



McDONALD INSTITUTE CONVERSATIONS

Far from the Hearth

Essays in Honour of Martin K. Jones

Edited by Emma Lightfoot, Xinyi Liu & Dorian Q Fuller

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(Above) Martin Jones at West Stow, 1972 (with thanks to Ian Alister, Lucy Walker, Leonie Walker, and West Stow Environmental Archaeology Group); (Below) Martin Jones in a millet field, Inner Mongolia, 2010. (Photograph: X. Liu.)





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Cover image: *Foxtail millet field near Xinglonggou, Chifeng, China, photographed by Xinyi Liu, September 2014.*

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CONTENTS

Contributors	vii
Figures	viii
Tables	xvi
Acknowledgements	xx
<i>Foreword</i>	xxi
JAMES H. BARRETT	
Part I	Introduction
	1
	Introduction: Far from the Hearth
	3
	XINYI LIU, EMMA LIGHTFOOT & DORIAN Q FULLER
Part II	A Botanical Battleground
	7
<i>Chapter 1</i>	The Making of the Botanical Battle Ground: Domestication and the Origins of the Worlds' Weed Floras
	9
	DORIAN Q FULLER & CHRIS J. STEVENS
<i>Chapter 2</i>	The Fighting Flora: An Examination of the Origins and Changing Composition of the Weed Flora of the British Isles
	23
	CHRIS J. STEVENS & DORIAN Q FULLER
<i>Chapter 3</i>	A System for Determining Plant Macro Archaeological Remains
	37
	VICTOR PAZ
<i>Chapter 4</i>	Phytoliths and the Human Past: Archaeology, Ethnoarchaeology and Paleoenvironmental Studies
	51
	CARLA LANCELOTTI & MARCO MADELLA
<i>Chapter 5</i>	Genetics and the Origins of European Agriculture
	65
	TERRY BROWN
<i>Chapter 6</i>	Martin Jones' Role in the Development of Biomolecular Archaeology
	71
	TERRY BROWN, RICHARD P. EVERSLED & MATTHEW COLLINS
Part III	The Stomach and the Soul
	75
<i>Chapter 7</i>	'Rice Needs People to Grow it': Foraging/farming Transitions and Food Conceptualization in the Highlands of Borneo
	77
	GRAEME BARKER, CHRISTOPHER O. HUNT, EVAN HILL, SAMANTHA JONES & SHAWN O'DONNELL
<i>Chapter 8</i>	How did Foraging and the Sharing of Foraged Food Become Gendered?
	95
	CYNTHIA LARBET
<i>Chapter 9</i>	Agriculture is a State of Mind: The Andean Potato's Social Domestication
	109
	CHRISTINE A. HASTORF
<i>Chapter 10</i>	Archaeobotanical and Geographical Perspectives on Subsistence and Sedentism: The Case of Hallan Çemi (Turkey)
	117
	MANON SAVARD
<i>Chapter 11</i>	Rice and the Formation of Complex Society in East Asia: Reconstruction of Cooking Through Pot Soot- and Carbon-deposit Pattern Analysis
	127
	LEO AOI HOSOYA, MASASHI KOBAYASHI, SHINJI KUBOTA & GUOPING SUN
<i>Chapter 12</i>	Food as Heritage
	145
	GILLY CARR, MARIE LOUISE STIG SØRENSEN & DACIA VIEJO ROSE

Part IV	<i>Between Fertile Crescents</i>	153
Chapter 13	From a Fertile Idea to a Fertile Arc: The Origins of Broomcorn Millet 15 Years On XINYI LIU, GIEDRE MOTUZAITE MATUZEVICIUTE & HARRIET V. HUNT	155
Chapter 14	A World of C ₄ Pathways: On the Use of $\delta^{13}\text{C}$ Values to Identify the Consumption of C ₄ Plants in the Archaeological Record EMMA LIGHTFOOT, XINYI LIU & PENELOPE J. JONES	165
Chapter 15	The Geography of Crop Origins and Domestication: Changing Paradigms from Evolutionary Genetics HARRIET V. HUNT, HUGO R. OLIVEIRA, DIANE L. LISTER, ANDREW C. CLARKE & NATALIA A.S. PRZELOMSKA	177
Chapter 16	The Adoption of Wheat and Barley as Major Staples in Northwest China During the Early Bronze Age HAIMING LI & GUANGHUI DONG	189
Chapter 17	When and How Did Wheat Come Into China? ZHIJUN ZHAO	199

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Figures

Chapter 1

1.1	<i>Wild barley spikelets (Hordeum spontaneum).</i>	11
1.2	<i>Seed size increase over time standardized to percentage change, comparing Southwest Asia and China.</i>	12
1.3	<i>Charts showing founder weed taxa over time and proportion of cereals in the plant assemblage.</i>	16
1.4	<i>A field of wheat in which weedy oats and wild barley appear to be rather better than the crop.</i>	17

Chapter 2

2.1	<i>Diagrammatic representation of seed-bank types—autumn sowing-tillage cycle.</i>	25
2.2	<i>Diagrammatic representation of seed-bank types—spring sowing-tillage cycle.</i>	25
2.3	<i>Relative presence and persistence of seed-banks types I–IV in the field after ard cultivation.</i>	26
2.4	<i>Relative presence and persistence of seed-banks types I–IV in the field after mouldboard plough cultivation.</i>	26
2.5	<i>Timeline of agricultural changes and number of introduced/reintroduced weed flora.</i>	30

Chapter 3

3.1	<i>Identification and determination of plant macro remains.</i>	42
3.2	<i>Diagram of determination process.</i>	45

Chapter 4

4.1	<i>Increase in phytolith studies in the last 15 years.</i>	52
-----	--	----

Chapter 5

5.1	<i>The first ancient DNA sequences obtained from charred grain.</i>	66
-----	---	----

