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To tree, or not to tree? On the Empirical Basis for Having Past Landscapes to Experience.

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Abstract

This article provides an overview of some of the complex issues involved in reconstructing and visualizing past landscapes. It discusses the importance of empirical data and introduces some of the terminology necessary for understanding methods which are often considered more in the domain of the natural sciences than humanities. Current methods and practices are put in the context of environmental archaeology, archaeological theory and heritage management as well as related, briefly, to the broader context of archaeological theory, practice and research data infrastructure. Finally, some examples and pointers for the future are given in the hope that the article may provide a point of reference for those looking to gain an entry point into the study of past landscapes, and understand their relevance in archaeological visualisation.

Aims

Our intention with this point of view paper is to help refocus an increasingly abstract and theoretically orientated Digital Humanities (DH). We will present a critical perspective on some of the problems and potentials relating to the visualisation of past (primarily non-urban) landscapes, with particular emphasis on the use of empirical evidence, from a combined environmental and archaeological point of view. We will outline some of the major challenges associated with reconstructing past landscapes from data, and give some examples of recent attempts to create platforms for addressing some of these issues. We will also briefly discuss the importance of landscape visualisation in the context of heritage management. 1

Introduction and some terminology

Visualization can mean many things to many people. Here we choose to limit ourselves to the Oxford English Dictionary [OED 2016] definition of “[t]he action or fact of visualizing; the power or process of forming a mental picture or vision of something not actually present to the sight; a picture thus formed”. For archaeologists, the only things “present to the sight” are the remains or results of past human activities and natural processes; any modern day landscape is the product of its history and geology. It could be said that what archaeologists are most often trying to understand - (loosely speaking) the nature of past human activities and their contexts - are *never* “actually present to the sight”, and thus that visualization is an intrinsic part of archaeology. In this paper, we focus primarily on the visualization of prehistoric, non-urban landscapes, rather than archaeological sites or structures, and the prerequisites for being able to do this. We use the term “environmental reconstruction” almost synonymously with visualization, the former being the more common expression for any form of quantitative or qualitative expression of an understanding of a past landscape, or wider archaeological site context. Whilst there is an increasing interest in the incorporation of multi-sensorial experiences in archaeological reconstructions (especially sound, see e.g. [Díaz-Andreu and Mattioli 2015]), we will limit the discussion to the more established visual attributes which are more easily quantifiable through palaeoenvironmental data. Although yet to be verified scientifically, it is the opinion of the authors that the word “reconstruction” has become a somewhat loaded word in DH discussions, and we would like to emphasise that we in no way advocate the recreation of static, 2 absolute and fully accurate reproductions of the past. Our use of the term implies a more diachronic (2D or 3D) simulation of archaeological and environmental interpretations based on the interrelationships between the different (and often few) materials studied by archaeologists and palaeoecologists. Absolute certainty is against the nature of the scientific method, and any form of reconstruction is always accompanied by an implicit set of error margins and notions of transience (see, however, [Oldfield and Steffen 2014] for a discussion of problems with this approach in relation to Earth Systems science and climate change). In this respect, our "environmental reconstructions" are close to those commonly employed in Quaternary Science (see [Lowe and Walker 2015]).

We use the term archaeology also in its broadest meaning - as a holistic science incorporating all of its various sub-disciplines, but also any methods incorporated to enable it to answer complex questions on the nature of the past. We therefore refer to *archaeologists* as practitioners of this holistic science, and ignore the tendency of real world archaeologists to label themselves within often highly specific sub-fields (although we will name some of these affiliations for the purpose of illustration; for an overview of archaeology as a discipline, see [Trigger 2006]). Similarly, we somewhat provocatively lump palaeoecologists (Quaternary scientists) involved in environmental reconstruction into this super-discipline, as they essentially undertake the same work as environmental archaeologists, but tend to be less reluctant to investigate times and places which lack any evidence of human activity. Palaeoecologists are those who collect data on past landscapes, using methods which study a variety of sources, from the properties of the sediments themselves to fossil pollen and insects. These sources, which some find analogous to artefacts and other archaeological materials (i.e. ecofacts; #bindford1964), are commonly referred to as *proxy data sources*, due to their use as proxies for past environmental change. 3

