WORKSHOP

Past populations in silico: Modelling archaeological and historical populations

Journée d'étude organisée

par l'axe "Concepts et méthodes" du réseau IN-HOPPE

International Network -Historical and osteoarchaeological Past Populations Exploration

avec le concours du CEPAM

Cultures – Environnements. Préhistoire, Antiquité, Moyen Âge, CNRS – UNS

et proposée par

Andreas DUERING

(Institut für forensisches Sachverständigenwesen, IfoSA, Munchen)

Sophie PENNEC (Ined, Paris)

And Isabelle SÉGUY (Ined, Paris)

Maison des Sciences de l'Homme et de la Société Sud-Est (MSHS Sud-Est), Nice, France

5-6 décembre 2019

Thème transversal aux Sciences humaines et sociales, la modélisation est ici déclinée autour de la restitution, de l'interprétation ou de la compréhension des comportements démographiques des populations historiques et préhistoriques, à travers leurs différents ressorts. Bien des facteurs influent sur la dynamique et sur le devenir des populations humaines : facteurs environnementaux (naturels et biologiques) conditions socio-économiques, croyances culturelles, niveaux de développements technologiques, etc. Prendre en compte les interactions qui existent entre eux, est un défi aux modélisateurs.
A travers de études de cas, mais aussi de réflexions épistémologiques, tout autant que prospectives, nous nous intéresserons aux avancées nouvelles de cette discipline, toute récente. Nous souhaitons que ces journées soient non seulement un moment convivial d'échanges et de débats, mais aussi forces de proposition quant aux activités à mener sur cette thématique dans le cadre du réseau IN-HOPPE.

WORKSHOP

Past populations in silico: Modelling archaeological and historical populations

Workshop organised by

the network IN-HOPPE - Axe "Concepts and methods"

International Network -Historical and osteoarchaeological Past Populations Exploration

And the CEPAM

Cultures – Environnements. Préhistoire, Antiquité, Moyen Âge, CNRS – UNS

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December 5th – 6th 2019

As a cross-cutting theme of human and social sciences, modeling is focusing here on the restitution, interpretation or understanding of demographic behavior of historical and prehistoric populations, through their different aspects. Many factors influence dynamics and future of human populations: environmental factors (natural and biological), socio-economic conditions, cultural beliefs, levels of technological developments, etc. Taking into account all these interactions is challenging for modellers.

Through case studies, but also epistemological reflections, as well as prospective ones, we will highlight new advances of this young discipline. We hope that these days will not only be a convivial moment of exchanges and debates, but also forces of proposal for the activities we could lead on this theme, within IN-HOPPE network.

ASPECTS PRATIQUES/ PRATICALITIES

The venue of the workshop is the Maison des Sciences de l'Homme et de la Société Sud-Est of Nice.You can find all the information about "How to come", using the following link: **http://unice.fr/mshs/presentation/acces-mshs**.

The address is **25 boulevard François Mitterand - 06300 Nice**
Room 418 (Fourth floor), the lift is in the central part of the building (after the stairs)

Coming from the airport to the city center:
- Tramway line 2, direction towards "Jean Médecin" stop (end of the line)
- And if necessary, at "Jean Médecin" stop, transfer to Tramway line 1

Coming from the airport to the hotel Appart'City Nice Acropolis:
- Tramway line 2, towards "Jean Médecin" (end of the line)
- At "Jean Médecin" stop, transfer to Tramway line 1, towards "Hôpital Pasteur" (both stops are a few meters apart)
- Get off at "Vauban" stop.

Coming from the city center to the Maison des Sciences de l'Homme et de la Société:
- Tramway line 1, towards "Hôpital Pasteur"
- Get off at "**Saint-Jean d'Angély université**" stop.

Coming from the hotel Appart'City Nice Acropolis to the Maison des Sciences de l'Homme et de la Société:
- One tramway stop: "Vauban" to "Saint-Jean d'Angély"
- Or five minutes walking

Tram rate (including transfers) costs 1,5 € (or 1 € for a multipass of 10 trips)

Please, pay attention: A **the national strike the 5th of December is foreseen**. There might be no public transport…

We will have lunches in restaurants nearby the Maison des Sciences de l'Homme et de la Société, and hopefully enjoy a sunny break.

