

**TRAC 2017**

**The 27th Theoretical Roman Archaeology Conference**

**Durham University, Durham, UK Tuesday 28 to Friday 31 March**

**SESSION TITLE:** PRODUCTION AND DISTRIBUTION OF FOOD DURING THE ROMAN EMPIRE.  
POLITICAL, ECONOMIC & SOCIAL DYNAMICS

**Date**

Wednesday 29th March, 2017

**Schedule:**

08:15 REGISTRATION & INFORMATION DESK OPENS

09:00 CONFERENCE POSTERS & SESSIONS

1. [The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics](#) (AM/PM)

17:30 END OF SESSION

**Organizers:**

José Remesal Rodríguez (CEIPAC-UB) – [remesal@ub.edu](mailto:remesal@ub.edu)

Víctor Revilla Calvo (CEIPAC-UB) – [vrevillac@ub.edu](mailto:vrevillac@ub.edu)

Antoni Martín i Oliveras (CEIPAC-UB) – [amartinioliveras@cellavinareria.cat](mailto:amartinioliveras@cellavinareria.cat)

Daniel J. Martín-Arroyo Sánchez (CEIPAC-UB) – [martin-arroyo@ub.edu](mailto:martin-arroyo@ub.edu)

**Chairman / lead discussant:**

Robert E Witcher (Durham University) [r.e.witcher@durham.ac.uk](mailto:r.e.witcher@durham.ac.uk)

**SESSION PROGRAMME / TIMING**

**Paper presentation**

1. MONTE TESTACCIO: FROM RUBBISH DUMP TO A DATA WAREHOUSE. José Remesal Rodríguez (Universitat de Barcelona) [remesal@ub.edu](mailto:remesal@ub.edu) (20 min)
2. THE ROMAN AMPHORAE ASSEMBLAGE DATABASE AND THE STUDY OF AMPHORAE-BORNE COMMODITIES TO THE GERMAN FRONTIER, A PRELIMINARY REPORT. Tyler V Franconi (University of Oxford) [tyler.franconi@arch.ox.ac.uk](mailto:tyler.franconi@arch.ox.ac.uk) (20 min)
3. MOVING FOOD SUPPLIES TO THE ROMAN GARRISON OF THE *DOBROGEA* REGION (ROMANIA). Stephen Matthews (Royal Holloway University of London) [Steve.Matthews.2008@live.rhul.ac.uk](mailto:Steve.Matthews.2008@live.rhul.ac.uk) (20 min)
4. EXPORTS IN THE PROVINCES: HOW MUCH OF THE ROMAN WORLD MADE IT TO THE EDGES OF THE EMPIRE? Darren L Poltorak (State University of New York SUNY-Buffalo) [poltorak@buffalo.edu](mailto:poltorak@buffalo.edu) (20 min)

**COFFEE BREAK (30 min)**

5. THE ECONOMY OF THE ROMAN WINE. PRODUCTIVE LANDSCAPES, ARCHAEOLOGICAL DATA, QUANTIFICATION & MODELLIZATION. Case Study Research: "*Regio Laetana-Hispania Citerior Tarraconensis*" (1st century BC-3th century AD). Antoni Martín i Oliveras (Universitat de Barcelona) [amartinioliveras@cellavinaria.cat](mailto:amartinioliveras@cellavinaria.cat) & Víctor Revilla Calvo (Universitat de Barcelona) [vrevillac@ub.edu](mailto:vrevillac@ub.edu) (20 min)
6. GIS-BASED MODELLING FOR THE *RIPARIA/UINEA* RATIO IN THE *TERRITORIUM OF NABRISSA VENERIA* (LEBRIJA, SPAIN). Daniel J. Martín-Arroyo Sánchez (Universitat de Barcelona) [martin-arroyo@ub.edu](mailto:martin-arroyo@ub.edu) & M. M. Castro García (Universidad de Cádiz) [mariadelmar.castro@uca.es](mailto:mariadelmar.castro@uca.es) (20 min)
7. THE LOCATION OF MARCO COLUMELA'S VINEYARDS: BETWEEN AGRONOMIC LITERATURE AND GIS ANALYSIS IN THE GUADALQUIVIR-GUADALETE INTERFLUVE. Pedro Trapero Fernández (University of Cádiz) [pedro.traperofe@alum.uca.es](mailto:pedro.traperofe@alum.uca.es) & Lázaro Lagóstena Barrios (University of Cádiz) [lazaro.lagostena@uca.es](mailto:lazaro.lagostena@uca.es) (20 min)
8. *VILLAE* AND *FIGLINAE* ON *LACUS LIGUSTINUS* BANKS. GIS ANALYSIS AND GEOPHYSICS SURVEY IN THE RIVERSIDE OF *HASTA REGIA TERRITORIUM*. L. Lagóstena Barrios (Universidad de Cádiz) [lazaro.lagostena@uca.es](mailto:lazaro.lagostena@uca.es), José Antonio Ruiz Gil (Universidad de Cádiz) [jantonio.ruiz@uca.es](mailto:jantonio.ruiz@uca.es), Jenny Pérez Marrero (Universidad de Cádiz) [jennyperezm@gmail.com](mailto:jennyperezm@gmail.com), Domingo Martín Mochales (Universidad de Cádiz) [arqueogmu@gmail.com](mailto:arqueogmu@gmail.com), Pedro Trapero Fernández (Universidad de Cádiz) [pedro.traperofe@alum.uca.es](mailto:pedro.traperofe@alum.uca.es) & Javier Catalán González (Universidad de Cádiz) [javiercatalangonzalez@gmail.com](mailto:javiercatalangonzalez@gmail.com) (20 min)

