



Dr. Els Cornelissen
(Royal Museum for Central Africa, Tervuren,
Belgium)

**Stone Age Hunter-gatherers in rainforests: a
perspective from the Congo-basin**

Lithic implements are the most durable and common part of the archaeological record allowing to identify the presence of past hunter gatherers. As such they are also instrumental to the archaeological study of human adaptations to rainforest ecologies. In Western Atlantic Central Africa Stone Age sites directly dated to at least 30 ka attest to Late Pleistocene occupation in a rainforest setting. In the north-eastern forests of the Congo basin, archaeological spatial patterning of currently available evidence from artefacts found in surface scatters and during mining operations points to a possibly relatively widespread distribution of implements of Lupemban affinity. Lupemban sites today outside of the forest have been dated to the Middle Pleistocene and are considered Middle Stone Age. Late Stone Age quartz industries have a comparatively more restricted distribution and were dated to at least 18 ka in the Ituri lowland rainforest. Though sites in the north-eastern Congo Basin are mainly chance finds, they show that access to a large variety of raw materials from rock outcrops or river cobbles was assured. In the Inner Congo Basin flaked and polished stone artefacts of any period are exceptionally rare; undated artefacts have some typological similarities with the Late Pleistocene quartz industries from the Ituri forest. However, the very few assemblages on silicified mudstone and fine grained quartzite considered Late Pleistocene are most likely of Holocene age. The limited information on Stone Age occupation in the Inner Congo Basin is certainly in part explained by lack of archaeological survey, however, access to, and availability of, raw material for the manufacture of lithic tools may have played a role in the past as well.

AN INVESTIGATION OF
GEOGRAPHICAL AND
TEMPORAL DIVERSITY
IN HUMAN 'RAINFOREST
PREHISTORIES'

WORKSHOP
OCTOBER 3-6, 2016

ORGANISED BY
PATRICK ROBERTS



MAX PLANCK INSTITUTE
FOR THE SCIENCE OF HUMAN HISTORY



Dr. Barbara Eichhorn
(Goethe University Frankfurt/Main, Germany)

Palms and pearl millet – deciphering Iron Age subsistence in the Central African rainforest

Food production in the Central African rainforest did not develop in situ and independently but was introduced from outside. The initial spread of agriculture is considered to be tightly related to a climate crisis in the second half of the first millennium BC, leading to a partial rainforest breakdown and the replacement by pioneer and secondary formations. Enhanced seasonality allowed for the temporary cultivation of the savanna crop pearl millet, to the substantiated state of knowledge introduced by migrating Bantu populations.

Ongoing interdisciplinary research in the Inner Congo Basin of the universities of Cologne (archaeology) and Frankfurt (archaeobotany) provides new evidence that this 'pearl millet interlude' also affected the core area of the rainforest, lasting longer than previously thought, beyond the end of the climate crisis. At least in the initial phase, other savanna crops – legumes providing proteins – were also present. The most prominent archaeobotanical finds are, however, wild tree fruits, predominantly from oil palm as source of fat, underlining the persistent importance of gathering during all settlement phases registered so far.

Pearl millet, at least the cultivars common today, is not adapted to all-year-round humid rainforest climate without distinct seasonality. The ICB charred pearl millet finds are rare and small, indicating that this crop never really thrived well. Nevertheless, for some hundred years people didn't abandon its cultivation completely, a mode of behaviour most likely to be explained by cultural preferences, conservatism and the will to preserve a 'cultural heritage'. Rather unexpectedly, pearl millet once more returns in the Middle Ages, probably related to climatic oscillations in the transition phase of Medieval Climatic Optimum and Little Ice Age.

Indigenous tubers and introduced bananas, the latter expected to be important for African rainforest subsistence since a considerable time, are so far difficult to trace. Water-logged sites, promising to provide the best conditions for preservation of tuber remains as well as bones, are currently investigated.