If you have any problem, you can call me (mobile or WhatApps): +33 6-87-44-86-17

PROGRAMME

(Horaires indicatifs / indicative schedule)

December 5th - salle 418

9:30-10:00 – Accueil des participants (café)/ Wellcoming coffee

INTRODUCTION AU THEME / INTRODUCTION TO THE TOPIC

10:00-11:00 - Sophie PENNEC, Ined : Méthodes de microsimulation: théorie et applications

11:00-12 :00 - Daniel COURGEAU, Ined : Démographie historique et paléodémographie basées sur des modèles (Model-based historical demography and palaeodemography).

12:00-14:00 – Discussion et lunch break

I - APPROCHES PAR LES FACTEURS SOCIO-CULTURELS / APPROACHES BY SOCIO-CULTURAL FACTORS

14:00-15:00 - Anna DEGIOANNI (Aix Marseille Université) : Modélisation de la population néandertalienne

15:00-16:00 - Andreas ANGOURAKIS et collègues (University of Cambridge): A general model for household-structured population dynamics: presenting the first component for a model of Indus civilisation settlements in Haryana, NW India

16:00-16:30 – Coffee break and discussion

16:30-17:30 - Philip VERHAGEN (Vrije Universiteit Amsterdam): Modelling the effects of recruitment on Roman demography in the Dutch limes zone

17:30-18:00 - Discussion

December 6th - salle 418

II – APPROCHES PAR LES FACTEURS ENVIRONNEMENTAUX / APPROACHES BY ENVIRONMENTAL FACTORS

9:00 – 10 :00 - Marek VLACH (Institute of Archaeology of the Czech Academy of Sciences, Brno): Exploring dynamics and quantitative aspects of the Antonine plague

10:00-11:00 - Frédérique BERTONCELLO et Marie-Jeanne OURIACHI (CEPAM - UMR 7264, CNRS-UCA, Nice): Exploring the role of environmental and human factors in the evolution of the Roman settlement system: the ModelAnSet Agent-Based Model

11:00-11:30 – Coffee break and discussion

11:30-12:30 - Timothy OSTLER (Cardiff University): Techniques used in modelling populations in a river, and their relevance in a historical context

12:30 -14:00 - Discussion and lunch break

III - AU-DELÀ DE LA DÉMOGRAPHIE - L'INTERDÉPENDANCE DE LA BIOLOGIE ET DE LA CULTURE / BEYOND DEMOGRAPHICS - THE INTERDEPENDENCE OF BIOLOGY AND CULTURE

14:00-15:00 - Justin LANE (Center for Modeling Social Systems, Prospectus Solutions): The Future of Simulating the Past

15:00-16:00– Michael J. GANTLEY (School of Archaeology & Institute of Cognitive and Evolutionary Anthropology, Linacre College, University of Oxford): Bridging the Gap: Using Ethnographic and Historical information to Model Transitions in Archaeological Populations

16:00-16:30 – Coffee break and discussions

16:30-17:30 – Andreas DUERING (IfoSA, Munich): Rituals and filters. Modelling past populations within social and religious networks

17:30-18:00 – Discussion and closure of the Workshop

RÉSUMÉS/ABSTRACTS

I - APPROCHES PAR LES FACTEURS SOCIO-CULTURELS/ APPROACHES BY SOCIO-CULTURAL FACTORS

Modélisation de la population néandertalienne

Anna DEGIOANNI
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Les hommes de Neandertal sont les hommes fossiles les mieux connus actuellement, grâce aux différentes analyses paléoanthropologiques, paléo génétiques, archéologiques et archéozoologiques. Nous connaissons certains détails de leur anatomie, leurs préférences alimentaires et leurs gouts pour les colliers. En revanche, la démographie de l'homme de Neandertal est très peu connue. Il est difficile de reconstituer la structure par sexe et par âge de la population et d'en connaitre la dynamique. A partir de la modélisation mathématique, plusieurs résultats ont été proposés. Nous allons détailler deux de ces résultats ; l'un est obtenu par modélisation génétique, l'autre est obtenu par modélisation écologique. Le but étant d'évaluer les différences entre ces deux modèles.