Theory, history and practice

There have been numerous attempts to inject a post-structural approach to visualizing past landscapes into archaeology. In the early 1990s, a number of archaeologists began emphasizing the importance of subjective experience in the process of understanding the existence of prehistoric peoples in their landscape contexts (e.g. [Tilley 1994]; see #fleming2016 for a critique). These authors were perhaps influenced by the perceptual geographers of the previous decades (e.g. [Tuan 1977], [Tuan 1979]; [Pocock 1989]) as much as their contemporaries in archaeology and anthropology (e.g. [Ingold 1993]) and geography (e.g. [Simmons 1993]), and characterized a rising tide of post-modern landscape archaeology riding in the sea of post-processual archaeology (see [Trigger 2006]). Although perhaps not intentionally, such work spurred on a habitual partitioning of academic practitioners of archaeology into the schools of *the theorist* and *the scientist*; the latter denoting specialists in the objective, empirically orientated archaeological sciences[1] and the former tending away from this into the use of more conjectural arguments to describe the past (see [Yoffee and Sherratt 1993] for a collection of contemporary narratives and [Johnson 2006] for further discussion). Despite this dichotomy, a large number of archaeologists, including a large and fundamentally pragmatic body residing outside of academia[2], have maintained the archaeological tradition of acquiring and using whichever theories and methods were most appropriate or accessible for solving the questions at hand (but see [Bradley 2006] for some thoughts on potential problems and possibilities resulting from the separation of academic and commercial archaeology). As a result, there are now increasingly large amounts of empirical data available, in a vast array of archives, from which past environments can be modelled (see e.g. [Kintigh et al. 2015]). 4

A number of environmental archaeologists were engaged in, or later reflected over, these discussions (e.g. [Evans 2003]), but many more continued to work in the tradition of the natural sciences, follow in hypo-deductive or inductive methodologies. Having theoretical frameworks for the interpretation of evidence from the past is, of course, extremely important, and concepts such as modern analogues, taphonomy, representivity and statistical significance are just examples of the multiple aspects of these. When it comes to populating landscapes with human actions, cultures and societies there are naturally other requirements, including social theory, agency, supply and demand and many other concepts, but these are outside the scope of this paper. 5

Archaeology has, in the words of Matthew Johnson, moved beyond the site [Johnson 2005, 156]; the site being the accepted term for the geographical location of evidence for past human activity, or archaeological remains (see [Reitz and Shackley 2012] for an environmental archaeology orientated discussion). After early forays beyond the trench that 6 would perhaps better be described as “sites-based” rather than landscape-based (e.g. [Beck 1995]), recent developments within archaeology and heritage studies have begun to consider the environment not simply as a Cartesian container of archaeological features but as a human artefact in itself [Fairclough 2002]. This is a conceptualization that converges with the generally more spatially orientated, yet less anthropocentric, approach to landscapes expressed in Quaternary science. The Anthropocene concept of the geological age of humanity is perhaps a culmination of these perspectives on the importance of humans as active parts of a landscape (see both [Foley et al. 2013] and [Braje et al. 2014] for Anthropocene discussions from both sides of the convergence).

The idea of representing the material record as a collection of points has been under sustained criticism in the past two decades (see, for instance, [Hicks et al. 2007] for an overview of these critiques). The notion that cultural activity only took place where traces of cultural activity are present misses the point that being in the landscape is an all-encompassing engagement with the environment, and that traces of this engagement extend beyond recognizably anthropogenic features. The points, in a sense, can be thought of as spatially scattered fragments lacking a conjoining context. Depending on the nature of the evidence preserved at these points, environmental archaeology may provide the potential to reveal certain aspects of this landscape context through proxy data sources. The landscape itself also tells a different story to that found in historical archives [Clark et al. 2003]. Clark, Darlington and Fairclough (*ibid.*) have argued that landscape is a medium of understanding the past, a “pathway into our memories” [Clark et al. 2003, 1]. It is also seen as a medium to manage issues “where people and land come together” [Makarow et al. 2010, 2], and to combine the efforts of academic disciplines and governmental bodies traditionally scattered across several research domains. 7

Heritage management and landscapes

Approaches to landscape in archaeological and heritage governance have broadened significantly in the past decades, particularly in Europe and with regard to the conceptualization of landscape. The broadening of scope began in the late 1980s and continued to develop throughout the 1990s, led by the initiative of English Heritage (now known as Historic England). The agency acknowledged the theoretical issues in protecting only sites on a list such as the Historic Environment Record (HER) and began to argue for approaches moving beyond the site itself. Initially, the focus was still on monuments (now in their landscape context), but then moved to the historic and archaeological dimension of the entire landscape, whether site-based or not [Fairclough 2002]. 8