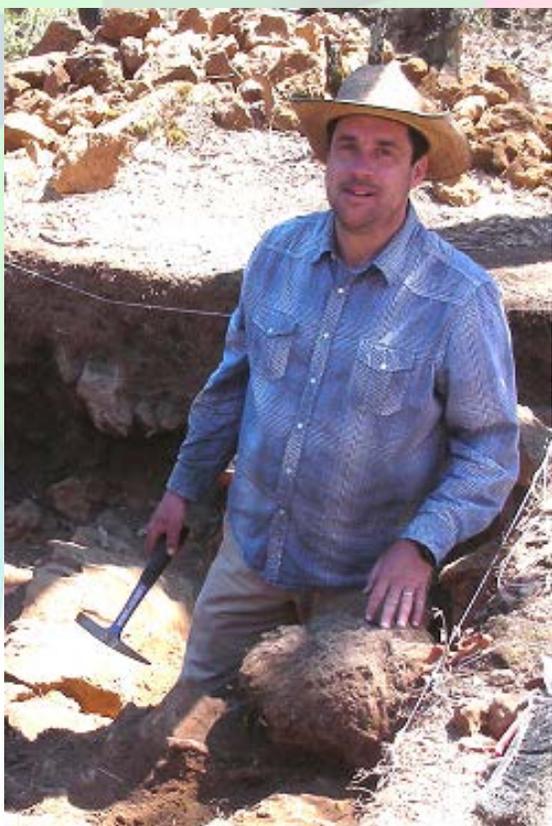
Today, indigenous African crops play only a minor role in Central African rainforest agriculture. Exotic crops such as cassava, maize and bananas have almost completely replaced them. For long periods of the Iron Age, African rainforest subsistence remains enigmatic and the role of cultivation of domesticated plants unknown.

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Chris Fisher
(Colorado State University, USA)

The Application of Airborne Mapping LiDAR for the Documentation of Ancient Cities and Regions In Tropical Regions

It is a conundrum of the 21st Century that there is so much left to discover and yet never before has our cultural and ecological patrimony been so threatened. This is especially true in tropical regions where heavy vegetation, inaccessibility, and rugged topography hamper traditional investigation. Here we present two case studies that add to a growing body of literature demonstrating the utility of airborne mapping LiDAR (a.k.a. Airborne Laser Scanning) for rapid archaeological assessments in undocumented, or poorly documented regions. The first outlines a program of LiDAR scanning to more quickly document the urban center of Angamuco in the Mexican State

of Michoacán. This work shows that (1) large urban centers with complex spatial organization were present centuries prior to the formation of the Purépecha Empire, (2) the settlement incorporate gardens and other landscape features within and around the settlement demonstrating a high degree of human environmental modification, and (3) current models for the evolution of social complexity in the region cannot account for the presence of Angamuco. The second presents the results of a LiDAR survey of a remote valley in the Mosquitia tropical wilderness of Honduras, which has seen little sustained archaeological research. Here we demonstrate that (1) though today the valley is a wilderness it was densely inhabited in the past; (2) this population was organized into a three-tiered system composed of 19 settlements dominated by a city; and, (3) this occupation was embedded within a human engineered landscape. For both LiDAR data fundamentally changed the understanding of coupled human/natural systems in these areas while providing critical baseline data for conservation and management.

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Anabel Ford
(University of California, USA)

Urbanism of Tropical Civilization: Recovering the Lost Landscape of the Maya Forest

We know that the preindustrial agrarian Maya emerged in the southern Mesoamerica lowlands (Mexico, Guatemala, Belize) and thrived as an expanding civilization for 2,000 years. By the Classic Period (250-900 CE), they were recording important events in carved stone, on decorated pottery vessels, and inside bark books, documenting regal feats—challenges to power, alliances and visits, as well as celebratory proceedings—recorded from the earliest times through the Spanish conquest. Our research on the Maya forest provides new insight into the development of the Maya and how they managed a field to forest system to

support great civic centers. Surveys of the landscape, working with the traditional farmers, and collaborating with governments to conserve the culture and nature of the Maya forest at El Pilar reveals a new integrative approach to the understanding of the Maya civilization.

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Anne Ford
(University of Otago, New Zealand)

**Onwards and Upwards: modern human occupation
of the rainforests of Papua New Guinea**

Colonization models for modern humans Out-of-Africa, across southern Asia, and into the continent of Sahul (Australia/New Guinea) primarily focus upon the use of coastal resources as the main subsistence strategy employed. The same model is applied to the colonization of Sahul itself, noting that as modern humans must have had the ability to use watercraft to complete the water crossings required to reach Sahul then these first colonists must have followed a coastal/marine lifestyle. Yet archaeological research in New Guinea has identified human presence within rainforest environments firmly within the earliest dates of colonization, thus challenging the coastal adaptation colonization model. This paper will examine the evidence for human occupation of the rainforests of New Guinea, with particular emphasis on the late Pleistocene period, exploring patterns of mobility, subsistence economy and adaptations to the rainforest environment.