Chapter 7

7.1	<i>Borneo, showing the location of the Kelabit Highlands and other locations.</i>	77
7.2	<i>Penan encampment in the Baram valley.</i>	78
7.3	<i>Kelabit longhouse at Pa'Daleh, southern Kelabit Highlands.</i>	79
7.4	<i>Map showing key sites and locations in the Kelabit Highlands.</i>	79
7.5	<i>Oxcal plots of summed probabilities from archaeological and landscape sites.</i>	82
7.6	<i>Stratigraphic summaries of the cores and geoarchaeological sites.</i>	83

Chapter 11

11.1.	<i>Burn mark above the waterline after experimental cooking of liquid-rich food.</i>	130
11.2.	<i>The style of Jomon and Yayoi major cooking pots.</i>	131
11.3.	<i>Removing excess water after boiling rice (Central Thailand).</i>	134
11.4.	<i>Steaming stage of the yutori boil-and-steam rice-cooking method reconstructed with Yayoi pots.</i>	134
11.5.	<i>Cooking pot styles of the Tianluoshan site.</i>	136
11.6.	<i>Shift of proportions of cooking-pot styles in Hemudu culture.</i>	137
11.7.	<i>TLS round-body pots characteristic soot and burn mark.</i>	137
11.8.	<i>Layered burn deposits formed after experimental porridge cooking.</i>	138

Chapter 12

12.1	<i>Photographs taken at the Refugee Camp in Idomeni, Greece, March/April 2016.</i>	146
12.2	<i>An example of a 'Mediterranean Diet' meal.</i>	147
12.3	<i>A Guernsey occupation-era kitchen, complete with food-related objects.</i>	149

Chapter 13

13.1	<i>Locations of key millet sites across Eurasia.</i>	156
13.2	<i>Harriet Hunt visiting the Vavilov Herbarium, St Petersburg.</i>	158
13.3	<i>Martin Jones at a broomcorn millet field near Lanzhou, Gansu Province, western China.</i>	159
13.4	<i>Visiting millet sites in Gansu Province, western China.</i>	159

Chapter 15

- | | | |
|------|--|-----|
| 15.1 | <i>Martin Jones visiting the N.I. Vavilov Research Institute for Plant Industry, St Petersburg.</i> | 178 |
| 15.2 | <i>Barley exemplifies the complexity of inheritance of different segments of a domesticated crop's genome.</i> | 183 |

Chapter 16

- | | | |
|-------|---|-----|
| 16.1. | <i>Distribution of prehistoric sites in the NETP and Hexi Corridor.</i> | 190 |
| 16.2. | <i>The actual yield percentage of the sites in the NETP and Hexi Corridor.</i> | 192 |
| 16.3. | <i>Sum of the actual yield percentage of the sites in the NETP and Hexi Corridor.</i> | 192 |
| 16.4. | <i>Carbonized plant seeds collected from Lijiaping Site.</i> | 194 |

Chapter 17

- | | | |
|-------|---|-----|
| 17.1. | <i>The potential routes for the spread of wheat into China.</i> | 205 |
|-------|---|-----|

Tables

Chapter 1

- | | | |
|-----|--|-------|
| 1.1 | <i>Presence/absence of a select roster of founder weeds.</i> | 14–15 |
|-----|--|-------|

Chapter 2

- | | | |
|-----|--|------|
| 2.1 | <i>Common weeds within British archaeobotanical assemblages.</i> | 28–9 |
|-----|--|------|

Chapter 3

- | | | |
|-----|---|----|
| 3.1 | <i>Classifications of seeds based on preservation conditions.</i> | 40 |
| 3.2 | <i>Variables relevant in establishing the level of confidence of determination.</i> | 40 |

Chapter 4

- | | | |
|-----|--|----|
| 4.1 | <i>Phytolith production and taxonomic specificity for the world's major crops.</i> | 54 |
|-----|--|----|

Chapter 6

- | | | |
|-----|---|----|
| 6.1 | <i>Projects and workshops funded by the NERC Ancient Biomolecules Initiative (1993–1998).</i> | 73 |
|-----|---|----|

Chapter 7

- | | | |
|-----|--|------|
| 7.1 | <i>Radiocarbon dates from archaeological and palynological sites in the Kelabit Highlands.</i> | 84–5 |
|-----|--|------|

Chapter 8

- | | | |
|-----|---|---------|
| 8.1 | <i>Published studies on remains of starchy plants during prehistoric hunter-gatherer periods.</i> | 100–101 |
|-----|---|---------|

Chapter 10

- | | | |
|------|---|--------|
| 10.1 | <i>Archaeobotanical results from Hallan Çemi.</i> | 118–19 |
|------|---|--------|

Chapter 14

- | | | |
|------|--|--------|
| 14.1 | <i>List of edible plants found in Haryana and their photosynthetic pathways.</i> | 170–72 |
|------|--|--------|

Chapter 16

- | | | |
|-------|---|-----|
| 16.1. | <i>Calibrated radiocarbon data in the Hehuang Basin and Hexi Corridor.</i> | 191 |
| 16.2. | <i>Charred seeds from the Lijiaping site, Linxia county, Gansu Province, China.</i> | 193 |

Chapter 17

- | | | |
|-------|--|-----|
| 17.1. | <i>Early wheat remains in last-century archaeological discoveries.</i> | 201 |
| 17.2. | <i>Early wheat remains with only relative ages.</i> | 202 |
| 17.3. | <i>Directly dated early wheat remains.</i> | 203 |
| 17.4. | <i>List of archaeological cultures in the Central Asian Steppe.</i> | 207 |

Acknowledgements

The initial idea of editing this volume grew out of a conversation between Xinyi Liu and Graeme Barker at St John's College, Cambridge in June 2016. The editors subsequently discussed the provisional layout of the volume. By April of the following year, our list of agreed contributors was complete. Abstracts followed, and the chapters themselves soon after. First of all, the editors would like to pay tribute to our 36 authors, whose excellent work and timely contributions made it all possible.