A similar development can be seen in the process leading to the European Landscape Convention (ELC). Initially, the aim was to define and list Heritage Landscape Sites [Darvill 1993]; essentially a register of the “best” components of the landscape, based on various criteria mostly concerned with aesthetics and closeness to a supposed “natural origin” with little signs of obvious change, while undervaluing other types of landscape and ignoring entirely certain types, such as industrial landscapes [Fairclough 2002, 26]. Successive iterations of Council of Europe recommendations moved away from this representative bias toward recognizing the heritage value of the environment in its entirety, through the interim step of “cultural landscape areas” [Council of Europe 1995] and reaching its most comprehensive form in the European Landscape Convention charter [Council of Europe 2000]. 9

The charter states that landscape is “an area, as defined by people, whose character is the result of the action and interaction of natural and/or human factors” [Council of Europe 2000, article 1]. There is much to unpack in this pithy definition. The term *area* denotes a move away from thinking of cultural resources in terms of point-based registers, the traditional method of defining heritage in spatial terms [Fairclough and Turner 2007] and toward what may be called an area-based landscape conceptualisation. In order to do this we require: (1) reliable and extensive multi-proxy palaeoenvironmental data (i.e. several lines of evidence, see [Reitz and Shackley 2012] for an explanation of these concepts), (2) reliable theories, methods and tools for processing, interrogating, analysing and helping to interpret these data, and (3) suitable tools and practices for presenting the visual representation of the plurality of results which may result from 2. Although 3 is often the focus of technology driven visualization projects (see [Nygren et al. 2014] for some Swedish examples), the results risk, without sufficient weight in 1 and 2, becoming simply narratives with little scientific value as opposed to narratives backed by scientific data. 10

The second clause acknowledges that landscape has been argued to be a way of seeing (cf. [Cosgrove and Daniels 1988]); a matter of perception and hence not amenable to strict and “objective” criteria based on expert analysis. Inherent in the definition is the notion that landscape cannot be adequately described without accounting for those who experience it, and the many cases of conflict and dispute over value and meaning of places with heritage designations exhibit the degree to which perceptions of landscape can differ (see, for example [Logan and Reeves 2009]). 11

Although it would be misleading to see the ELC as panacea for all issues relating to managing the historic environment, the framework has the potential to capture some of the ambiguities and entanglements of landscape. As Bender notes, “landscapes refuse to be disciplined. They make a mockery of the oppositions that we create between time (History) and space (Geography), or between nature (Science) and culture (Social Anthropology)” (Bender; quoted in [Massey 2006, 34]). Attempts at reconstructing landscape must consider this to a degree, and in particular consider ways to address multiple perceptions and valuations of landscape, as well as providing affordances for multiple – and contesting - interpretations of landscape. Finally, inherent in this way of seeing landscape is the key element of uncertainty arising from perceptions from multiple perspectives, incomplete data sources and the degree of uncertainty ever-present in the interpretations of complex systems such as palaeolandscapes. 12

Aspects of the ELC are clearly influenced by anthropocentric concepts of landscape, but there has been debate for some years on the nature of the natural, i.e. pre-human, landscapes, and their use as baselines for conservation and “re-wilding”. Accepted concepts of woodland stability, based on evidence from the fossil pollen record, have been challenged both theoretically (e.g. [Vera 2000]) and empirically as more lines of evidence have been investigated (e.g. [Hodder et al. 2009]; [Whitehouse and Smith 2010]). More often than not, the combination of different proxies in multi-proxy analyses leads to a less clear picture, serving to illustrate both the different strengths and weaknesses in the data sources the true complexity of landscapes (e.g. [Buckland et al. 2005]). 13

Collecting data on past landscapes: Can’t see the wood for the trees or can’t see the trees for the wood?