**Discussion period (20 min)**

**LUNCH TIME (90 min)**

9. FOOD AND POWER IN THE POST- ROMAN NORTH: THE ROLE OF FOOD SUPPLY IN THE SHAPING OF POWER IN POST-ROMAN BRITANNIA. Paul Gorton (University of Leeds) [P.M.Muir@leeds.ac.uk](mailto:P.M.Muir@leeds.ac.uk) (20 min)
10. *DE AGRI CULTURA* EXPERIENTIA: FROM MODERN AGRONOMY TO ROMAN ECONOMIC ANALYSIS. Helen Goodchild (University of York) [helen.goodchild@york.ac.uk](mailto:helen.goodchild@york.ac.uk) (20 min)
11. FINDING THE LIMITS OF THE *LIMES*: SIMULATING THE LIMITS AND POSSIBILITIES OF THE AGRICULTURAL ECONOMY IN THE ROMAN DUTCH *LIMES* ZONE VIA AGENT-BASED MODELLING. Jamie Joyce (Vrije Universiteit Amsterdam) [j.a.joyce@vu.nl](mailto:j.a.joyce@vu.nl) & Philip Verhagen (Vrije Universiteit Amsterdam) [j.w.h.p.verhagen@vu.nl](mailto:j.w.h.p.verhagen@vu.nl) (20 min)
12. THE ANCIENT RURAL SETTLEMENT STRUCTURE AROUND *POMPEII* – INFERRED FROM SPATIAL STATISTICS AND PREDICTIVE MODELLING ON *VILLAE RUSTICAE*. Sebastian Vogel (University of Potsdam) [seb\\_vogel@gmx.de](mailto:seb_vogel@gmx.de), Domenico Esposito (Freie Universitaet Berlin) [archeomimmo@hotmail.com](mailto:archeomimmo@hotmail.com), Michael Märker (Pavia University) [michael.maerker@unipv.it](mailto:michael.maerker@unipv.it) Florian Seiler (German Archaeological Institute Berlin) [florian.seiler@dainst.de](mailto:florian.seiler@dainst.de) (20 min)

**COFFEE BREAK (30 min)**

13. MODELLING ROMAN WINE CONSUMPTION, DEMOGRAPHY AND URBANISATION IN CENTRAL ADRIATIC (ITALY). Dimitri Van Limbergen (Ghent University) [Dimitri.VanLimbergen@UGent.be](mailto:Dimitri.VanLimbergen@UGent.be) & Frank Vermeulen (Ghent University) [Frank.Vermeulen@UGent.be](mailto:Frank.Vermeulen@UGent.be) (20 min)
14. INTRODUCING MERCURY: AN AGENT-BASED NETWORK MODEL OF CERAMIC DISTRIBUTION FOR STUDYING ROMAN ECONOMIC INTEGRATION. Tom Brughmans (University of Oxford) [tombrughmans1@gmail.com](mailto:tombrughmans1@gmail.com) & Jeroen Poblome (University of Leuven) [jeroen.poblome@kuleuven.be](mailto:jeroen.poblome@kuleuven.be) (20 min)
15. UNDERSTANDING AMPHORAE PRODUCTION WITH AGENT BASED MODELLING: THE CASE STUDY OF BAETICA PROVINCE. Maria Coto-Sarmiento (Barcelona Supercomputing Center) [maria.coto@bsc.es](mailto:maria.coto@bsc.es), Simon Carrignon (Barcelona Supercomputing Center) [simon.carrignon@bsc.es](mailto:simon.carrignon@bsc.es), Xavier Rubio-Campillo (University of Edinburgh) [xavier.rubio@ed.ac.uk](mailto:xavier.rubio@ed.ac.uk) & José Remesal (Universitat de Barcelona) [remesal@ub.edu](mailto:remesal@ub.edu) (20 min)
16. IDENTIFYING PATTERNS OF DISTRIBUTION IN THE TRADE OF OLIVE OIL. Xavier Rubio-Campillo (University of Edinburgh) [xavier.rubio@ed.ac.uk](mailto:xavier.rubio@ed.ac.uk) (20 min)

