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Forests of plenty: Ethnographic and archaeological rainforests as hotspots of human activity

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Tropical rainforests are some of the oldest and most diverse terrestrial ecosystems on Earth (Wilson, 1988; Whitmore, 1998). They offer human foragers and farmers an ample supply of fresh water from well-fed rivers and streams (Larsen, this volume) and a huge variety of the world's plant and animal species (Wilson, 1988). However, it has also been suggested that dense protein and carbohydrate resources are hard to come by (Hart and Hart, 1986; Bailey et al., 1989), high humidity and temperature make human thermoregulation difficult (Perry and Dominy, 2009; Perry and Verdu, this volume), and low-light and dense vegetation hinders navigation (Hutterer, 1983; Bailey and Headland, 1991). This has seen tropical rainforests contrastingly categorized as pristine, static green 'deserts' (Bailey and Headland, 1991) and dynamic, intensely occupied human 'artefacts' (Barton et al., 2012). Over the last two decades, these environments have gone from being completely neglected in archaeological and palaeoanthropological discussions, as 'barriers' to our species' migration and ecological adaptations (Gamble, 1993; Bird et al., 2005; Boivin et al., 2013), to being a clear example of the adaptive plasticity of *Homo sapiens* (Rabett, 2012; Roberts and Petraglia, 2015; Roberts et al., 2016).

While J.D. Clark acknowledged the potential importance of tropical rainforests to early adaptations of *Homo sapiens* as early as 1988, it was Julio Mercader (2002a,b) who stimulated a spate of archaeological work in these habitats over the last two decades. Mercader (2002a,b) highlighted that African tropical rainforests could have been occupied and utilized by our species from its earliest evolution there c. 200 ka. While direct evidence for this at such an early date is still lacking in Africa, research in Southeast Asia (Barker et al., 2007; Barker, 2013), Melanesia (Summerhayes et al., 2010), and South Asia (Deraniyagala, 1992; Perera et al., 2011; Roberts et al., 2015a,b; Roberts et al. 2017) has highlighted that our species occupied and utilized tropical rainforests during its expansion beyond Africa during the Late Pleistocene from at least 45 ka (Roberts and Petraglia, 2015). The last two decades of archaeological research have also highlighted the early and diverse origins of agricultural practices and urban settlements in tropical

rainforests (Golson, 1977; Denham et al., 2003; Heckenberger and Neves, 2009; Iriarte et al., 2012; Neumann et al., 2012), whose soils were once considered too impoverished to support such activities (Meggers, 1954).

Despite this resurgence in rainforest archaeology and the emergence of a 'rainforest prehistory' (Mercader, 2002b), with some notable exceptions (Barton et al., 2012; Barker, 2013), there has thus far been little attempt to explore the diversity of environments that fall within this category, as well as human adaptations to this diversity. The term 'rainforest' was actually coined by the botanist A.F.W. Schimper in 1898 (*tropische Regenwald* – Allaby, 2010) to describe forests of the permanently wet regions of the tropics (as opposed to savannah forests and thorn forests), and contains a huge spectrum of variability. In practice, tropical rainforests that range from the montane rainforests characteristic of the New Guinea Highlands to the peat swamp rainforests common in Borneo, Southeast Asia. The emergence of diverse methodologies, including stable isotope analysis, experimental archaeology, modern conservation science, and LiDar survey, now offer various, state-of-the-art ways to study, in detail, human relationships with environments that have too often been seen as blank spots on the archaeological map of human history.

This Special Issue was born from a conference session of the same name at the Society for American Archaeologists 2016 Meeting in Orlando, Florida. The purpose of the session, and this Special Issue, was to bring together researchers with different methodological and regional expertise in tropical rainforest research, in archaeology, anthropology, and conservation studies, in order to demonstrate the diverse nature of these habitats, the diverse methods we now have available to study them, and the diverse ways human populations have occupied, exploited, and co-existed within them across the globe. Following on from the Special Issue 'Long-term perspective on human occupation of tropical rainforests' by Barton et al. (2012), this volume seeks to demonstrate how rapidly the field of rainforest archaeology is developing, how much we are learning about the geographical and temporal diversity of human adaptations in these environments, and how much we still have left to learn. The aim was to highlight a necessary move from a 'rainforest prehistory' to methodologically and regionally diverse 'rainforest prehistories' that span from *Homo sapiens'* first encounter with global rainforest environments to modern conservation issues faced by populations in these habitats.

1. Rainforest prehistories

Now that tropical rainforests are becoming increasingly popular as settings in which to look for human occupation, there is a

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growing realization that tropical rainforest formations are not as similar as the category itself might belie. As Macho (this volume) demonstrates, there are a number of different factors that will influence the biology and adaptations of hominins and primates occupying tropical rainforests, and these will vary between different rainforest formations. The montane and evergreen-deciduous forests of the New Guinea highlands are prone to burning and large openings frequently form as a result of cyclones (Whitmore, 1998). This may explain the early evidence for human burning in this region that would have stimulated the availability of a diversity of tropical floral resources and their consumers (Groube, 1989; Denham and Barton, 2006). Of all the regions where early human rainforest contact has been documented, Africa appears to be the most susceptible to rainforest reduction as a result of climatic impacts (Morley, 2000; Malhi and Wright, 2004; Malhi et al., 2013). This may be why many Middle Stone Age sites or early agricultural sites are found on the fringes of the Central African rainforest as populations expanded during periods of forest fragmentation (Basell, 2008; Blome et al., 2012; Grollemund et al., 2015). A number of contributions to this volume provide in-depth 'rainforest prehistories' that study human interactions with tropical rainforests in different regions and at different time periods.