For the last two-and-a-half years, the volume has been known as 'Fantastic Beasts' in order to keep it a secret from Martin. As we enter the final stage, we wish to extend our thanks to all who have ensured Martin remains blissfully unaware, including Lucy Walker, and we offer her our sincere thanks. We are extremely grateful to Harriet Hunt, Diane Lister, Cynthia Larbey and Tamsin O'Connell, who are kindly

organizing the gatherings to mark Martin's retirement and the publication of this volume.

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*Xinyi Liu, Emma Lightfoot and Dorian Fuller
August 2018*

Foreword

The 28-year term of Martin Jones as the first George Pitt-Rivers Professor of Archaeological Science witnessed, and in part created, a transformation in the fields of environmental and biomolecular archaeology. In this volume, Martin's colleagues and students explore the intellectual rewards of this transformation, in terms of methodological developments in archaeobotany, the efflorescence of biomolecular archaeology, the integration of biological and social perspectives, and the exploration of archaeobotanical themes on a global scale. These advances are worldwide, and Martin's contributions can be traced through citation trails, the scholarly diaspora of the Pitt-Rivers Laboratory and (not least) the foundations laid by the Ancient Biomolecules Initiative of the Natural Environment Research Council (1989–1993), which he chaired and helped create. As outlined in Chapter 6, Martin's subsequent role in the bioarchaeology programme of the Wellcome Trust (1996–2006) further consolidated what is now a central and increasingly rewarding component of archaeological inquiry. Subsequently, he has engaged with the European Research Council, as Principal Investigator of the Food Globalisation in Prehistory project and a Panel Chair for the Advanced Grant programme. As both practitioner and indefatigable campaigner, he has promoted the field in immeasurable ways, at critical junctures in the past and in on-going capacities as a research leader.

The accolades for Martin's achievements are many, most recently Fellowship of the British Academy. Yet it is as a congenial, supportive—and demanding—force within the Pitt-Rivers Laboratory that the foundations of his intellectual influence were laid. Here, each Friday morning, the archaeological science community would draw sticks to decide who would deliver an impromptu research report or explore a topical theme. Martin is among the most laid-back colleagues I have worked with, yet simultaneously the most incisive in his constructive criticism. As a provider of internal peer-review he was fearless without being unkind. The themed Pitt-Rivers Christmas parties were equally impactful—on one occasion Alice Cooper appeared, looking ever so slightly like our professor of archaeological science.

Martin's roles as a research leader extended to several stints as head of the Department of Archaeology, chairing the Faculty of Archaeology and Anthropology and serving as a long-term member of the Managing Committee of the McDonald Institute for Archaeological Research. Having started his professional career as an excavation-unit archaeobotanist in Oxford, he was a long-standing proponent of the highly successful Cambridge Archaeological Unit. In the wider collegiate community, he is a Fellow (and was Vice-Master) of Darwin College and was the staff treasurer of the Student Labour Club. In all roles he fought valiantly and often successfully for the interests of his constituency. His capacity to fight for deeply held priorities while recognizing the value of diverse perspectives was of utmost importance. His nostalgic enthusiasm for the debate with archaeological science that was engendered by the post-processual critique is one signal of an underlying appreciation of plurality. His active support for the recent merger of the Divisions of Archaeology and Biological Anthropology, within our new Department of Archaeology, is another. As a scientist (Martin's first degree, at Cambridge, was in Natural Sciences) he values the peer-reviewed journal article above all scholarly outputs, yet has authored as many highly regarded books as a scholar in the humanities. His *Feast: Why humans share food* has been translated into several languages and won Food Book of the Year from the Guild of Food Writers. He views academia and society as a continuum, campaigning for archaeobotanical contributions to global food security (e.g. by promoting millet as a drought-resistant crop) and working with world players such as Unilever to encourage archaeologically informed decisions regarding food products.

That Martin's achievements and influence merit celebration is clear. That his colleagues and students wish to honour him is equally so. Yet does the McDonald Conversations series publish *Festschriften*? This is a semantic question. As series editor I am delighted to introduce a collection of important papers regarding the past, present and future of archaeobotany, representing its methodological diversity and maturity. That this collection concurrently pays respect to a treasured colleague is a very pleasant serendipity.

Dr James H. Barrett

Part III
The Stomach and the Soul

Chapter 7

‘Rice Needs People to Grow it’: Foraging/Farming Transitions and Food Conceptualization in the Highlands of Borneo

Graeme Barker, Christopher O. Hunt, Evan Hill, Samantha Jones
& Shawn O’Donnell

Introduction

At the transition from the Pleistocene to the Holocene 11,500 years ago, most of the world’s population lived by various combinations of hunting, fishing and gathering. By 5000 years ago a wide variety of agricultural systems had been established in the Americas, Africa and across Eurasia (Barker 2006). Though examples of sedentism, population increase, systems of inequality and conflict, separately and in combination, can all be observed in the hunter-gatherer archaeological record, these are still mostly first evident with the development of food production. Today, most of the world’s 7 billion people rely on a small number of crops as their food staples: maize, rice, wheat, potato, cassava and sorghum (in descending order of annual tonnage). Only five large (over 50 kg) domestic animals are globally important: cow, sheep, goat, pig and horse. From this perspective the development of agriculture was clearly a genuine revolution in human history, in many respects the most important. All too frequently, however, despite the major successive theoretical movements in which the beginnings of farming have been studied since V. Gordon Childe (culture history, processual archaeology, post-processual archaeology, etc.), and the extraordinary parallel developments in archaeological science, the debates have remained obstinately beset by notions of ‘linear progress’ that would be familiar to the Victorian antiquarians and archaeologists who first proposed pathways of human progress from savagery to civilization. Though a range of different scenarios have been proposed, with foragers variously being ‘pushed’ or ‘pulled’ into food production by factors such as climate change, population pressure, contact with agriculturalists and/or internal social competition, the arguments have been predominantly based,