In order to visualize a landscape at any point in the past, we require empirical data on the nature of the environment at that point in time. In general, archaeology has only access to snapshots of time, as made available through sampling or excavation. These samples may contain traces of the past in the form of organic remains (fossils), chemical or physical properties which in some way reflect the nature of the environment in which they were deposited: proxy data sources. For example, pollen from a tree may be blown into a lake and, as time passes, subsequently be covered by more sediment (Figure 1). If sampled, the presence of this tree’s pollen will allow us to deduce the presence of the particular tree species in the past environment of the lake. By analysing and dating multiple sediment layers, the palynologist (pollen analyst) can start to build a picture of changes in the prominence of different species of plant in the landscape around the lake over time. The proportion of pollen from different plants is, however, dependent on a large number of factors (e.g. number and density of plants, plant age and health, hydrology, human activity) and it is a far from simple task to create a visualisation of the “most probable landscape” from these data. By using multiple proxies, such as fossil insects and soil properties, we can enhance the complexity of the picture beyond just the vegetation, but we can never escape from a plurality of possible reconstructions. 14

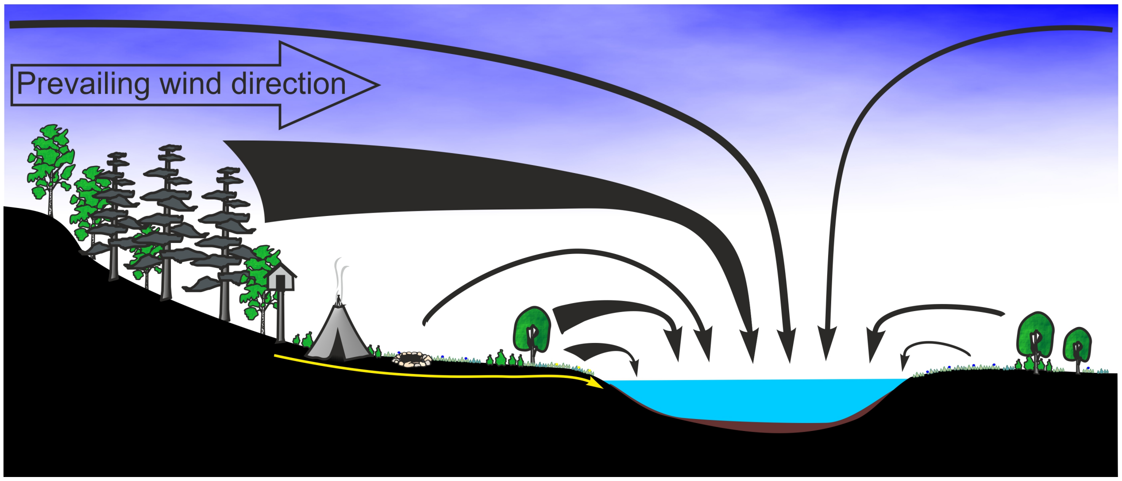

Figure 1. The deposition of proxy environmental evidence (e.g. pollen, plant macrofossils, insect remains) in a lake. To illustrate the variability of representation, the size of the arrow indicates the relative amount of pollen entering the lake from different vegetation types and distances. A prehistoric settlement, here represented by a tent, elevated storage hut and hearth, will most likely only be detectable by the presence of small amounts of charcoal from burning. The actions of the settlement's inhabitants, however, may be indirectly represented through any impacts they had on the surrounding landscape. Changes in the composition of the vegetation over time will be represented by changes in the fossils deposited in the lake as sediments accumulate. Reading this archive allows us to reconstruct environmental changes over time, although transcribing this point source to spatial variation is a complex task (see text).