**Discussion period (20 min)**

**Posters**

1. THE *PORTICUS* BEAR ALL THE GRAIN: AN UPDATE OF THE AREA OF THE PORTICUS MINUCIAE (ROME) BETWEEN ARCHAEOLOGY AND SOCIAL HISTORY. Andrea Guaglianone (Università di Venezia "Ca' Foscari") [andrea.guaglianone@hotmail.it](mailto:andrea.guaglianone@hotmail.it)
2. MEAT MARKET: ORGANIC RESIDUE ANALYSIS OF FOOD CONSUMPTION AT *CORINIUM*. Caitlin Greenwood (University of Bristol) [cg0841@bristol.ac.uk](mailto:cg0841@bristol.ac.uk)
3. OIL AND WINE PRODUCTION AND DISTRIBUTION IN NORTH ITALY AND THE ADRIATIC WESTERN COAST (1st CENTURY BC – 2nd CENTURY AD). Silvia Cipriano (Museo della Centuriazione Romana–Borgoricco-Padova) [silviacip@libero.it](mailto:silviacip@libero.it), Stefania Mazzocchin (Università di Padova) [#stefania.mazzocchin@unipd.it#](mailto:stefania.mazzocchin@unipd.it)

**Abstracts**

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**PAPER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** MONTE TESTACCIO: FROM RUBBISH DUMP TO A DATA WAREHOUSE

**Author:** José Remesal Rodríguez (Universitat de Barcelona) [remesal@ub.edu](mailto:remesal@ub.edu)

**Abstract:**

Monte Testaccio, located in the historic area of Ancient Rome, is a hill almost a kilometer in diameter and almost 50 meters high, composed exclusively of the remains of millions of amphorae which, containing olive oil, reached Rome between the time of Augustus and the middle of the 3<sup>rd</sup> century AD. Of these, almost 85% come from the Roman province of *Baetica* (Andalusia, Spain). The rest arrived for the most part from Bizacena and Libya, and only a small percentage from the eastern regions of the Empire.

In the Testaccio, there have been preserved not only the seals which carried these amphorae, but also their painted inscriptions (*tituli picti*), which contain a complex information, which in the case of the Baetican amphorae I consists of: tare of the amphora, net weight of the oil contained, the name of the person or persons who were in charge of its commercialization or transport and a fiscal control in which it is indicated the fiscal district from which they come, the confirmation of the net weight, the names of the persons who intervened in the control and the consular dating.

The Testaccio allows us to have serial data with precise dates. It is therefore a *unicum* in the studies of economics of the Roman Empire, where the fundamental problem is, precisely, the lack of data.

While seals in Baetican olive oil amphorae appear abundantly throughout the western part of the Roman Empire, the inscriptions painted on the amphorae have disappeared, so that the information we obtain in Testaccio is valid to date many strata in excavations throughout Europe and, at the same time, this mass of data allows to raise multiple questions related to the commerce and the political evolution of the administration of Rome.

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**TITLE:** THE ROMAN AMPHORAE ASSEMBLAGE DATABASE AND THE STUDY OF AMPHORAE-BORNE COMMODITIES TO THE GERMAN FRONTIER, A PRELIMINARY REPORT.

**Author:** Tyler V Franconi (University of Oxford) [tyler.franconi@arch.ox.ac.uk](mailto:tyler.franconi@arch.ox.ac.uk)

**Abstract:**

The Roman Amphorae Assemblage Database (RAAD) project is a new initiative of the Oxford Roman Economy Project, aiming to quantify the production, distribution, and consumption of food in the Roman world through the construction of a geo-database recording the details of quantified amphorae assemblages across the Empire.

This paper will be the first presentation of the database infrastructure of the project, along with the initial data population from Roman Germany. The paper will highlight the main research questions of the project at both a theoretical and practical level.

The German frontier provides the opportunity to investigate the consumption patterns of both military and civilian population centres, and thus informs key questions of economy and foodways in provincial and frontier society. From a practical standpoint, this project also offers the opportunity for international standardisation of typology and recording practices of amphorae assemblages.

This standardisation allows for a higher degree of scholarly integration across the Empire and also increased ease of comparison between different sites and regions.

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**TITLE:** MOVING FOOD SUPPLIES TO THE ROMAN GARRISON OF THE *DOBROGEA* REGION (ROMANIA)

**Author:** Stephen Matthews (Royal Holloway University of London)  
[Steve.Matthews.2008@live.rhul.ac.uk](mailto:Steve.Matthews.2008@live.rhul.ac.uk)

**Abstract:**

The Roman *Dobrogea* presents a compact study region to model food distribution, with quantifiable needs in the persons of the Roman garrison. Comparing the location of sites reported on the Romanian national database of sites – cIMeC – against the well-researched road network allows for a consideration of the travelling distance of agricultural produce within the region.