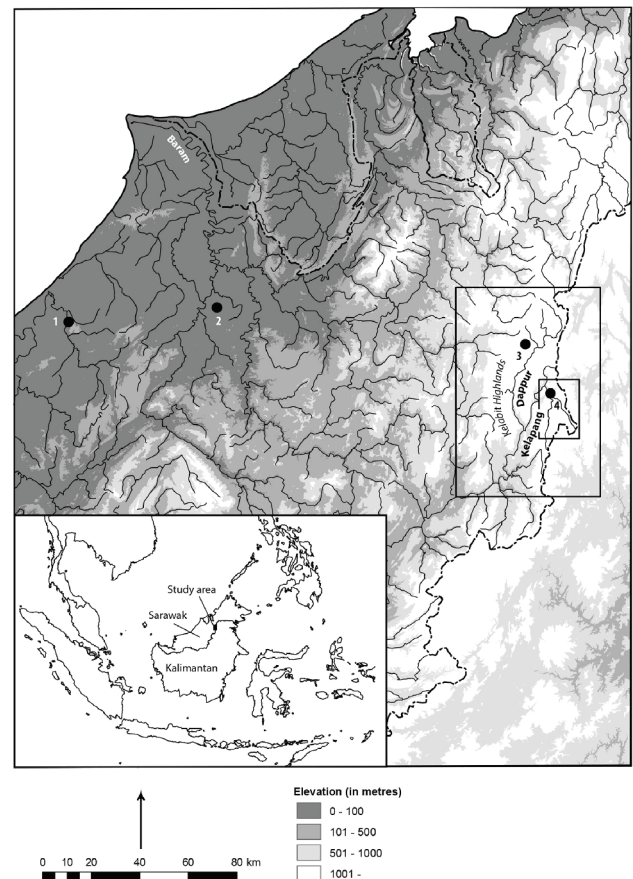


Figure 7.1. Borneo, showing the location of the Kelabit Highlands and other locations mentioned in the text: (1) Niah Caves; (2) Loagan Bunut; (3) Bario, northern Kelabit Highlands; (4) Upper Kelapang Valley, southern Kelabit Highlands. (Illustration: Lucy Farr & Chris Hunt.)

in the Old World especially, on the assumed economic value of the new resources as food staples. By contrast,



Figure 7.2. *Penan encampment in the Baram valley. (Photograph: Monica Janowski, reproduced with her kind permission, and permission from the McDonald Institute.)*

whether writing about Palaeolithic diets in Europe, or early farming in Europe or China, or the diets of later societies, Martin Jones has consistently emphasized the cultural as well as economic value of food, with the meal being the major locus of social interactions, past and present (e.g. M. Jones 2007). In this contribution, we explore how these themes intersect in the rainforest lives of Island Southeast Asians, present and past, taking as our main case study the Kelabit Highlands of interior Borneo.

The Kelabit Highlands and their present-day inhabitants

The Kelabit Highlands straddle the present-day border between Malaysian Sarawak and Indonesian Kalimantan (Fig. 7.1). Tributary rivers form on the Sarawak side that drain westwards and southwestwards to form the Baram River that eventually flows into the

South China Sea at the border between Sarawak and Brunei. The river valleys, mostly between 1000 m and 1500 m above sea level, are the most inhabited parts of the Highlands, surrounded by mountains that rise to almost 2500 m above sea level.

The region today is occupied by two main tribal groups, the Penan and the Kelabit. In recent decades the Penan, who number some 16,000 people, have been actively encouraged by the Malaysian government to settle down and engage in cultivation, including rice cultivation. Traditionally, however, they were (and a few hundred still are) foragers or hunter-gatherers who practised residential mobility: small family groups of men, women and children moved together every few weeks from camp to camp in search of food (Brosius 1991; 1999; Nicolaisen 1976; Sellato 1994; Urquhart 1959). Their camp-sites were ephemeral, consisting of flimsy roofed shelters mostly without walls (Fig. 7.2).



Figure 7.3. Kelabit longhouse at Pa'Daleh, southern Kelabit Highlands: (above) external view showing the family structures attached to the main communal area and (below) internal view showing the communal area and the family hearths on the right. (Photographs: Graeme Barker.)

During their seasonal cycle of mobility, the Penan collected a wide range of edible plants, but obtained most of their carbohydrates by extracting starch from the sago palm *Eugeissona utilis* (Brosius 1991). Cut stems were pounded to a mash and this was then washed on matting at a stream to produce a kind of dough. The trees were carefully managed by thinning branches and clearing competitor vegetation, a system of protection or management that the Penan termed *molong* ['stewardship' or 'caring for']. The Penan also hunted a wide range of animals with dogs and (before the advent of guns) spears and blowpipes, the most valued prey being the bearded pig (*Sus barbatus*), which could sometimes be killed in numbers during their movements through the forest in search of fruiting trees. Other favoured game included sambar deer (*Cervus unicolor*) and barking deer (*Muntiacus muntjac*). Traditionally the Penan also traded forest products such as baskets, rattan maps, dammar resin from dipterocarp trees, bezoar stones from monkey intestines, rhinoceros horn, camphor and hornbill feathers for metal, cloth, salt and tobacco, obtained from neighbouring agriculturalists.

The Penan term for forest, *tana'*, refers to the entire forest world of which they are a part, a forest animated by spirits that need nurturing (and sometimes appeasing) through *molong*. They take care only to leave footprints (*uban*) in the forest as a record of their passing, marks or pathways through the forest that, though ephemeral in the literal sense, endure in memory from generation to generation as evidence of their continued 'belonging' to the forest (Janowski & Langub 2011, 121).