Palaeoenvironmental landscape reconstruction relies on the ability of the available evidence, and the methods available to analyse it, to represent a past landscape. It is largely a question of using many detailed, and often indirect, pieces of information to construct a whole. Variation in theory and methodology, as well as implicit variability catered for in a methodology, will allow for these pieces to be put together in practically innumerable combinations. Deciding which combinations produce the more probable reconstructions is not easy, and has led to disagreements between ecologists and palaeoecologists, and even between different groups of palaeoecologists on how the evidence represents different aspects of the landscape. This is particularly well illustrated by the continuing debate on the nature of mid-Holocene (roughly 6000 years ago) woodlands, regarded by many as representing the last woodlands truly unaffected by human activity. Until recently, the majority of palynologists agreed on these having been closed canopy woodland, and more or less continuous over much of Europe (see e.g. [Mitchell 2005]), an interpretation which has had much influence on "natural"/pre-industrial baseline orientated conservation strategies. The ecologist Franz Vera (2000) hypothesized an alternative landscape history, with a more dynamic cycle of open and closed forests driven by large grazing animals, and challenged the representivity of the pollen data. The evidence from palaeoentomology (fossil beetle analyses) is, however, inconclusive, and there is much debate on how the fossil remains of woodland insects should be interpreted [Alexander 2012]. Problems of representivity are common to the use of all proxy data sources, and methods have been developed for mathematically translating raw data counts into broader implications. In palynology (pollen analysis), there are algorithms for translating fossil pollen data, through the use of modern calibration data, into landscapes of probable vegetation (e.g. [Bunting and Middleton 2009]; [Sugita 2007]). These methods are complex, reflecting the difficulty of the task, and have the capacity to provide multiple outcomes with an indication of their relative probability of being close to the truth. However, "all models are wrong, some are useful" [Box and Draper 1987], and these *reconstructions* should be considered as tools with which to explore and understand the past rather than devices for providing definitive answers. Similarly, the BugsCEP software for fossil insect analysis [Buckland 2014] allows users to produce no less than 16 different reconstruction models from the same dataset (see Figure 2 for examples). These are exported by the software as bar graphs and raw data, and used in combination with a detailed understanding of the ecology of the species behind the reconstruction to construct a narrative, often supported by the use of photographs of equivalent modern environments. 15

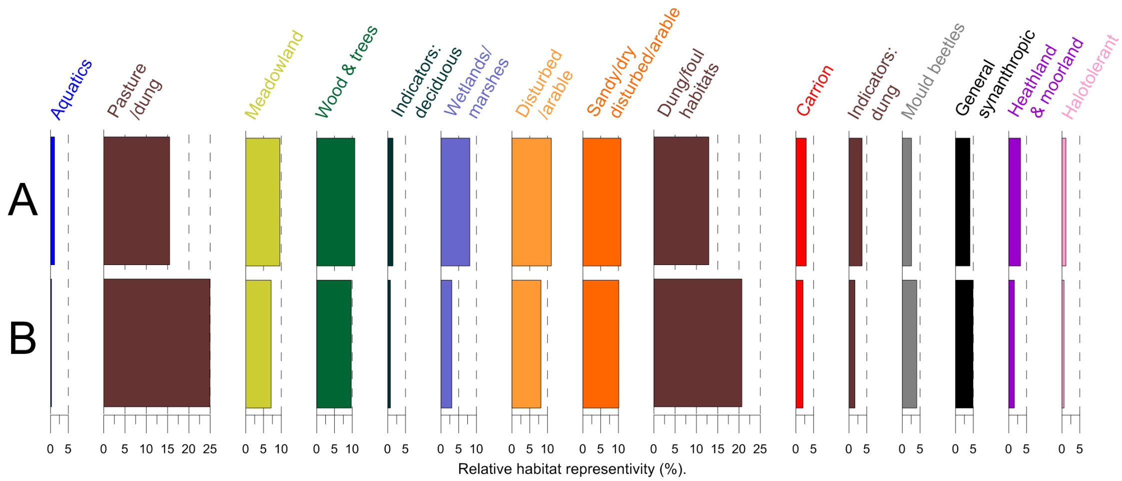

Figure 2. Two of the 16 potential environmental reconstruction figures, for one sample, produced by the BugsCEP fossil insect analysis software [Buckland and Buckland 2006]. The upper row of bars, A, uses only the presence of species (essentially the alpha diversity) to calculate the importance of different landscape elements in the sample's catchment. The lower row, B, includes the numbers of individuals of each species, and in this case suggests a higher prominence of grazing animals than A (see #buckland2018 for the context of this figure, where Roman well deposits were used to interpret the contemporaneous landscape of Sherwood Forest, UK, and compared with other sites). The choice of method is up to the discretion of the user, and will depend on the context of the samples, the quality of the data, and the purpose of the study. It would be possible to produce a more realistic and widely understandable landscape image from the results behind this figure, but this would most likely be at the risk of losing the important details in the statistics.

Where did all the soil go?

