for simplifying descriptions of differences between groups.

79 landmarks in the lower second molar and 106 landmarks for the lower third molar were used in form analysis.

All statistical analyses were performed in PAST (Paleontological Statistics) version 1.57 (Hammer, 2001), SPSS (version 15.0.1, 2006) and MorphoJ version 1.05a (2012).

**Remarks:**
**Phenetic relationships have revealed a clear and interpretable phenotypic signatures in the samples. Our results reveal similarities between the Neolithic pigs in Cucuteni and Gumelnita Cultures, but in the same time show models of variation differed significantly.**

- **Significat differences of:**
  - **talonid: trend to elongation of this structure in populations of pigs from Boian and Gumelnita and those of wild boar from Mesolithic period.**
  - **pentapreconulid and hypopreconulid: shorter in pig populations from Precucuteni and Cucuteni Cultures comparative with those from Boian and Gumelnita and wild boar from Mesolithic period (Figure 3).**

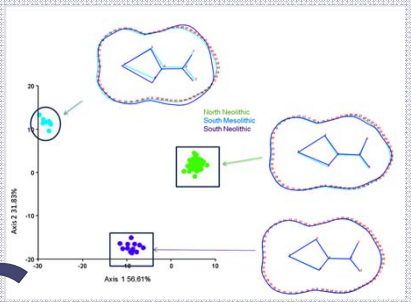



Figure 4. Discriminant Analysis excluding Allometry and Corect Size - characteristic patterns of $M_2$-

- **Molar shape analysis: most similarities were observed between the Neolithic pigs in Moldova and Muntenia.**
- **Molar form analysis: the $M_2$ variability targets the distal-labial cusps: hypopreconulid and protoendoconulid (central cusps) (Figure 4).**

**References**:
Cucchi T., Fujita M., Dobney K., 2009. New Insights into Pig Taxonomy, Domestication and Human Dispersal in Island South East Asia: Molar Shape Analysis of Sus Remains from Niah Caves, Sarawak, Int. J. Osteoarchaeol. 19: 508–530
Cucchi T., Hulme-Beaman A., Yuan J., 2011. Dobney K., Early Neolithic pig domestication at Jiahu, Henan Province, China: clues from molar shape analyses using geometric morphometric approaches, Journal of Archaeological Science 38: 11-22.
Hammer O, Harper DAT, Ryan PD (2001) PAST: Paleontological Statistics Software Package for Education and Data Analysis. Palaeontol Electron 4:9.
Kendall, D., 1977. The diffusion of shape. Advances in Applied Probability 9, 428e430.

**This work was supported by a grant of the Romanian National Authority for Scientific Research, CNCS – UEFISCDI, project number PN-II-RU-TE-2011-3-0146.**