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David Friesem
(University of Cambridge, UK)

Geoarchaeology in tropical forests: a micro-archaeological perspective

This paper focuses on the usefulness of geoarchaeological analysis of microscopic materials to study the both the anthropogenic and environmental factors which contribute to archaeological site formation in tropical forests. The microscopic archaeological record highlights that although caves and rock shelter exhibit better state of preservation, open-air sites in tropical forests have the potential to preserve, at least to at the microscopic scale, archaeological evidence. Forager behaviour can be inferred by studying the deposition patterns of microscopic residues, in particular the formation of activity areas. Taphonomic processes in tropical forests are characterized by acidic conditions and intensive biological activity which result in enhanced degradation of organic matter and the complete dissolution of carbonates (e.g., bones and ash). Yet, charcoal and phytoliths tend to preserve well in such environmental conditions and can be used as reliable indicators of human activity. Overall, although forager ways of living in tropical forests and the environmental conditions challenge the formation of well-preserved archaeological evidence, an integrated approach examining the different scales of the archaeological record can successfully reconstruct human behavior and the formation processes of archaeological sites.

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Dylan Gaffney
(University of Otago, New Zealand)

**Human-rainforest prehistories in Holocene Melanesia—
recent advances and future prospects**

This paper will discuss the nature of human-rainforest interactions during the early-mid Holocene in Melanesia. The Melanesian archaeological record is complex and attests to substantial temporal and geographic variation in the intensity of forest interactions and landscape management. In some areas, major shifts to human subsistence systems did occur, concurrent with dramatic changes to climate, sea level, and vegetation following the Pleistocene. For instance, extensive investigations into the origin of plant food production and domestication at Kuk Swamp in the New Guinea Highlands have produced a sophisticated discourse on prehistoric agricultural innovations in the tropics. These investigations lie at the interface between archaeological/palaeoenvironmental sciences and the interpretive frameworks built on ethnography. However, in many areas of Melanesia, archaeological evidence suggests people managed, manipulated, and negotiated rainforests in ways that are not easily bounded by conventional archaeological classifications. In this way, sub-regional diversity within Melanesia, in terms of the timing and intensity of rainforest utilisation, has not been fully explored. This theme in particular remains a central and on-going research agenda in Melanesian archaeology.

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Chris Hunt
(Liverpool John Moores University, UK)

Late Quaternary to recent human-rainforest interaction in Southeast Asia

People seem to have interacted with rainforests, and particularly with rainforest plants, from the earliest days of modern human activity in Southeast Asia. During Late Pleistocene low sea, the Southeast Asian continent was much extended and linked to the many islands on the the Sunda Shelf as this became exposed. This, together with changes in atmospheric circulation, resulted in climatic dryness, especially during stadial phases, when rainforest vegetation became much restricted. During interstadials, increasing rainfall led to expansion of forests. At Niah, Borneo, there is an indication that the interstadial forests were manipulated repeatedly to produce edge-habitats through burning from ~53 ka. Edge-habitat plants were exploited, as evidenced by starch, phytoliths, parenchyma and pollen in the sediments of the Great Cave of Niah.

During the Early Holocene, evidence for rainforest disturbance and plant manipulation is probably clearest in the deep borehole at Loagan Bunut in Borneo, but disturbance floras are pervasive through both Mainland and Island Southeast Asia. In colonial times, some early botanists recognised the enormous scale of forest manipulation by indigenous people. Some relics of these indigenous forest management systems are still functioning, but threatened, in the modern world.

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Ji Xueping
(Yunnan Institute of Cultural
Relics and Archaeology, China)

Primate and Hominin Diversity of Subtropical-tropical area of Southwest China since Late Miocene

Southwest China, on the eastern margin of Qinghai-Tibet Plateau, has widely been reported as a biodiversity and ethnic diversity 'hotspot' today. Tropical forest fauna are represented since late Miocene (12-6 Ma) (including different species of *Lufengpithecus* through time). However, there is currently no record of Pliocene fauna in southwest China or Southeast Asia. The

Pleistocene fauna that adapted to subtropical and tropical environments in this region had previously been widely distributed in southern China, usually accompanied by human activities, expanding north and south as climate changes cycled. The fossil evidence indicates that the humans and tropical fauna coexist relatively continuously since the early Pleistocene in southern China and southeast Asia, with possible physical interbreeding and cultural interactions occurring between human populations in these two areas. During the Last Glacial Maximum, the tropical rain forest became increasingly fragmented in China, becoming vestigial to the southernmost parts of the region. As the development of interaction between the uplift of Tibetan Plateau and Asian monsoon intensified, together with the diverse topographical diversity in the area, the tropical forest may have acted as a refugium for hominin and associated fauna in southwest China and southeast Asia.