This has been carried out using the Service Area function of ArcGIS to rapidly show the proximity of producers to consumers and offer the most effective means of supplying particular forts. The program will show several days' theoretical travel about any particular site at different speeds as irregular polygons. Then the impact of providing animal feed to the traction animals can be assessed.

This requires some extensive repetitive calculations that have been carried out within Excel to form simple algorithms. In so doing one can assess the efficiency of certain vehicular combinations and the relative merits of using fewer mule-drawn vehicles that would have required a greater quantity of feed, over slower oxen-drawn vehicles, that would have required less arable to be turned to feed.

Having failed to identify sufficient arable to feed the full garrison, it is also possible to consider the impact of moving an overseas component within the *Dobrogea* and again the relative merits of providing the animal feed locally, against providing it from overseas. The power of the algorithms allows one to adjust suggested yields, size of garrison, productivity of workers, and the number of workers to a site, one can also work in calculations for the likely number of dependents that each worker may have also supported.

The end result is a series of models where key variables are adjusted to offer suggestions as to the most likely scenarios in terms of yields, productivity and agricultural population.

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**TITLE:** EXPORTS IN THE PROVINCES: HOW MUCH OF THE ROMAN WORLD MADE IT TO THE EDGES OF THE EMPIRE?

**Author:** Darren L Poltorak (State University of New York SUNY-Buffalo) [poltorak@buffalo.edu](mailto:poltorak@buffalo.edu)

**Abstract:**

The Roman Empire had access to a great deal of foodstuffs from across their lands. While we know access within the capital would be easy, what of the provinces? What makes its way not only inwards, but around the Empire.

Using Fourier Transfer Infrared Spectroscopy to study ceramic residues, several Roman period sites from Dacia are examined to find what foods are making it out to the province, and who has access to them.

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**TITLE:** THE ECONOMY OF THE ROMAN WINE. PRODUCTIVE LANDSCAPES, ARCHAEOLOGICAL DATA, QUANTIFICATION & MODELLIZATION. Case Study Research: "*Regio Laeetana-Hispania Citerior Tarraconensis*" (1st century BC-3rd century AD)

**Authors:** Antoni Martín i Oliveras (Universitat de Barcelona) [amartinioliveras@cellavinaria.cat](mailto:amartinioliveras@cellavinaria.cat)  
Víctor Revilla Calvo (Universitat de Barcelona) [vrevillac@ub.edu](mailto:vrevillac@ub.edu)

**Abstract:**

The study of the Roman viticulture economy has multiple fields of knowledge and expertise with enormous possibilities for research.

Most studies have in common to use the archaeological information and the written sources as a complementary support to confirm the absolute chronology of a settlement, a socio-economic phenomenon or an exact location of a wine production centre or a pottery activity in a specific territory.

Regional variability is a key point for understanding the changing patterns of rural settlement and its evolution as the specific interaction between intra-regional and extra-regional economic networks.

These studies can be conducted by geospatial and geoeconomic analyses in different territorial scopes: macro-spatial (*regio*) meso-spatial (*territorium*) and microspatial (*torcularium atque figlina*).

The level of dependence of the rural population in the regional market, respect for local urban centers and their subsequent screening in foreign markets (in our case study research: Western Europe, Italian Peninsula and Rome itself), responding to a series of socioeconomic patterns and behaviors that may be modeled and studied by different economic and econometrical ways.

The extensive use of mathematical models, statistical and linear programming to analyze, interpret and make predictions/regressions and reconstructions on the evolution of those complex systems, regarding, inter alia, different variables as the potential production of a region or territory, the regional consumption, the surplus production that could be traded in foreign markets, and other variables such as the sale prices, the market reactions, the production and transport costs, and the trends of consumption, is an increasingly widespread reality.

This paper present a PhD Research Project that try to analyse in four scenarios, the answers to this questions and the evolution of this complex economic system, related with the production processes, the long-distance trade and the consumption of Laeetanian wine in the Roman period, between the 1st century BC and the 3th century AD.



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**TITLE:** GIS-BASED MODELLING FOR THE *RIPARIA/UINEA* RATIO IN THE *TERRITORIUM* OF *NABRISSA VENERIA* (LEBRIJA, SPAIN).

**Authors:** Daniel J. Martín-Arroyo Sánchez (Universitat de Barcelona) [martin-arroyo@ub.edu](mailto:martin-arroyo@ub.edu)  
María del Mar Castro García (Universidad de Cádiz) [mariadelmar.castro@uca.es](mailto:mariadelmar.castro@uca.es)

**Abstract:**

Economic and cultural differences between Punic *sine pedamentis* and Italic *cum pedamentis* viticulture are attested by Latin agronomists. In this paper, the exploration of such a duality is conducted in GIS by modelling the *riparia/uinea* ratio in the *territorium* of *Nabrissa*. This ratio is based on Columella's standard (IV, 30, 2) of the proportion between vineyards and riparian spaces required to provide raw material for a vine training system. A model has been developed to test the self-sufficiency of plots within the ideal application of this ratio, in order to provide surplus for land owners.