The Kelabit are one of the smallest ethnic groups in Sarawak, numbering only about 6600 people, most of whom have migrated to the coastal towns such as Miri in recent decades; many work in the off-shore oil industry, for example. Only about 1500 Kelabit still live permanently in the Kelabit Highlands, though urban Kelabit frequently visit their family villages, a journey made far easier in the past 15 years or so by the construction of logging roads into the interior. The Kelabit live in small communities of about 100 people in substantial timber longhouses, usually two or three per settlement (Fig. 7.3). Each longhouse is divided into a public area (*tawa'*) with sleeping spaces for separate families (*telong*) down its side, each family's private space fronted by a substantial cooking hearth (Janowski 2003). The Kelabit grow rice, both wet rice on bottomland paddies and hill rice on cleared swidden fields that are used for a few years and then left to revert to secondary forest. They also grow a range of vegetables and fruits, and keep chickens, pigs and buffalo, but they derive much of their fruit and

vegetables by gathering in the secondary forest (the 'women's forest') and most of their meat by hunting, the latter especially in the untouched primary forest or 'men's forest' reserved for hunting so game is not scared away. Before the availability of metal sheets for roofing, the Kelabit used sago leaves for thatch, and they eat sago shoots as a vegetable, but they do not process sago for its starch like the Penan, nor practise *molong* of forest resources.

In her 1980s study of the Kelabit community of Pa'Dalih in the Upper Kelapang Valley in the southern Highlands (Fig. 7.1: site 4), Janowski (2003) described their social relations as 'rice-based kinship', with the thrice-daily rice meal creating the appropriate hierarchical relations between parents and children. Rice and rice growing were also the key signifiers of status: those who provided food for others in the community, most commonly in the 'hearth group' to which they belonged, had higher status than those who were fed. The group leaders—of groups of longhouses, or of single longhouses, or of hearth groups within a longhouse—were invariably leaders in rice cultivation. 'Rice, then, both organizes Kelabit kinship and makes it hierarchical' (Janowski 2003, 51).

Before their conversion to Christianity in the 1950s, an important component of Kelabit traditional life was the making of 'marks' (*etuu*) on the landscape that, unlike the Penan's *uban*, were intended as permanent records of how Kelabit lives were imposed on the forest. 'An *etuu* is a long-lasting mark on the landscape, with the most important *etuu* involving the moving of stone or earth' (Janowski & Langub 2011, 127). Stone menhirs (*batu senuped*) were erected; stone slabs were cut to make burial cists (*batu nangan*) and stone jars (*batu longon*) were carved as burial containers; boulders were incised, including with anthropomorphic figures (*batu narit*); stone mounds (*perupun*) were raised; ditches (*nabang*) were excavated and tree-lines (*kawang*) cut in prominent locations such as sharp-sided ridges to be visible from a distance; and rice fields were constructed. In living memory, and according to the Kelabit in the past too, the death of a prominent individual was marked by the communal enterprises such as constructing *perupun* for depositing valuable possessions of the deceased, or cutting *nabang* and/or *kawang*, followed by a feast (*irau*) at which a pig or buffalo would be killed.

Though in terms of their subsistence economy the Kelabit are profoundly reliant on the forest for meat and many vegetable foods as well as for materials for longhouse building and craft products, they are also reliant on it in psychological terms because the wild life force (*lalud*) of the forest has remained central to their sense of place in the cosmos, despite (and in

fact accommodated within) the tenets of Christianity following their conversion. Whilst domestic animals were slaughtered at *irau*, *lalud* was acquired by consuming meat from animals killed in the forest. For the people of Pa'Dalih in the late 1980s and early 1990s, rice was categorically opposed to forest products, both meat and handicraft materials: '[rice] was, in fact, the antithesis of forest products, because it can only grow in the tropical forest if people plant it, whereas forest products grow on their own (*mulun sebulang*)' (Janowski 2003, 51). The Kelabit were self-conscious rice growers, rice growing making a statement about their *non*-reliance on the forest. Rice had a special role in defining and creating human culture (*ulun*): its cultivation symbolized the control of nature. Rice was eaten three times a day, always with foods from the forest, so eating the latter brought *lalud* into the home, whereas eating rice made *ulun* possible.

Rice-growing and the Austronesian hypothesis

The Penan and the Kelabit speak languages that belong to the Malayo-Polynesian branch of the Austronesian language family that is spread widely across Island Southeast Asia and the Pacific, with outliers to the west in Madagascar. For almost four decades, research on the origins of rice farming in Island Southeast Asia has been dominated by debates about the strengths and weaknesses of the Austronesian language and farming dispersal model initially proposed by Peter Bellwood in 1985, and since expanded and defended by him in numerous publications (e.g. Bellwood 1988; 1996; 1997; 2001; 2002; 2005; 2011; Bellwood *et al.* 1992; Diamond & Bellwood 2003). The thesis derived originally from linguistic arguments that the language family had its origins in Taiwan, the region of highest linguistic diversity (Blust 1976; Pawley & Green 1975; Shutler & Marck 1975). Bellwood argued that rice cultivation and animal husbandry (of pigs, dogs and chickens) began in mainland China and then spread to Taiwan, and that (proto)-Austronesian-speaking Neolithic farmers then spread southwards across Island Southeast Asia and onwards to the further Pacific, taking with them the practices of rice farming and animal husbandry (of pigs, dogs and chickens) and new sets of material culture (pottery, polished stone tools and shell ornaments). Sites with Neolithic material culture had been dated to *c.* 6000 BP in Taiwan, *c.* 5000/4500 BP in the Philippines and Sulawesi and *c.* 4000 BP in East Timor (Bellwood 1985), indicating a broad chronological trend from northwest to southeast that fitted the hypothesis of a maritime Austronesian/Neolithic colonization movement, memorably described by Jared Diamond (1988) as the 'Austronesian express train'.