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Vida Kusmartono
(Australian National University, Australia)

The archaeology of upper Kapuas Basin: evidences for the occupation of the interior equatorial rainforest of Kalimantan

From the onset of archaeological research in Kalimantan (Indonesian Borneo) in 1939, there have been only 2 investigations within the deep interior equatorial rainforest of the island. These were at the sites of Nanga Balang and Diang Kaung, both in the upper Kapuas drainage basin in the geographical centre of Borneo, and both dated to c. 3000 BP by the previous researchers. But sites closer to the coastline of Borneo, especially the Niah Caves in Sarawak, have yielded chronologies indicating a much greater span of late Pleistocene (50 kya onwards) to Holocene occupation. So, did hunter-gatherer populations also exist in the deep interior of Borneo throughout the same period? Were they present prior to 3000 BP? My two seasons of excavation (2013–2014) in two caves in the upper Kapuas Basin indicate two main periods of human activity, ranging in date (12 charcoal samples) one being 15 to 11 cal. kya, with a second spanning the recent past from 1500 to 150 BP. Taken together, these dates confirm the intermittent existence of human occupation of the deep interior equatorial rainforest of Borneo through at least 15,000 years. These new chronologies for human occupation of deep interior equatorial rainforest are significant for the prolonged “rainforest debate” of the late 1980–1990s, and confirm the importance of interior Borneo within the prehistoric framework of Southeast Asia.

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Matthew Larsen
(Smithsonian Tropical Research Institute, Balboa, República de Panamá)

**Contemporary human uses of forested lands in the neotropics:
benefits and risks**

Abstract: The benefits, or ecosystem services, that prehistoric societies could obtain from tropical forests and riparian corridors in forested regions of the tropics include water, food resources, and transportation routes that provided access to multiple ecosystems. However, there are risks inherent in extracting these benefits, for example, living on or near nutrient-rich river floodplains provides access to animal and plant food sources, but also exposes inhabitants to flood risk. Societies living on large river systems could take advantage of this risk because floods are generally more predictable and, if anticipated through calendric knowledge, less risky. One of the best known early human examples is the Nile River valley: humans >5,000 years ago adapted to annual sediment-laden floods that sustained nutrients for agriculture, thereby enhancing food production.

Modern ecosystem services from forested watersheds are numerous and include water, wood products, biodiversity, genetic resources, enhanced resilience to wildfire, pathogens and invasive species, plus recreation and ecotourism. Some lesser appreciated, but nonetheless important services from tropical (and other) forests are those that mitigate risk. These include increased availability of groundwater and base flow in streams during annual dry seasons and droughts, reduced peak river flow during storms, reduced soil erosion and landslide probability, and along forested coastlines, buffers or barriers to storm surge and tsunamis.

Contemporary societies face significant challenges in sustaining these ecosystem services in two general areas: 1) land use and governance, and 2) climate change. Deforestation, forest fragmentation, and urban growth and encroachment on forest margins degrade all the services described above and increase wildfire frequency, thereby worsening an existing risk. Over longer time scales, climate change results in warming temperatures and precipitation changes, both averages and extremes, as well as changes in the intensity, frequency, duration of storms and droughts.

It is estimated that 80% of global diversity resides in the tropics, much of it in forests. Improved governance at local, regional, national, and international scales is key to sustaining the critically important services that modern humans obtain from tropical forests. This includes international agreements to mitigate climate change by limiting the rise in greenhouse gas emissions.

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Gabriele Macho
(University of Oxford, UK)

Rainforests: drivers and constraints on hominin life histories.