From a heritage management perspective, climate change, and especially erosion, is one of the most serious threats to cultural heritage today [Blankholm 2009]. Sites are simply disappearing as they are washed into the sea or eroded from river banks globally[3] (see [Adams 2015] for a broad summary of the implications of climate change for cultural heritage and [Hollesen et al. 2018] for a more up to date overview of the situation in the Arctic). Erosion, and the resultant deposition, are physical processes that have been active throughout the history of the Earth. They are, however, an often neglected component of landscape change over archaeological timescales, despite having significant implications for changes in the value of land and water over time. There is evidence that many areas of the world have experienced major episodes of sediment movement in prehistory, most likely associated with cultural activities such as deforestation, the introduction of slash and burn agriculture or the deep cutting plough. As a consequence, many potential upland archaeological sites have been lost and many lowland sites buried under metres of sediment. Similarly, the geomorphology of landscapes has changed as sediments have been eroded from higher areas and deposited in lowlands or water bodies. Using modern day Digital Elevation Models (DEM's) as the basis for landscape reconstructions can therefore be misleading. If one is to understand the archaeology in its contemporary landscape context, a more specific understanding of past sediment movements is essential. At the time of writing, no significant models incorporating sediment fluxes have been produced and integrated into archaeological landscape models. However, we now have the technology to facilitate this and are on the verge of creating the transdisciplinary sciences necessary to integrate the full range of skills required for implementation. Advances in the field of "deposit modelling", most often used in the context of heritage management and subsurface risk assessment, may also provide key insights (see [Carey et al. 2018] for an overview). 16

Visualisation platforms and landscape interpretation

The recent development and introduction of game engines and virtual reality platforms in the cultural heritage sector presently allows archaeologists to visualize accurate and multi-temporal interpretations of the past. The introduction and diffusion of instruments for 3D acquisition such as laser scanning or image-based 3D reconstruction techniques, together with the development of more powerful and user-friendly geo-database systems, makes it possible to integrate and display, at different scales, all the materials retrieved during an investigation together with the information obtained 17 by the specialists described above [Wilhelmson and Dell'Unto 2015]. These systems allow for a deeper understanding of the relationships and dynamics which characterized and determined the development of ancient landscapes and sites by potentially providing researchers and scholars with powerful simulation environments for testing different hypotheses and interpretations of the past. Open access, multi-proxy palaeoecology database systems, such as SEAD (http://www.sead.se; [Buckland 2013]) and Neotoma (http://www.neotomadb.org) [Williams et al. 2018]provide sources from which data could be pulled into landscape modelling software. Linking in this way would not only ensure a connection between visualizations and source data, but could also facilitate experimentation with multiple reconstructions whilst maintaining research transparency. In fact, Neotoma already includes open code and tools [Goring et al. 2015] that could be implemented in a GIS based model, and SEAD has an API (Application programming interface) framework for providing data to other systems, including Neotoma.

Since its introduction, 3D modelling has been perceived by many archaeologists as an instrument through which researchers would be forced to formulate complex interrogative questions, by providing the potential for multiple solutions to the problem of reconstruction [Renfrew 1997]. During its early years, three-dimensional visualization was considered as an opportunity for simulating and discussing the past by looking at data from completely new perspectives [Reilly 1991] [Forte 1997]. Despite these great expectations, the development of this new approach in the archaeological sector was strongly limited by factors such as low availability of computational resources, and lack of knowledge on how to apply these new instruments to more traditional field practices. Consequently, three-dimensional simulation environments were primarily adopted for communicating with the general public. Museums, more than other institutions, have initiated numerous experimental programs where different typologies of technologies have been tested and evaluated (see https://ec.europa.eu/digital-single-market/en/news/v-mustnet-how-museums-will-look-future). The Ename 974A project represents a pioneering example, having developed an on-site virtual reality installation called TimeScope in 1997. This system allowed visitors to obtain an idea of the past appearance of a Benedictine abbey and an early medieval fortress located in Ename, Belgium by superimposing multiple 3D interpretations of the archaeological structures on top of the building foundations visible on site [Pletinckx et al. 2000]. 18

The diffusion of a three-dimensional visual approach in support of archaeological practice and interpretation is still at an early stage. However, the exponential dissemination and availability of powerful computational resources, as well as new instruments for 3D recording and visualization, have allowed archaeologists to start experiencing the use of three dimensional data to a larger scale. Several research projects have started incorporating 3D modelling techniques, as part of their archaeological practice, in order to experience the third dimension for visualizing complexity rather than clarity [Callieri et al. 2011] [Forte et al. 2012] [Dellepiane et al. 2013] [Dell'Unto et al. 2015] [Berggren et al. 2015] [Opitz and Johnson 2016]. 19

