Multidisciplinary studies in environmental archaeology with particular reference to China: An introduction to the Special Issue

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Multidisciplinary studies in environmental archaeology with particular reference to China: An introduction to the Special Issue

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Abstract

An important focus in research over the past decade is the relationship between climatic/environmental change and human cultural evolution during the Holocene. This decade saw an increasing number of natural scientists involved in this research, which led to debates and collaborations between natural scientists and archaeologists/anthropologists. This decade also witnessed an increase in multidisciplinary research across these subjects, which has improved significantly the understanding of the human–environment relationship. As part of this research drive, this Special Issue highlights the importance of multidisciplinary studies, mainly from China, on early rice agriculture, impacts of environmental change in Neolithic communities, and new approaches for environmental reconstruction.

Keywords

China, climate change, coast, early rice exploitation, environmental archaeology, Holocene, lake

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Introduction

The connection between environmental change and Neolithic cultural/agricultural development has been a prominent topic in recent scientific research, with attention drawn to two important areas. First, large-scale fluctuations in Holocene climate have been studied intensively, and correlations made between these changes and the collapse of ancient civilisations across the globe (e.g. Anderson A et al., 2007; Roberts et al., 2011; Weiss and Bradley, 2001; Wu and Liu, 2004). Second, the role of climatic warming in the development of agriculture and human communities during the early Holocene has been examined (e.g. Catto and Catto, 2004; Kuper and Kröpelin, 2006). Despite the fact that some of these studies were considered by archaeologists and anthropologists as deterministic (e.g. O'Sullivan, 2008), scientific research in these areas has advanced significantly in the past decade. This Special Issue collected contributions, partly from the ICG (International Conference of Geobiology) conference, held in June 2010 in Wuhan, China, with the aim of addressing an overarching scientific question: how changes in climate, hydrology, landscape and vegetation have affected food production (and collection) and the development of human society during the Holocene. This collection provides new insights into the linkage between environmental change and Neolithic agricultural development, with examples from both inland river valleys and coastal settings, and demonstrates the strength of some research methods for improving palaeoenvironmental reconstructions. More importantly this Special Issue raises some contentious questions and encourages wider collaboration between palaeoenvironmental scientists, archaeologists and anthropologists. This Special Issue is organised under three subthemes.

Theme 1: Importance of multidisciplinary studies in early rice exploitation

From archaeological perspectives, Crawford (2011, this issue) reviews the current understanding of domesticated rice evolution and the development of food production and agriculture in the case of the Lower Yangtze region, because new genetic, palaeoenvironmental, archaeological and archaeobotanical data have been generated from this region recently. He raises some questions in the study of early rice exploitation and indicates the need for considering the implications of the wide range of domesticated related traits in rice, examining the complexity of early food production systems, and combining both archaeological and palaeoenvironmental data in the study of early rice agriculture. Crawford indicates the importance of food availability alongside rice in early food production/collection, which echoes the contribution of Wang et al. (2010) who evaluated archaeological evidence of early rice farming in the lower Yangtze region and suggested a correlation between the start of agriculture and the richness of available gathering food in different places across East Asia. Crawford's article highlights the need for a broader

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conceptualisation of human–plant–animal interactions beyond traditional perspectives related to agriculture.

On the other hand, Zong et al. (2011a, this issue) provide an overview of the Holocene environmental history of the east coast of China and the lower Yangtze wetlands in particular, and identify three phases of coastal change that coincided with the three stages of Neolithic farming development. During the early Holocene, sea level rise and sedimentary processes have changed the coastal landscape from an open, brackish water environment to a sheltered, freshwater wetland system, a type of habitat suitable for rice agriculture. Such an opportunity was taken by early farmers in the area. Since the middle Holocene, the wetlands evolved slowly, and the Neolithic communities adapted to the changes, and the advantages of natural resources available to them, before the Bronze Age when human societies in the region were able to modify the wetland landscape by constructing dykes and sluices.

Funabiki et al. (2012, this issue) report evidence of landscape change in the Song Hong delta plain, northern Vietnam. The natural levees along the main distributaries were formed during a period of sea-level fall and rapid deltaic progradation. As the deltaic distributaries extended seawards, back-swamp wetlands emerged between distributaries and became habitats suitable for human settlement development.