Hominin relationship with, and exploitation of, rainforests has changed considerably throughout history. The Last Common Ancestor of hominins and panins (LCA) was most likely a tree-dwelling, frugivorous primate, whereas early hominins evolved in more open and arid environments, where fruits are rare. The behavioural and biological consequences of these habitat changes were profound and led to the evolution of bipedality, omnivory and an increase in body and brain size. Importantly, the more open and seasonal habitats probably also triggered the evolution of our unique life history, which combines high reproductive rates with slow growth. These changes are not entirely fixed however. For example, modern humans show great variation in interbirth interval and growth rates, as well as in morphology (e.g., stature). Although developmental and behavioural flexibility undoubtedly underlies the success of Homo to occupy nearly all corners of the globe, comparative analyses of primates, controlled for phylogeny and brain size, indicate that this trait may not be unique to our lineage. Rather, primate life histories are apparently modulated by overall aridity and seasonality, most probably through resource availability. In rainforests, food sources are unpredictable and not easily available, especially to large-bodied terrestrial primates like humans: fruits are high up in the canopy, where they cannot be easily reached, they are clumped and their fruiting season is unpredictable due to the relatively uniform rainfall throughout the year. In contrast, more open habitats provide carbohydrate-rich food sources and animal prey, whilst fruits are available on a seasonal basis. From an animal's standpoint such environments are therefore more predictable, which enables primates to time key stages of their development, particularly gestation length and weaning. Living in open environments also has a positive effect on extending primate longevity.

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Julio Mercader
(University of Calgary, Canada)

Of forests, lithics, molecular palaeontology, and false positives: Cleanrooms to study microbotanical residues from Olduvai Gorge, Tanzania

The combination of stone tools, meat eating, and plant processing is a key to understanding the impact techno-dietary changes had on early biological and cultural evolution. Few places in the world have an archaeological record from the Plio-Pleistocene where lithics, bones, and plant remains juxtapose at the same site in a tight chronostratigraphic context. Olduvai

Gorge in northern Tanzania is one of these places. Olduvai was once a lake surrounded by wetlands, marshes, forests, woodlands, and grasslands, where variably productive ecotones supported multiple plant resources such as underground storage organs, seeds, nuts, and legumes.

Several compendia have illustrated the reach of conventional approaches to exploring the evolutionary origin of omnivorous diets. Included are the cost of developing unusually large brains and bodies, tooth size, shape, enamel thickness, mechanics and wear, and the chemical signal (e.g. isotopes) from diet left on bones and teeth. Over the last decade, a new interpretation of human origins has proposed a long history of dependence on fire, suggesting that humans are biologically adapted to cooked foods. However, both the conventional and more recent approaches have not provided direct indication of plant utilization as a key dietary component, nor have they revealed which tools were used to process different types of food.

Lithic residue is a triple proxy at the interface of tool use, paleoenvironment, and diet. The number of stone tool assemblages yielding Plio-Pleistocene microremains such as starch granules is very limited, and authenticity has not been rigorously established in many cases. What taphonomic lines of evidence must we unlock to address current preservation/authenticity controversy in molecular paleontology? Contamination is one of the key issues. Strict controls are rarely followed in practice. Many researchers still ignore stringent criteria possibly because they believe they are not really necessary but give no indication as to why the criteria ignored are not relevant. In this presentation we describe anticontamination measures deployed at Olduvai Gorge and the University of Calgary to increase the reliability of the recovered signals from lithic residue both in the field and laboratory.

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George Perry
(Pennsylvania State University, USA)

Ecological genomics of human rainforest hunter-gatherers

I will discuss how analyses of genomic data can or could help inform our understanding of human rainforest hunter-gatherer ecological prehistories, including on the antiquity of this mode of subsistence and on the history of interactions between rainforest hunter-gatherer and neighboring agriculturalist populations. I will also present results from our lab on the identification and evolutionary analysis of regions of the genome that underlie the pygmy phenotype in the Batwa, a rainforest hunter-gatherer population from Uganda.



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Cosimo Posth
(Max Planck Institute for the Science of Human
History, Germany)

Game-changers in ancient DNA research

In recent years, the application of next generation sequencing technologies in the field of ancient DNA (aDNA) reshaped our comprehension of human population dynamics through time. Shifting from the study of short mitochondrial DNA fragments to entire ancient human genomes has enabled the identification of changes in the modern human genetic makeup from the Late Pleistocene onwards. Although the first palaeogenomic studies were limited to the analysis of endogenous DNA from

exceptionally well-preserved specimens, recent technological innovations have expanded the amount of human remains from which genome-wide data can be obtained. The development of new protocols for the extraction and targeted enrichment of nuclear DNA, in combination with the investigation of different anatomical elements and state of the art computational pipelines, expanded aDNA research further back in time and to tropical climates. In this presentation, we discuss the challenges of retrieving genomic data from human specimens, such as those unearthed from rainforests, where environmental conditions heavily affect aDNA preservation. Expanding the world's regions where the genetic landscape of ancient humans can be reconstructed will provide further insights into population movements in human prehistory.