Today virtual environments are used more and more as discussion spaces, where interaction (Human-Human, Human-Machine) and interpretation are supported by different datasets interlinked by a temporal and spatial structure. In the last decade the European Community, under the Seventh Framework Programme (FP7 2007/2013) and currently under Horizon 2020 (2013/2020), has supported several projects where 3D acquisition instruments, 3D models and 3D visualization platforms have been developed and/or employed for the communication and study of archaeological landscape and sites. Projects such as Arcland (http://www.arcland.eu/), 3DIcons (http://3dicons-project.eu/) and Ariadne (http://www.ariadne-infrastructure.eu/) are among the many examples where 3D visualizations have been discussed in relation to archaeological practice. 20

An early example of best practice which goes in this direction can be recognized in the The Giza project. Developed by Harvard University, this project focused on linking traditional archives, created in the last two centuries by different teams working on the Giza Plateau, with a realistic three dimensional visualisation of the site [Der Manuelian 2013]. The system functions as a large 3D repository where data produced as a result of different field investigation campaigns are published in relation to the three dimensional structures. Virtual characters were incorporated into the platform in order to study the use of the space in antiquity. Moreover, by using this visualization system, researchers were able to reconstruct the chronological deposition sequence of the equipment retrieved in the burials as well as recognize a number of previously unnamed tombs [Der Manuelian 2013]. 21

Another ground-breaking research project, where a game engine platform has been developed and used to analyse the ancient landscape, is MayaArch3D (http://mayaarch3d.unm.edu/). In the framework of this research activity, an online repository called QueryArch3D was developed. This platform allows for the simulation of the relationship between landscape and architecture by providing researchers with the capability of accessing georeferenced maps, three dimensional models, and virtual environments. This application makes it possible to visualize a multitude of bi-dimensional as well as three-dimensional data concerning the eighth-century Maya kingdom of Copan, Honduras. Through the system, users can link and visualize together three-dimensional data at different levels of detail [Agugiaro et al. 2011] [Agugiaro and Remondino 2014]. Moreover, it is also possible to use the platform to combine the analytical capabilities of Geographic Information Systems with a powerful 3D visualization in order to perform real-time analyses by assembling different types of dataset [Von Schwerin et al. 2013]. 22

Conclusions and room for improvement

The reconstruction of past landscapes is complex, both theoretically and practically, and the importance of reliable primary data and methods for interpreting these cannot be overemphasized. How these reconstructions are visualized has important implications for the perception of the past, not least with respect to landscape management policies and in interdisciplinary scientific discourse. The growth in the availability of palaeoenvironmental data, coupled with more readily available topographic data and GIS modelling techniques, is in the process of enabling a plethora of new approaches which may use and misuse these data and reconstructions. 23

The possibility of merging and visualizing the results of different studies of ancient landscapes exponentially increases the capacity of new platforms for producing more realistic and complex scenarios of the past. Through the use of 3D model libraries, these systems have the potential to allow the rapid visualization of complex ecosystems using the information provided by environmental archaeologists [Huyzendveld et al. 2012] *including* multiple variations originating from the same data. Although there have been significant developments in the visualization of different levels of certainty in urban or structural reconstructions (e.g. [Dell'Unto et al. 2015]), these have yet to have been successfully applied to broader landscapes. However, the creation of new analysis and visualization tools, as well as the capacity to import or link to more and more datasets, will hopefully encourage the scientific community to consider these instruments as a “sandbox” where all the information retrieved during a landscape investigation can be visualized and interrogated at multiple levels and in the same space. In this sandbox they will be able to discuss, collaboratively and from multiple perspectives, new interpretations and push the frontiers of integrated landscape archaeology forward. Nevertheless, the relevance of visualizing woodland, a tree, or not a tree, for any point and place in the past will always remain entirely dependent on the collection of empirical data through field and laboratory based analyses. 24

Notes

[1] Note that we in no way intend to suggest theory is not science!

[2] Archaeology is to a large degree professionalised, with consultancy or contract archaeology, as well as museums, representing the larger part of archaeological excavation and data acquisition internationally.

[3] The Scotland's Coastal Heritage at Risk project (http://scharp.co.uk/) provides numerous examples of how coastal erosion is destroying sites in Scotland, as well as providing a platform for community engagement in the monitoring of these sites.

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