Since the formulation of the model, however, genetic studies of modern populations in Island Southeast Asia have shown that the main population movements that formed them were not in fact at the time of the putative Austronesian expansion, but in the Late Pleistocene, when the region was first colonized by modern humans, and especially at the beginning of the Holocene, when an area of continental shelf the size of Europe was flooded by rising sea levels (Soares *et al.* 2008). Most of the present-day diversity of Near and Remote Oceanian populations was already established by the end of the Pleistocene (Soares *et al.* 2011). Mitochondrial DNA, Y-chromosome and genome-wide data do not indicate significant population movement in the mid-Holocene out of Taiwan around 5000 years ago. Two minor flows, one from Mainland Southeast Asia to Java, Sumatra, Borneo and possibly Sulawesi, and another from South China via Taiwan into the Philippines but not beyond, are interpreted as evidence of small-scale migration and language drift, rather than a large demographic event (Soares *et al.* 2016).

Direct evidence for domesticates associated with Neolithic material culture in Island Southeast Asia, and even more so for a dietary reliance on them, remains remarkably thin on the ground. Rice grains in pottery temper have been reported from Neolithic sites in the northern Philippines, but their domestic status was not demonstrated in detail (Snow *et al.* 1986). Grains and phytoliths of domestic rice have been found as pottery inclusions in Gua Sireh cave in Sarawak, northern Borneo, dated to *c.* 4300 cal. BP (Bellwood *et al.* 1992; Datan 1993). Grains of domestic rice were found as inclusions in 14 of the *c.* 1500 Neolithic sherds from the 1950s and 1960s excavations by Tom and Barbara Harrisson in the Niah Caves (Doherty *et al.* 2000; Fig. 7.1: site 1) and, whether imported or grown locally, rice appears to have made a negligible contribution to the diet, which, as in the earlier Holocene, was based almost entirely on forest foods (Lloyd-Smith *et al.* 2013). Rice phytoliths have been recovered from sediments at Minanga Sipakko and Kamassi in western Sulawesi dated to *c.* 3600–2900 cal. BP associated with Neolithic material culture, but whilst their bilobate and fan morphologies are similar to those of modern domestic rice, they may derive from an unknown species of wild rice (Anggraeni *et al.* 2014, 750) like the rice phytoliths dated to around 6000 cal. BP in a sediment core from Loagan Bunut lake near the Niah Caves (Hunt *et al.* 2016; Fig. 7.1: site 2). Bones of domestic pig associated with Neolithic material culture have been identified at Nagsbaran in the northern Philippines dated to 4500–4200 cal. BP (Piper *et al.* 2009) and (together with bones of domestic

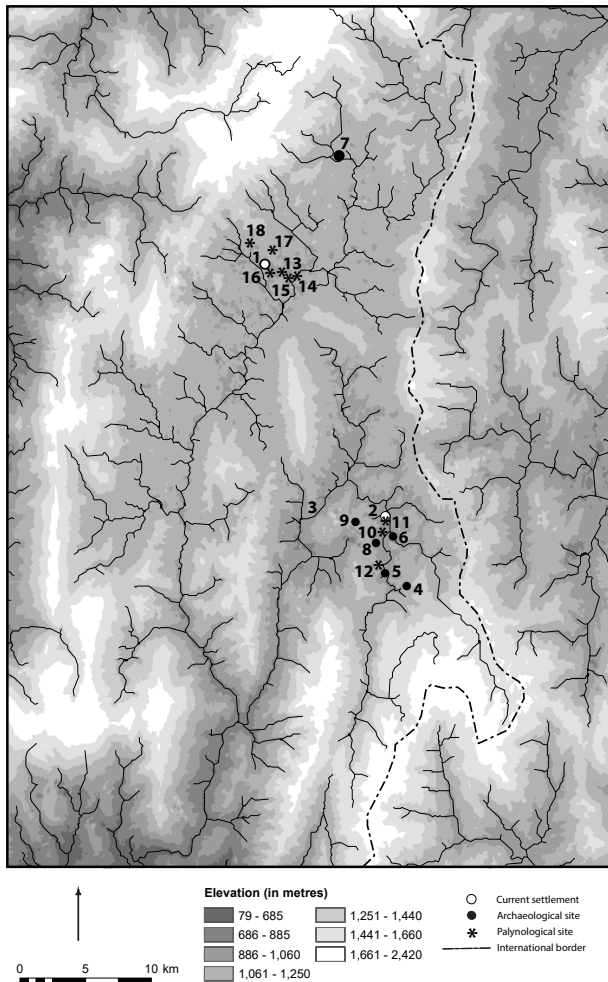


Figure 7.4. Map showing key sites and locations in the Kelabit Highlands investigated by the Cultured Rainforest Project. Modern sites: (1) Bario; (2) Pa'Dalih; (3) Kelapang River. Archaeological sites: (4) Lepo Batu; (5) Rumah Ma'on Dakah, Rumah Ma'on Taa Payo, Perupun Long Kelit; (6) Menatoh Long Diit; (7) Perupun Rayeh, Pa' Lungan, Ra'an Ma'on Ubud; (8) Perupun Payeh Telipa; (9) Rumah Ma'on Raan Berangan. Landscape sites: (10) PDH212; (11) PDH223; (12) BPG, Pa' Buda; (13) Ba (Bario); (14) BIO5; (15) BIO7; (16) BIO16; (17) BIO50; (18) BIO51; (19) BIO53; (20) BIO54; (21) CO1. (Illustration: Lucy Farr & Chris Hunt.)

dog) at Minanga Sipakko and Kamassi in sediments dated to 3600–2900 cal. BP (Anggraeni *et al.* 2014), but in both cases the principal fauna consisted of game. Rice grains and chaff in Metal Age pottery from a number of coastal sites in Sarawak suggest that rice growing only became widespread in this part of Borneo through this period, which is dated from around 2000 to 500 years ago (Doherty *et al.* 2000). A pollen

core in coastal swamp forest in Batulicin in southern Kalimantan (southern Borneo) likewise indicates that rice growing only became common in recent centuries (Yulianto *et al.* 2005). Bones of domestic pigs and dogs also only occur in the Niah Caves in Metal Age deposits (Szabó *et al.* 2013). So why was rice not adopted immediately as a staple food? And when, how and why did the present-day subsistence systems and associated cosmologies of the Penan and Kelabit in interior Borneo develop?