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Patrick Roberts
(Max Planck Institute for the Science of Human
History, Germany)

**Stable isotope analysis as a means of directly
testing human rainforest resource reliance**

In the past two decades there has been a growing interest in tropical rainforests as viable habitats for human foragers, from our species' expansion beyond Africa during the Late Pleistocene onwards. Multidisciplinary approaches to sites in these environments are revealing faunal evidence for specialised hunting strategies, archaeobotanical evidence for toxic plant processing, and technological evidence for projectile hunting and the digging up of underground storage organs during periods of occupation by *Homo sapiens*. Nevertheless, organic assemblages such as these can only ever provide 'snapshots' of human subsistence in the past, particularly in environments that are hostile to organic preservation. Here, I discuss the potential benefits of stable isotope analysis of fossil human tooth enamel and, where preserved, bone collagen as a means of directly inferring the degree of tropical forest resource reliance in prehistoric individuals. Case studies from prehistoric Southeast Asia and Sri Lanka, as well as historical hunter-gatherer collections from South Asia, indicate that this methodology can distinguish between long-term, specialised tropical forest subsistence, diets consisting of a substantial mixture of forest and open resources, and increased reliance on open resources and farming crops during later periods of prehistory. The application of this methodology holds much promise in deducing the nature of hominin tropical forest adaptations. This is particularly for *Homo erectus* and *Homo floresiensis* individuals in Southeast Asia whose tropical forest use during the Early and Middle Pleistocene remains a source of interest and contention.

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Carlos Sierra
(Max Planck Institute for Biogeochemistry,
Germany)

The ecology of 'undisturbed' tropical forests

For a long time, ecologists have been fascinated by the structural complexity of tropical rain forests, particularly their species richness and productivity. A common paradigm among ecologists has been the idea that these forests have remained undisturbed from human influence and therefore exhibit characteristics of 'natural vegetation'. In this presentation, I will show how this early idea of natural vegetation in equilibrium has mutated over time to new conceptions of highly dynamic ecosystems constantly experiencing both natural and human disturbances. I will approach this topic through two main ideas in tropical ecology, the constancy of ecological communities over time, and the carbon sink capacity of tropical forests. Both points of view provide enough evidence to reject the idea that tropical forests have been in a state of equilibrium with natural forces, and suggest a strong interaction with human occupation of tropical lands.

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Hermine Xhaufleur
(University of Cambridge, UK)

Are Southeast Asian denticulates born from the forest?

Lithic industries in Southeast Asia are characterized, broadly speaking, by the paucity of stone tool types and simple production techniques, which lasted, unchanged for millennia. These characteristics are explained by some scholars as being the result of human adaptation to the rainforest. According to the proponents of the “Bamboo Hypothesis”, humans would not have invested in stone but in ligneous materials, more adapted to a mobile lifestyle in the rainforest, for their technology. They would have used these simple stone tools found in the archaeological sites to manufacture more complex implements made of wood or bamboo, which did not preserve. The existence of such a “lignic industry” during Prehistory still remains to be demonstrated. Whether or not it existed, other aspects of the lithic technology of prehistoric Southeast Asia might be the result of an interaction between humans and the forest. Denticulates correspond to one of the only stone tool types found in the region: they consist of flakes (blanks) whose edge presents a series of adjacent notches. They are considered as unique testimonies of a particular willingness of their prehistoric makers to control the shape and the properties of stone tools. Nevertheless, unexpected results we obtained while doing plant processing experiments showed that these denticulates might actually be the involuntary result of an activity whose aim was completely different: splitting rigid plant materials. Indeed, this activity, when performed with the help of a specific process that we called the “twist-of-the-wrist”, produces very large micro-scars corresponding to the notches observed on denticulates and interpreted so far as intentional. In this talk, we will explore the origin of denticulates, between lithic and plant technology.

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