Barker et al. (this volume) build on multidisciplinary work at the Niah Caves, Borneo, to track cultural and ecological relationships between humans and tropical rainforests in this region from 45 ka to the present day. Rabett et al. (this volume) present a comprehensive multidisciplinary study of Tràng An in Vietnam, in order to analyse the relationship between climatic and environmental change and human activities at the site between 30 and 12 ka. Kusmartono et al. (this volume) expand Southeast Asian rainforest archaeology into the little-touched rainforest interior of Kalimantan. Summerhayes et al. (this volume) highlight the diversity of tropical rainforest habitats encountered by *Homo sapiens* as it moved into Sahul during the Late Pleistocene, while Ford (this volume) looks at the potential subsistence and technological strategies adopted by our species in this region. Finally, Livingstone-Smith et al. (this volume) report detailed information from exploratory archaeological and environmental survey along the Congo and its tributaries in Central Africa in order to further our knowledge of a region that has been under-studied and often ignored from the perspective of forager and farmer occupation during the Holocene. Together, these studies demonstrate the ongoing role of archaeological 'discovery' in the investigation of different tropical rainforest habitats that have often been neglected by previous research.

2. Methodological diversity

Poor organic preservation and high hydrological activity (Tappen, 1994; Kourampas et al., 2009; Friesem et al. this volume) has often meant that the production of archaeological data has relied on chance or a bias towards rockshelter and cave sites where sequences remain more intact. Although these problems remain, increased efforts placed on rainforest survey, both from the ground (Livingstone-Smith et al., this volume) and from the sky (Fisher et al., this volume), and an increased interest in these environments from an archaeological perspective has demonstrated that the previous partial picture was, at least in part, a product of research focus. Methodological innovation in the form of LiDAR scanning has allowed Fisher et al. (this volume) to study a vast network of urban networks buried under rainforest vegetation in Honduras. This method, while still fairly expensive, offers a key resource in the uncovering of rainforests as complete 'artefacts' of human occupation and exploitation (Willis et al., 2004; Barton et al., 2012). Livingstone-Smith et al. (this volume)

by contrast show the importance of 'boots-on-the-ground' (Fisher et al. this volume) to add detail regarding the date and nature of human occupation in different rainforest regions.

Methodological advances have now also made it possible to look at different aspects of prehistoric human rainforest life. Stable isotope analysis offers a means of directly studying human rainforest resource reliance (Krigbaum, 2003, 2005; Roberts et al., 2015b; Roberts et al. 2017). With promising collagen preservation, Hermenegildo et al. (this volume) are able to apply this method to hypothesize the contribution of different types of resources to human rainforest populations in the Amazon of South America. Perry and Verdu (this volume) and de Luna (this volume) demonstrate the potential of genetic and linguistic studies of ethnographic groups in Africa to shed light on environmental and cultural interactions of human populations with rainforests in this part of the world. Xhaufclair et al. (this volume) and Larsen (this volume) use detailed insights from ethnographic communities and conservation studies of human watershed use in the modern world to explore the different opportunities and dangers presented by rainforests in Southeast Asia and South America, respectively, to human groups, past and present. Finally, Macho (this volume) takes a biological approach to explore the relationship between abiotic factors characteristic of tropical rainforests and hominin life history adaptations.

3. Hotspots through time

As the contributions to this volume show, tropical rainforests have been intensely utilized and modified by our species, from their first arrival in the tropics beyond Africa during the Late Pleistocene (Barker et al., this volume; Rabett et al., this volume; Summerhayes et al., this volume) to the cities of the modern world (Larsen, this volume). Given that in the late 1980s and early 1990s it was argued that rainforest foraging was impossible without trade with agricultural communities (Bailey and Headland, 1991), and that recent reviews of early human migration considered them barriers to human movement (Gamble, 1993; Bird et al., 2005; Boivin et al., 2013), this clearly demonstrates just how far rainforest archaeology has come in such a short space of time. However, the realization that there is no such thing as 'Virgin' rainforest (Willis et al., 2004) and that almost every rainforest is an 'artefact' of millennia of human influence and manipulation (Barton et al., 2012) is not to say a) that 'rainforest archaeology' has reached its goal or b) that current human occupation and exploitation of rainforests habitats is inevitably sustainable. On the contrary, both rainforest archaeology and human relationships with rainforests in the modern world face pressing challenges.

4. The future of rainforest archaeology and anthropology

This volume has aimed to demonstrate the growing interest in the diverse rainforest prehistories of our species around the globe as well as the increasing variety of methods that can be used to study them. Now that 'rainforest archaeology' is on the map in discussions of human evolution and human ecological adaptations it is essential to develop new questions including: How do different tropical forests vary and how does this influence how humans adapted to them in the past?; How have climatic and environmental change in different tropical forests varied, and how have they influenced human populations in these forests?; How susceptible are human foragers, farmers, and urban dwellers to natural disasters and climate change in tropical rainforest environments?; Which factors dictate human life histories in tropical forests? With more archaeologists and anthropologists working in tropical forests than ever before, and with the diversity of methodological

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