Silius Italicus (*Pun.*, III, 393) related the name of *Nabrissa* - on the coastline of the *lacus Ligustinus*, today the Doñana Marshlands - with the cult of Bacchus, god of wine. The iconography of coinage and the amphorae production point with distinct clarity to viticulture as an important factor in the development of the region. In fact, Baetican wine exportation is attested by the literary sources. Nonetheless, a further understanding of the role of viticulture in a specific study area requires the employment of GIS methodology. In this way, settlement patterns can be tested to ponder the value of some natural resources (superficial water, certain kind of soils...) and the viability of some agricultural strategies. In this case, outcomes from the analysis of the territory of *Nabrissa* will be confronted to those from the *confinia* between the nearby cities of *Gades* and *Hasta Regia*, as a result of previous attempts.

Modelling and historical parallels complete a series of sceneries where the researcher can define certain limits to his theoretical proposals. Agrarian strategies and social constructions, such as the *latifundium* or discontinued land property, could have been historically reshaped. Their consequences can be evidenced by the archaeological record as patterns of settlement. In this paper, the principal role of viticulture in the Roman economy is explored, drawing on a GIS-based model.

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**TITLE:** THE LOCATION OF MARCO COLUMELA'S VINEYARDS: BETWEEN AGRONOMIC LITERATURE AND GIS ANALYSIS IN THE GUADALQUIVIR-GUADALETE INTERFLUVE.

**Authors:** Pedro Trapero Fernández (University of Cádiz) [pedro.traperofe@alum.uca.es](mailto:pedro.traperofe@alum.uca.es)  
Lázaro Lagóstena Barrios (University of Cádiz) [lazaro.lagostena@uca.es](mailto:lazaro.lagostena@uca.es)

**Abstract:**

*Lucius Junius Moderatus Columella* praises in his book the *Res Rustica*, the work done by his paternal uncle *Marcus Columella*, who is *vir illustribus disciplinis eruditus ac diligentissimus agricola Baeticae provinciae*, especially interested in vineyard production.

As both uncle and nephew were citizens of *Gades*, we could locate these fields in the interfluvium between Guadalquivir and Guadalete River, a land dominated by three important cities, *Gades*, *Hasta Regia* and *Asido Caesarina*.

Columella wrote about special land conditions because of the good management effected by his uncle in his agricultural holding and other general considerations about *Baetica* province.

Comparing this data clues included in Columella's book with actual land characteristic, information of others ancient agriculture treatise and archaeological knowledge allow us the possibility to reconstruct rural areas and exploitation units, in order to discriminate part of the rural land ordination and propose where the Marco Columella's vineyards could be located.

Using GIS spatial analysis, we could also model the productive potential of vineyards in this region.

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**TITLE:** *VILLAE* AND *FIGLINAE* ON *LACUS LIGUSTINUS* BANKS. GIS ANALYSIS AND GEOPHYSICS SURVEY IN THE RIVERSIDE OF *HASTA REGIA TERRITORIUM*.

**Authors:** Lázaro Lagóstena Barrios (Universidad de Cádiz) [lazaro.lagostena@uca.es](mailto:lazaro.lagostena@uca.es)  
José Antonio Ruiz Gil (Universidad de Cádiz) [jantonio.ruiz@uca.es](mailto:jantonio.ruiz@uca.es)  
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Javier Catalán González (Universidad de Cádiz) [javiercatalangonzalez@gmail.com](mailto:javiercatalangonzalez@gmail.com)

**Abstract:**

The *territorium* of the *Hasta Regia* Roman colony is located between the watershed of the Guadalquivir basin and the bank of the old *Lacus Ligustinus* in *Baetica* province.

This territory is characterised by a fertile countryside and at the same time “riparian” conditions due to the marsh of Guadalquivir estuary, as described Strabo. The land had economic activities like intense farming and especially the production and exportation of wine derivatives into Haltern 70 amphorae.

The application of GIS analysis techniques combined with the geophysical survey with GPR 3D, allows us to know new keys for land management, only investigated until now by using traditional surface surveys.

The distribution of *villae* system is analysed in a possibly of a *centuriati* space, also we will identify and analyse the pottery workshops of *amphorae*, which productions will allow us to know the distribution of *Hastensis* products.

The exploration of various settlements with GPR Stream X, allow us to think on the methodological application of new techniques to a non-invasive study of the productive territory of the Roman city.

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**TITLE:** FOOD AND POWER IN THE POST- ROMAN NORTH: THE ROLE OF FOOD SUPPLY IN THE SHAPING OF POWER IN POST-ROMAN BRITANNIA.

**Author:** Paul Gorton (University of Leeds) [P.M.Muir@leeds.ac.uk](mailto:P.M.Muir@leeds.ac.uk)

**Abstract:**

The transfer of power in the period after the end of direct Roman control has long been a difficulty in the consideration of how late Roman became sub-Roman.