These three articles highlight the fact that understanding environmental change and human adaptability can help answer key questions of early rice exploitation and agriculture. At present, the study of environmental archaeology involves multidisciplinary research on landscape, climate, hydrology, vegetation and their linkages to food collection and production (cereals, fruit, nuts, fish and meat), as well as archaeology, archaeobotany and their linkages to social and economic development (social organisation, landscape manipulation, tools making and economic models). These studies provide evidence of how human society has responded to environmental change, from cultural collapse, to societal reorganisation, migration or expansion (cf. Anderson DG et al., 2007).

Theme 2: Impacts of environmental change on Neolithic communities

Climate variability has resulted in changes of hydrology, landscape and vegetation. Based on sedimentary archives and Neolithic settlement records from the Dongting Lake area of the middle Yangtze basin, Liu et al. (2011, this issue) analyse the spatial and altitudinal patterns of Neolithic settlement movements as a response to phases of high and low water level of the lake. During climatic warm period, water level rose, and the Neolithic community retreated to high ground. When water level dropped in cooler periods, local people returned to the mudflats around the lake taking advantage of available food sources.

A study by Zong et al. (2011b, this issue) on the Neolithic settlement movement in Taihu Lake area reports a similar human–environmental history. In this area, sea level rose slowly for about 2 m from 7000 to 3000 cal. yr BP. This sea-level change raised the water level in the area around Taihu Lake, converting the inland area into a lacustrine environment. During the same period, however, marshes and tidal flats emerged in the seaward areas of Taihu Lake. Again, the Neolithic community in this area adapted to such landscape change and migrated seaward to tap into the new resources along the coast. These two studies demonstrate that the Neolithic societies had the ability to cope with long-term, albeit gradual, environmental change. With migration, they avoided being affected by environmental degradation, and gained new, emerging food resources.

In a separate study, Huang et al. (2011, this issue) report evidence of a large palaeo-flood from a tributary of the Yellow River and its impact on Neolithic settlements. This flood, along with other similar flood events reported from the middle basin of the Yellow River, was possibly caused by abrupt climate change. This study implies that the ability of the Neolithic communities to cope with short-term, abrupt environmental change was somewhat limited. However, after witnessing these large-scale hazards, they understood the need for collaboration. Subsequently, they reorganised themselves, developed flood prevention methods and expanded their agriculture during the Xia and Shang periods.

Theme 3: New approaches for environmental reconstruction

Palaeoenvironmental reconstruction plays an important role in advancement of the study of environmental archaeology. Particularly useful are the reconstructions of palaeo-climate, vegetation cover, hydrology and landscape change, which inform archaeologists about the ecological and habitat characteristics of a region or a locality in relation to the economic and social activities of any given Neolithic community, including food collection/production and settlement development. Here, Zhou and Li (2011, this issue) examine pollen data for forest changes in northern China and synthesises forest responses to climate change during the Holocene. They explore the forest responses in a spatial context, which has advanced from the traditional, single-location, reconstructions. This study has significantly improved our understanding of forest dynamics and responses to changes in monsoon climate.

Yu et al. (2011, this issue) apply the newly developed geochemical methods to the reconstruction of freshwater discharge from the Pearl River. Their high-resolution organic carbon isotope data indicate a gradual decline in freshwater discharge throughout the mid to late Holocene as a result of the weakening summer monsoon precipitation. The declining trend fluctuates a little, a possible response to millennial-scale solar activity. Similar methods are applied by Zhan et al. (2011, this issue) to the Yangtze, where the authors reconstruct Holocene environmental history. Their results indicate a significant change in the palaeoenvironment around 9000 yr ago caused by a phase of rapidly rising sea level. Subsequently, as the rise in sea level slowed down by 7000 yr BP, monsoon-driven freshwater discharge played a more prominent role in environmental change.

Kosmas et al. (2011, this issue) investigate the vertical displacement trends in the Aegean coastal zone for the Holocene using geo-archaeological data. In this study they evaluate methods for palaeogeographical reconstruction with consideration of global long-term glacio-hydrostatic processes and regional short-term tectonic movements. In turn, the spatial patterns of vertical displacement of the coastal zone, as their results show, can help archaeologists to explore possible connections between coastal change and human settlement migration from the Neolithic to present.

Conclusions

Despite the research advances made in environmental archaeology mentioned above and reported elsewhere, there are some issues remained to be explored. First, there is still a lack of detailed environmental data. Methods for palaeo-environmental reconstruction must be improved in order to quantify the magnitude and rate of environmental change, reveal spatio-temporal variations in landscape/hydrological conditions and their natural/human drivers, and establish the relative importance of environmental factors and human adaptability to environmental change. Thus, new technologies need to be developed, or adapted to environmental reconstruction to help answer outstanding scientific questions. Second, there is a need for environmental scientists to work closely with archaeologists and anthropologists. This is because some palaeoenvironmental data can be difficult to interpret. Several studies in this issue indicate the ability of human society to cope with long-term, gradual environmental change. In some cases, human society was not only able to adapt to environmental change, but also to manipulate landscape and hydrology to improve food collection and production. Therefore, a close collaboration between environmental scientists and archaeologists/anthropologists can help reach a balanced view of the environment–human relationship.