The history of people and rainforest in the Kelabit Highlands

Both the Penan and the Kelabit believe that they and their very different ways of living in the forest have a deep antiquity, but until a decade ago there was virtually no evidence about the character of past societies and land-use systems in the Kelabit Highlands beyond their origin myths. The Cultured Rainforest Project was an investigation of past and present-day 'rainforest lives' in the Kelabit Highlands, funded primarily by the UK Arts and Humanities Research Council as a contribution to its Landscape and Environment programme (Barker *et al.* 2008; 2009; 2016; Janowski & Langub 2011; Lloyd-Smith *et al.* 2010). Its fieldwork, primarily conducted between 2008 and 2011, combined anthropological and ethnographic studies of present-day Penan and Kelabit communities with mapping and excavations of selected archaeological sites and monuments, mainly in the southern Highlands, and sediment coring in both the northern and southern Highlands for palynological analysis of forest history, including human impacts on the forest (Fig. 7.4).

The archaeological and palynological components of the project identified a complex Late Holocene history of human activity and vegetation change, which is summarized in Figure 7.5. Here, the Oxcal plot of summed radiocarbon dates on charcoal found in our landscape evaluations provides an indication of the frequency of fire in the landscape, while summed dates from archaeological sites provide evidence for phases of human presence. The presence of pollen of key starchy food plants in our cores is also indicated. The summed radiocarbon dates are listed in Table 7.1. We make the assumption from the pattern of dates that human activity is the most common cause of fire in this landscape, in which there is no true dry season. It must not be forgotten that radiocarbon dates on charcoal record the date of the growth of the part of the tree that was later burned, and not the date of the burning. Trees in Borneo do not seem to reach great ages, but some of the dates discussed below may well pre-date the fires that produced the charcoal by one or

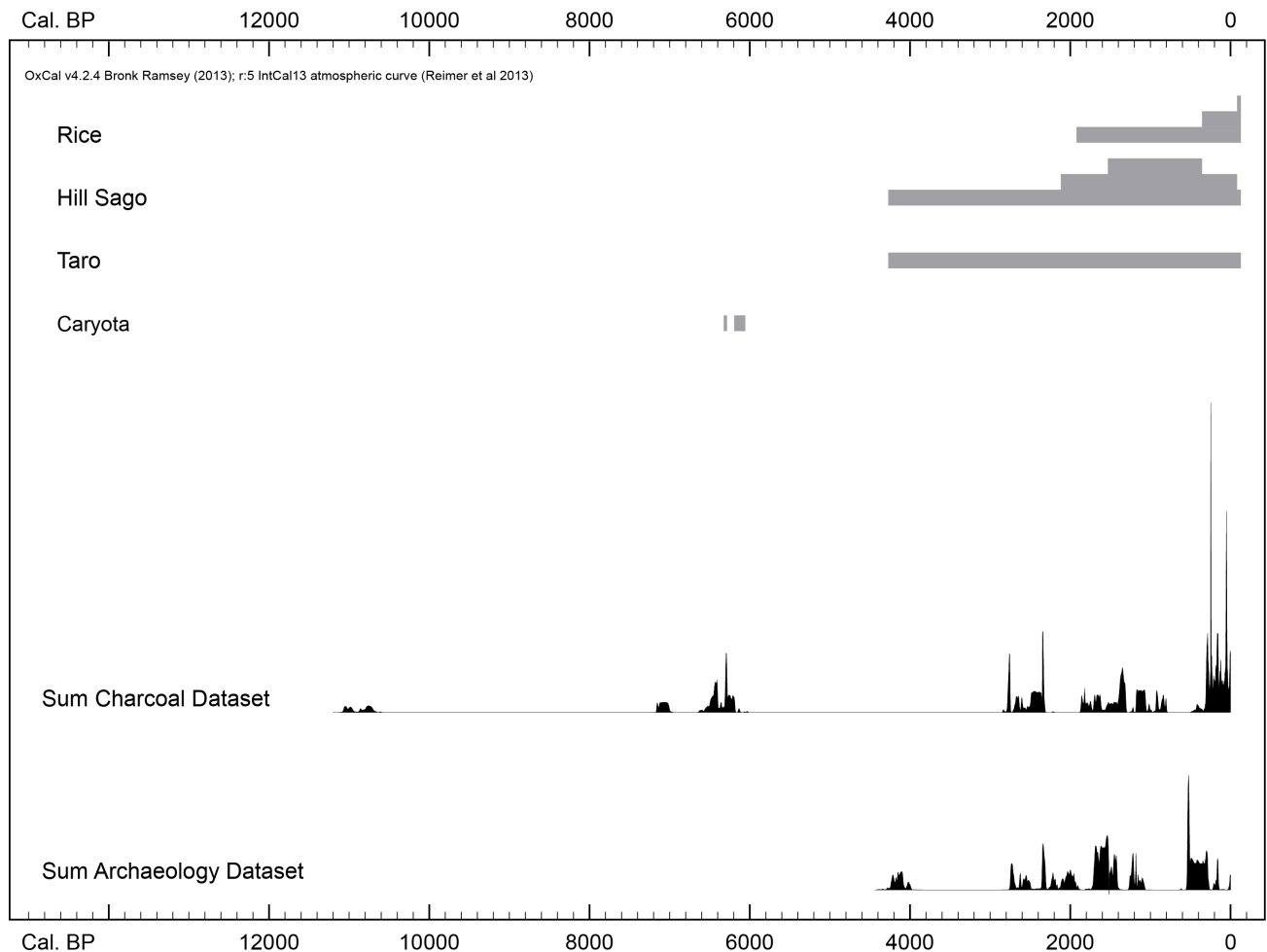


Figure 7.5. Oxcal plots of summed probabilities from the radiocarbon dates from charcoal from archaeological and landscape sites, providing an indication of the timing of human activity in the Kelabit Highlands, and evidence from our cores for the presence of important starchy food plants. (Illustration: Chris Hunt & Evan Hill.)