For the villa zone of the southern provinces of the former British diocese, James Gerrard has suggested that the fifth century saw a period of the consolidation of resources marked by the movement of the manufacturing process, namely grain driers, closer to the centre of estates.

This consolidation enabled Romano-British elites to consolidate their economic power in the agricultural sector and enhanced the importance of these sites enabling these to become centres of power from which these elites could exercise their authority.

This paper tests the application of such a model to the northern frontier system of the British provinces. Considering the evidence for changes to food provisioning at various sites across the frontier, including Binchester, Birdoswald, *Vindolanda* and the villa at Ingleby Barwick, the point is how far we can see the kind of consolidation at these sites that would have allowed them to continue to represent centres of power in the fifth century.

Further, it will also consider the differences in supply situations on the East and West of the frontier system and the potential for differences in the supply situation representing a continuing military command structure in the western half of the frontier.

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**TITLE:** *DE AGRI CULTURA* EXPERIENTIA: FROM MODERN AGRONOMY TO ROMAN ECONOMIC ANALYSIS

**Author:** Helen Goodchild (University of York) [helen.goodchild@york.ac.uk](mailto:helen.goodchild@york.ac.uk)

**Abstract:**

The modelling of modern agriculture is a complex discipline, and it is therefore not surprising that the multitude of techniques currently applied to current, very detailed datasets, have not been explored in more depth in terms of their applicability to the past.

Methods such as Ecological Niche Modelling, Agro-Ecological Zoning, Habitat Suitability Modelling, and more, reflect the diversity of approach taken by geographers to either measure or predict human productive output.

This paper will present some recent experiments in applying modern agronomic and climate modelling techniques, and discuss the potentials and limitations of using these methods to investigate economic strategies in relation to agricultural and pastoral practices in the past.

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**TITLE:** FINDING THE LIMITS OF THE *LIMES*: SIMULATING THE LIMITS AND POSSIBILITIES OF THE AGRICULTURAL ECONOMY IN THE ROMAN DUTCH *LIMES* ZONE VIA AGENT-BASED MODELLING

**Authors:** Jamie Joyce [j.a.joyce@vu.nl](mailto:j.a.joyce@vu.nl) (Vrije Universiteit Amsterdam)

Philip Verhagen [j.w.h.p.verhagen@vu.nl](mailto:j.w.h.p.verhagen@vu.nl) (Vrije Universiteit Amsterdam)

**Abstract:**

In this paper, we present the results of using computer simulation to investigate the agricultural economy of rural settlements in the Dutch limes zone between 15BC and AD 240.

The Roman occupation of the Lower Rhine delta resulted in the development of multiple military installations whose garrisons required food and fuel. Given that at least some part of the demands of the occupying forces were likely to have been met from the native farmers in the region, it is also likely that changes from the subsistence-based agricultural economy of the pre-Roman Iron Age would have occurred.

To investigate the limits and possibilities of the agricultural economy in the Roman Dutch limes zone, we have developed an agent-based model to analyse the principle determinants and limitations on subsistence and surplus agricultural production. The model simulates the major elements of the agricultural economy: arable farming, animal husbandry and fuel-wood acquisition. Departing from the assumption that the availability of land and labour placed limitations on agricultural production, we simulated different agricultural strategies to evaluate the interaction of environmental and socioeconomic factors in the rural economy of the study region and the relative limits on production. From this we have developed hypotheses regarding the organisation of local provisioning of the Roman army.

In this paper, we give therefore a condensed description of the model developed including key characteristics and assumptions. In addition, we present the results and key findings of using an ABM approach to model the ancient economy of the Dutch limes zone and how these results impact the current state of knowledge. Finally, an evaluation of our approach to the investigation of a complex economic system will be offered.

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**PAPER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** THE ANCIENT RURAL SETTLEMENT STRUCTURE AROUND *POMPEII* – INFERRED FROM SPATIAL STATISTICS AND PREDICTIVE MODELLING ON *VILLAE RUSTICAE*

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**Abstract:**

The build-up of a comprehensive GIS database of archaeological evidence of the pre-Roman and Roman period in the hinterland of *Pompeii* has, so far, yielded a dataset of more than 600 entities. About 150 of them were assigned to Roman farms (*villae rusticae*) which are believed to have played an important role in ancient rural life and economy of the Sarno River plain.

This involves agricultural production not only of food to supply the urban centers *Pompeii*, *Stabiae* and *Nuceria* but also of goods (e.g. wine) to be exported to Rome as well as to the western and eastern Mediterranean.

To gain a more detailed understanding of the ancient rural settlement structure of the Sarno River plain, this fragmentary dataset on *villae rusticae* was used to carry out a series of quantitative GIS-based spatial analyses.

At first spatial statistics aimed at recognizing spatial patterns, trends and relationships of the distribution of *villae rusticae* to validate the first simply visual impression of a clustered organization around the urban centers *Pompeii* and *Stabiae*. Subsequently, a predictive modelling approach aimed at determining the potential area that may have been occupied by *villae rusticae* and agricultural production.