A general model for household-structured population dynamics: presenting the first component for a model of Indus civilisation settlements in Haryana, NW India

Andreas ANGOURAKIS
With BATES, Jennifer; BAUDOUIN, Jean-Phillipe; CECCARELLI, Alessandro; GIESCHE, Alena; SURYANARAYAN, Akshyeta; WALKER, Joanna; USTUNKAYA, M. Cemre; WRIGHT, Nathan; SINGH, Ravindra N.; PETRIE, Cameron A.
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We present the current state of an agent-based model addressing the potential diversity of agricultural strategies adopted by Indus settlements in different socio-ecological scenarios in Haryana, NW India. This work is part of the multi-disciplinary TwoRains project and brings together research on material culture, settlement distribution, food production and consumption, vegetation, and paleoenvironmental conditions. The model aims to assess the implications of different food production strategies for the sustainability of urban populations and the resilience of these in the face of changes in the intensity and variability of winter and summer water availability. As the first step in creating this model, we designed a general demographic model that generates population dynamics mediated by a household structure. Individuals are explicitly represented, not as separate agents, but as values (e.g. age, sex) in lists kept by household agents. Even though specifying individual-level properties and processes, individual decisions are not explicitly represented. Instead, we integrate three parametric equation-based models to define age and sex-specific probabilities for individuals to form a couple (nuptiality), give birth (fertility), and die (mortality). The fertility and nuptiality models correspond to the simplest parametric models presented in Peristera and Kostaki (2009, 2015). The mortality model is the Coale-Demeny Life Tables Model, available in the demoR package in R (Jones, 2007). Additionally, we implement two residence rules (‘matrilocal-matrilineal’ and ’patrilocal-patrilineal’) and a taboo on nuptials within lineages. Although created by couples, households in the model are not necessarily ´nuclear´; they can vary from single individuals to several couples and their children, and can continue to exist for multiple generations. We present the results of the explorations of this general demographic model, highlighting its capacity to generate more insights into the population dynamics in the past than traditional approaches. The potential utility of this model goes beyond the goals of our project. We believe it could serve as a reference or template for the modelling community in history and archaeology.

Modelling the effects of recruitment on Roman demography in the Dutch limes zone

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The study of demography has been at the core of Roman studies for a long time. Reconstruction of population sizes and other quantitative characteristics is essential to much archaeological research, but the goal of 'doing demographics' is also to provide an underpinning for the study of other aspects of Roman society, such as economic interactions. Without knowing the quantitative characteristics of ancient populations we cannot hope to adequately estimate such basic economic parameters as productive capacity, subsistence needs and purchasing power. Considerable progress has been made over the past decade in estimating population sizes from settlement data, aided by the increased use of GIS and spatial analysis. Researchers have thus been able to describe the major trends of population increase and decline, map population densities, and estimate the absolute numbers of people involved in numerous case studies all over the Empire. However, estimating other population characteristics such as age structure, household composition, gender balance and migration is much more challenging, since settlement data do not offer good proxies for this. For this reason, archaeologists and classicists have also relied extensively on data and concepts derived from modern-day demography to reconstruct and understand the Empire's population structure. Palaeodemographic simulation models have already been developed and applied in various archaeological studies but thus far were not specifically designed for use in Roman-period case studies. We therefore tried to develop a dynamical simulation model of the recruitment of Batavian soldiers for the Roman army, as part of a larger modelling effort to understand and estimate the agricultural productive capacity of the Lower Rhine region. The model clearly shows that the 'stable population' assumption is too simplistic for the study of ancient demography: both external drivers, such as diseases, warfare or the demand for manpower, as well as internal, socio-cultural factors related to marriage and birth control strategies, can greatly influence short-term and long-term growth rates. From this, we conclude that populations in the ancient world had a considerable amount of control over their reproductive capacity, allowing them to adapt to changes in economic, political and environmental circumstances. The model, however, also shows that there is a limit to adaptation: sustained pressure on population growth because of frequently recurring diseases or oppressive recruitment practices will in the end lead to population collapse. The case study presented here shows that it is possible to model and understand the effects of different social and biological factors influencing population growth rates with relatively simple assumptions and modelling tools. Starting out as an attempt to test a specific hypothesis on the recruitment of Batavian soldiers and its effects on population size and structure, it has developed into a more generic model that can be used to experiment with different socio-cultural, biological and environmental factors. We thus see a large potential for this and similar models to be used as heuristic tools that can help to understand the development of population characteristics through time and to assess the importance of the different factors contributing to population growth and decline.Exploring dynamics and quantitative aspects of the Antonine plague