References

Anderson A, Gagan M and Shulmeister J (2007) Mid-Holocene cultural dynamics and climatic change in the western Pacific. In: Anderson DG, Maasch KA and Sandweiss DH (eds) *Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transition*. Elsevier, 265–296.

Anderson DG, Maasch KA, Sandweiss DH et al. (2007) Climate and cultural change: Exploring Holocene transitions. In: Anderson DG, Maasch KA and Sandweiss DH (eds) *Climate Change and Cultural Dynamics: A Global Perspective on Mid-Holocene Transition*. Elsevier, 1–23.

Catto N and Catto G (2004) Climate change, communities, and civilizations: Driving force, supporting player, or background noise? *Quaternary International* 123–125: 7–10.

Crawford G (2011) Early rice exploration in the lower Yangtze valley: What are we missing? *The Holocene* (this issue). doi: 10.1177/0959683611424177.

Funabiki A, Saito Y, Vu P et al. (2012) Holocene evolution of natural levees of Song Hong (Red River) delta, northern Vietnam. *The Holocene* (this issue). doi: 10.1177/0959683611430847.

Huang C, Pang J, Zha X et al. (2011) Sedimentary records of extraordinary floods at the ending of the mid-Holocene climatic optimum along the Upper Weihe River, China. *The Holocene* (this issue). doi: 10.1177/0959683611409781.

Kosmas P, Vasilios K, Katerina T et al. (2011) Vertical displacement trends in the Aegean coastal zone (NE Mediterranean) during the Holocene assessed by geo-archaeological data. *The Holocene* (this issue). doi: 10.1177/0959683611423683.

Kuper R and Kröpelin S (2006) Climate-controlled Holocene occupation in the Sahara: Motor of Africa's evolution. *Science* 313: 803–807.

Liu T, Chen Z, Sun Q et al. (2011) Migration of Neolithic settlements in the Dongting Lake area of the middle Yangtze River basin, China: Lake-level and monsoon climate responses. *The Holocene* (this issue). doi: 10.1177/0959683611405084.

O'Sullivan P (2008) The 'collapse' of civilizations: What palaeoenvironmental reconstruction cannot tell us, but anthropology can. *The Holocene* 18: 45–55.

Roberts N, Brayshaw D, Kuzucuoglu C et al. (2011) The mid-Holocene climatic transition in the Mediterranean: Causes and consequences. *The Holocene* 21: 3–13.

Wang W, Ding J, Shu J et al. (2010) Exploration of early rice farming in China. *Quaternary International* 227: 22–28.

Weiss H and Bradley RS (2001) What drives societal collapse? *Science* 291: 609–610.

Wu W and Liu T (2004) Possible role of the 'Holocene Event 3' on the collapse of Neolithic cultures around the central plain of China. *Quaternary International* 117: 153–166.

Yu F, Zong Y, Lloyd JM et al. (2011) Mid-Holocene variability of the East Asian monsoon based on bulk organic $\delta^{13}C$ and C/N records from the Pearl River estuary, southern China. *The Holocene* (this issue). doi: 10.1177/0959683611417740.

Zhan Q, Wang Z, Xie Y et al. (2011) Assessing C/N and $\delta^{13}C$ as indicators of Holocene sea level and freshwater discharge changes in the subaqueous Yangtze delta, China. *The Holocene* (this issue). doi: 10.1177/0959683611423685.

Zhou X and Li X (2011) Variation in spruce (*Picea* sp.) distribution in the Chinese Loess Plateau and surrounding areas during the Holocene. *The Holocene* (this issue). doi: 10.1177/0959683611400195.

Zong Y, Wang Z, Innes JB et al. (2011a) Holocene environmental change and Neolithic rice agriculture in the lower Yangtze region of China: A review. *The Holocene* (this issue). doi: 10.1177/0959683611409775.

Zong Y, Innes JB, Wang Z et al. (2011b) Environmental change and Neolithic settlement movement in the lower Yangtze wetlands of China. *The Holocene* (this issue). doi: 10.1177/0959683611414933.