This model incorporates paleo-environmental parameters and also tries to quantify some socio-economic parameters that may have controlled the spatial distribution of *villae rusticae*. For that, a recently generated, pre-AD 79 paleo-landscape model of the Sarno River plain was utilized characterizing the ancient topographical conditions before the eruption of *Vesuvius* in AD 79.

The aim of this paper is to illustrate theoretical considerations, the methodological realization and the archaeological discussion of the analysis of the ancient rural settlements and agriculture around *Pompeii*.

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**TITLE:** MODELLING ROMAN WINE CONSUMPTION, DEMOGRAPHY AND URBANISATION IN CENTRAL ADRIATIC (ITALY)

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**Abstract:**

Studies on the history of central Adriatic Italy's wine industry during the Late Republican and the Early/High Imperial period (ca. 150 BC - AD 150) have until now stressed the importance of external stimuli as driving forces behind changes in the domestic viticultural sector.

The focus was hereby on the many extra-Italian trade and consumption markets spawned by Rome's progressive conquest of the wider Adriatic and the (Eastern) Mediterranean in the 250-year period following the First Punic War (264-241 BC). However, there has been almost no attention for the possible role of regional or even local stimuli and constraints in changes in Italian Adriatic viticulture.

Therefore, this contribution would like to focus on how internal developments in demography, urbanisation and consumption over time may have influenced the extent to which the area was able to produce wine surpluses for the external market, and how such developments may have influenced viticultural practices in the countryside.

The case study is based on many years of active fieldwork by Ghent University in this central-Adriatic region, where settlement dynamics, environmental variables and economic production have been intensely screened. We will in particular try to model the production and distribution mechanisms of wine within the political, economic and social dynamics of this era of globalisation and rapid technological and organisational change.



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**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** INTRODUCING MERCURY: AN AGENT-BASED NETWORK MODEL OF CERAMIC DISTRIBUTION FOR STUDYING ROMAN ECONOMIC INTEGRATION

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**Abstract:**

There is a need in the study of the Roman economy for more formal computational modelling for representing and comparing the many existing conceptual models, and for testing their ability to explain patterns observed in archaeological data where possible.

This paper aims to share our experiences in exploring this approach through MERCURY (Market Economy and Roman Ceramics Redistribution, after the Roman patron god of commerce), an agent-based model (ABM) of ceramic tableware trade in the Roman East.

MERCURY presents a representation of two conflicting conceptual models of the degree of market integration in the Roman Empire, both of which serve as potential explanations for the empirically observed strong differences in the distribution patterns of tablewares.

This paper illustrates how concepts derived from network science can be used to abstract both conceptual models, to implement these in an ABM and to formally compare them.

The results of experiments with MERCURY suggest that limited degrees of market integration are unlikely to result in wide tableware distributions and strong differences between the tableware distributions.

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**PAPER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** UNDERSTANDING AMPHORAE PRODUCTION WITH AGENT BASED MODELLING: THE CASE STUDY OF *BAETICA* PROVINCE

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**Abstract:**

The goal of this study is to analyze the cultural dynamics among amphora workshops in the Roman Empire. Specifically, we focus on the evolution of the production of olive oil amphorae found in *Baetica* province (currently Andalusia) from 1st to 3rd century AD.

In particular, we analyze a set of measures among different kinds of amphorae shapes from different workshops to quantify the dynamic of changes. To achieve this goal, multivariate methods was used to classify each amphorae workshop. These methods allow us to know if there were differences on the pattern productions among workshops. Specifically we want to identify the origin of these changes and if these changes were produced by cultural reasons depending on the spatial distance and other cultural constraints. As hypothesis, we propose that spatial distribution of pottery workshops is the main influence of the making techniques processes.

Therefore we propose to create a simple Agent Based Model using concepts borrowed from Cultural Evolution Studies. This method allow to compare different processes of transmission (vertical Vs horizontal) and cultural accumulation in different context and content. We implement a mechanism to quantify which one of those processes explain better the distribution and pattern revealed in the data analysis.

This study aims to better understand the cultural processes acting among the workshop of *Baetica* during the Roman Empire and explain the nature of the patterns and differences observed in the archaeological evidence.

**Keywords:** amphorae production, Roman Empire, Cultural Evolution, Agent Based Modelling.

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**PAPER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** IDENTIFYING PATTERNS OF DISTRIBUTION IN THE TRADE OF OLIVE OIL

**Author:** Xavier Rubio-Campillo (University of Edinburgh) [xavier.rubio@ed.ac.uk](mailto:xavier.rubio@ed.ac.uk)

**Abstract:**

Large-scale trade relies on the existence of infrastructures able to organize and ship massive volumes of goods over thousands of kilometers. One of the most illustrative examples is the shipment of large quantities of olive oil amphorae from producing regions towards the places where these containers were found.