II- APPROCHES PAR LES FACTEURS ENVIRONNEMENTAUX/ APPROACHES BY ENVIRONMENTAL FACTORS

Exploring dynamics and quantitative aspects of the Antonine plague

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Since the beginnings of the "3rd century crisis" discussions the famous epidemic called the Antonine plague has represented one of featuring factor within the range of causes. During the crisis period various segments and regions of the Roman world experienced different forms of turmoil (social unrest and uprising, economic problems, political instability etc.) or external incursions (warfare, barbarian raids). The present scientific knowledge encompasses considerable margins of estimated death toll of the epidemics. The main intention of the paper dwells is testing of possibilities of impact on the basis of emulative digital modeling and simulation. Geographically explicit context of the cellular framework represents a workspace for spatio-temporal quantitative simulation of various scenarios. Model input data include e.g. reconstructed distribution of population density, infrastructure, and historical clinical data of the respective disease. The vital part of simulation dynamics is defined through the well-established epidemiology mathematics (compartment model). Along with the large-scale (Roman Empire) model also agent-based network structured model on small geographic scale has been created in order to provide a tool to validate dynamics of the large-scale model. The main intention of the modelling is establishment of testing scenarios for assessment of possible quantitative and spatial aspects of epidemic impact within the demographic structures of the Roman Empire.

Exploring the role of environmental and human factors in the evolution of the Roman settlement system: the ModelAnSet Agent-Based Model

Frédérique BERTONCELLO et Marie-Jeanne OURIACHI
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The ModelAnSet Agent-Based Model was developed in order to explore the respective role of environmental and social factors in the evolution of the settlement pattern and dynamics during the Roman period in South-Eastern France. The model aims at simulating the impact of the climatic and macro-economic conditions on the behaviour of Gallo-Roman landowners related to their agricultural holdings. According to the profit they derive from their farms and/or villas, which depends both on natural and socio-economic factors, the landowners can decide to maintain without change, improve, enlarge or abandon their agricultural holdings or to create a new one. Through the repeated landowners' decision-making, the ABM thus simulates a changing macro-level settlement pattern, in terms of number, type and location of the settlements.

Techniques used in modelling populations in a river, and their relevance in a historical context

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Whilst individual organisms can be observed within a river, parameters governing whole population interactions are much more difficult to characterise. I will discuss the use of techniques such as stability analysis and numerical simulation to derive parameter probability distributions which I have used to analyse river dynamics, and how these can be useful within the modelling of historical populations

III – AU-DELÀ DE LA DÉMOGRAPHIE - L'INTERDÉPENDANCE DE LA BIOLOGIE ET DE LA CULTURE / BEYOND DEMOGRAPHICS - THE INTERDEPENDENCE OF BIOLOGY AND CULTURE

The Future of Simulating the Past

Justin LANE
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Simulating demographic changes in religion is an important topic for both historical and current populations. Arguably, religious change is a cognitive process, involving changes in the beliefs and behaviors of individuals that result in shifts in identification from one group (or groups) to some other group. In this paper, I will discuss several models of religious demographic shifts in historical and contemporary contexts. It concludes with a discussion of work in progress for predicting global-scale shifts in religious demography and how such efforts can be applied to archaeological data.

Bridging the Gap: Using Ethnographic and Historical information to Model Transitions in Archaeological Populations

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The mechanisms of demographic and societally changes are often difficult to examine using sparse or fragmentary archaeological material. In attempting to address this problem, we argue that a methodology which incorporates data gathering, analysis and modelling techniques make it possible to integrate data from ethnographic, historical and archaeological resources into a single analytical framework. Our approach allows us to overcome the inherent material culture limitations regarding data on key variables by using available historical or ethnographic data to make statistically testable inference regarding the archaeological data, which directly aid model calibration and validation.
In this paper, we have focus on the application of our integrated method in relation to two aspects of the Pre Pottery Neolithic of the Jordan Valley. Firstly, we employ agent based modelling to provide new insights into the demographic aspect of the Neolithic transition. In particular, we use the Population and Cemetery Simulator (PCS) to model and simulate the development and collapse of the population at Ain'Ghazal—one of the first high density sites in human history. Secondly, we outline how the method we advocate can be applied in the context of ritual archaeological material culture for the purpose examining the emergence and effective spread of ritual/religious forms during the agricultural transition.
Using our examples, we demonstrate how major gaps in the evidentiary record can be overcome using the techniques we outline. We assert that using a strategic combination of data collection, analysis and modelling, we can reach a more holistic approach to simulating archaeological populations by using the wealth of available ethnographic and historical resources.

Rituals and filters. Modelling past populations within social and religious networks

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Modelling past populations does not only require a good understanding of their demographics but also of ritual and social filter factors influencing the formation of archaeological sites. Cemeteries and settlements react in different ways to changing demographic parameters. Burial in the past is highly influenced by factors restricting access to the burial place for specific groups and individuals. Scientific and social parameters must be considered when models of archaeological populations are constructed. In this paper, I will discuss several filter factors affecting burial rituals and show examples from the Neolithic to the Medieval period.