The archaeological record is able to tell us consumption and production places but evidence on the particular process is scarce and several questions remain open to debate: is there any link between did different producers ship to different places? Do nearby consumption places share the same trade networks? Were different routes such as riverine or sea transport managed in different ways?

This work will explore these challenges by applying a quantitative approach. Amphoric stamps are identified as the proxy of different producers and their spatial patterns are analyzed. Methods borrowed from biology are applied to identify what regions and settlement share the same stamps while spatial analysis is used to test the different hypotheses. The interpretation of these results suggests that certain patterns are significant despite the challenges posed by the fragmented archaeological evidence.

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**POSTER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** THE *PORTICUS* BEAR ALL THE GRAIN: AN UPDATE OF THE AREA OF THE *PORTICUS MINUCIAE* (ROME) BETWEEN ARCHAEOLOGY AND SOCIAL HISTORY.

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**Abstract:**

This poster will try to examine how the monthly distributions of free grain to the urban citizens of Rome worked.

Starting from the already well-known problem of the monthly distributions of free grain from the Republican to the Imperial era, it will try to reconstruct the original aspect of the buildings where they took place, generally known as *porticus Minuciae* (the *vetus* one and the *frumentaria* one), by means of a new comparative approach involving the archival data (from 1884 to 1941) and the nowadays archaeological evidences.

The examination of the excavation journals of its discoverers Guglielmo Gatti and Antonio Maria Colini (done on 1937-1941) allows for both the reconstruction of the appearance of the building at its discovery and for the dating of its phases.

A careful analysis of this archival material with the help of the successive documents of the adjacent excavations of Giuseppe Marchetti Longhi (non-edited notes, drawings, tracings and photos of the years 1928-1937) has permitted the reconstruction of the history of the excavation of the building and the identification of the Marchetti Longhi’s excavation pits and of the relative finds.

Moreover, a study of the present state of the monument (the temple of *via delle Botteghe Oscure* and the ruins under *via S. Nicola dei Cesarini*) and a new survey of the structures revealed a bulk of unpublished information, not yet accessible through the journals.

On these grounds, it is now possible to offer a scientific reconstruction of the building that impedes the general interpretation as one of the two *porticus Minuciae* known, and sheds new light on the topic, providing new directions for further research.

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**POSTER PRESENTATION**

**SESSION 1: The production and distribution of food in the Roman Empire: modelling political, economic and social dynamics**

**TITLE:** MEAT MARKET: ORGANIC RESIDUE ANALYSIS OF FOOD CONSUMPTION AT *CORINIUM*

**Author:** Caitlin Greenwood (University of Bristol) [cg0841@bristol.ac.uk](mailto:cg0841@bristol.ac.uk)

**Abstract:**

This research presented in this poster combines heritage collections with cutting-edge methodology (Correa-Ascencio and Evershed, 2014) to produce a large dataset of food residues from Roman Cirencester (*Corinium*), UK. Organic residue analysis (ORA) is the interdisciplinary study of preserved fats, oils and waxes in ceramics and other contexts in the archaeological record, allowing both qualitative and quantitative analyses. Besides the work of Cramp (2008, *et al* 2012) this has not been widely undertaken in Britain.

*Corinium* was the largest *civitas* in western Britain, later capital of *Britannia Prima*, and has been extensively excavated and researched, making it an ideal case study and pilot for my PhD project: a regional study of diet in Roman Gloucestershire.

The pilot investigated jars and *mortaria* spanning 1<sup>st</sup>-4<sup>th</sup> centuries, seeking evidence for consumption patterns and possible long-distance trade links. Preliminary results show very high concentrations of lipid in jars, relative both to *mortaria* and to jars from comparable sites (e.g. Cramp *et al* 2012).

The lipids were predominantly animal fats: isotope analysis (due for completion January 2017) will provide evidence for the origins of the animal fats (ruminant adipose (muscle); ruminant dairy; porcine; marine). Discussion will combine these results with zooarchaeological and human bone isotope data to discuss consumption trends at *Corinium*.

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**TITLE:** OIL AND WINE PRODUCTION AND DISTRIBUTION IN NORTH ITALY AND THE ADRIATIC WESTERN COAST (1st CENTURY BC – 2nd CENTURY AD).

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**Abstract:**

We are carrying out the research on the production and distribution areas of ancient containers starting from the Typology, Epigraphy and Archaeometry study of more than a thousand of complete amphorae re-used in *Venetia* reclamation's contexts.

The analysis focused on economic dynamics of oil and wine local North Italic and Adriatic amphorae production, in relation with the incoming of these foodstuffs from the Hystrian and Tyrrenic areas and from the Roman *Provinciae*.

Thanks to the study of reclamation closed contexts, it's possible to examine the evolution of the consumption, production and distribution between different areas in the chronological period from 1st century BC to 2nd century AD.