two centuries. The very recent charcoal-based dates recorded in Table 7.1 suggest that, in some cases, much younger plants were burned, however, and in older dates the cumulative radiocarbon errors are well over a century, so we are not adding a correction for old wood to the discussion of the charcoal dates. In the last *c.* 3000 years there is a fair degree of correspondence between the broad patterns, although very young archaeological sites were not dated by radiocarbon and Oxcal will not calibrate post-1950 dates, thus truncating the landscape record, which contains several very recent dates (Table 7.1).

Although the Kelabit Highlands record of human presence only goes back around 6000 years, from our earlier work at the Niah Caves on the Sarawak lowlands we know that people in Borneo—anatomically modern humans, on the evidence of the ‘Deep Skull’ found in the 1958 Harrison excavations of the

West Mouth of Niah Great Cave—were systematically burning the forest from as early as 50,000 years ago (Barker 2013; Barker & Farr 2016; Barker *et al.* 2007; Hunt *et al.* 2007; 2012; 2016). A wide range of archaeological evidence (carbonized plant remains such as fruits and nuts, tuber parenchyma, phytoliths and starch grains in sediments and in organic residues attached to stone artefacts) suggests that foragers were combining hunting, fishing and gathering with the management (‘vegiculture’) of tuberous plants such as taro and yams, and sago palms, presumably making use of the clearings being created by firing forest edges (Barker *et al.* 2007; 2011; Barton 2016; Barton & Denham 2011; Barton *et al.* 2016). Similar evidence has been found elsewhere in Island Southeast Asia and New Guinea (Barker *et al.* 2011; Hunt & Rabett 2014; Summerhayes *et al.* 2010). Remarkable evidence for the ability of these rainforest foragers to translocate plants

Table 7.1. Radiocarbon dates from archaeological and palynological sites in the Kelabit Highlands, calibrated using Calib 7.0.4, CALibomb and the INTCAL13 and INTCAL13.f14c calibration curves (Hua et al. 2013; Reimer et al. 2013).

Sample code	Lab. code	Material	Radio-carbon age BP	±	AMS $\delta^{13}\text{C}$	F ¹⁴ C	±	Cal. age ranges 2σ	Cal. age ranges BP 2σ	Probability
<i>Archaeological sites</i>										
Perapun Raya Pa'Lungan	Beta-280504	Burnt bone	1980	40	-19.8			86–78 BC 55 BC–AD 90 AD 98–124	2027–2035 1860–2004 1826–1852	0.008 0.958 0.0337
Rumah Ma'on Raan Berangan	Beta-237854	Charcoal	400	40				AD 1432–1526 AD 1556–1632	424–518 318–394	0.700 0.300
Menatoh Long Kelit	Beta-237848	Charcoal	240	40				AD 1520–1592 AD 1620–1684 AD 1733–1807 AD 1928–1956	358–430 266–330 143–217 –6–22	0.150 0.414 0.318 0.119
Perupun Long Kelit	UBA-1221	Charcoal	501	22				AD 1408–1441	509–542	1.000
Laman Pa' Rmain	Beta-424168	Charcoal	1740	30				AD 237–384	1566–1713	1.000
Rumah Ma'on Dakah, Long Kelit	Beta-280502	Charcoal	2050	40				173 BC–AD 28 AD 40–48	1922–2122 1902–1910	0.987 0.013
Rumah Ma'on Dakah, Long Kelit	Beta-237849	Charcoal	3770	40				2334–2325 BC 2301–2114 BC 2101–2037 BC	4274–4283 4063–4250 3986–4050	0.007 0.864 0.129
Lepo Batu	Beta-237853	Charcoal	2550	40				806–728 BC 713–710 BC 693–658 BC 653–542 BC	2677–2755 2659–2662 2607–2642 2491–2602	0.464 0.003 0.126 0.406
Rumah Ma'on Taa Payo	Beta-237850	Charcoal	1620	40				AD 345–372 AD 376–541	1578–1605 1409–1574	0.056 0.944
Rumah Ma'on Taa Payo	Beta-280503	Charcoal	1630	40				AD 339–538	1412–1611	1.000
Menatoh Long Diit	UBA-12420	Charcoal	1238	22				AD 688–754 AD 757–779 AD 789–872	1196–1262 1171–1193 1078–1161	0.525 0.165 0.310
Menatoh Long Diit	Beta-280500	Cremated bone	310	40				AD 1471–1654	296–479	1.000
Menatoh Long Diit	Beta-280499	Charcoal	1710	40				AD 241–409	1541–1709	1.000
Menatoh Long Diit	Beta-280501	Charcoal	2300	40				1606–1583 BC 1559–1553 BC 1546–1405 BC	3532–3555 3502–3508 3354–3495	0.034 0.006 0.960

is the presence of swamp sago, *Metroxylon*, which is native to the islands east of the Wallace Line but not to Borneo, in layers dated to around 10,000 cal. BP from a deep sediment core at Loagan Bunut in the lowlands close to Niah, where it is associated with evidence for persistent vegetation management by fire (Hunt & Premathilake 2012; Hunt & Rushworth 2005). Furthermore, the 'Deep Skull', part of a secondary burial

dated by uranium series to some 37,000 years ago (Pike 2016), is associated with unworn quartz crystals brought from one of the granites in the interior (Hunt & Barker 2014). We found charcoal in several Late Pleistocene and Early Holocene sequences from cores in both the northern and southern Highlands that is suggestive of fires (S. Jones *et al.* 2014), but there is no archaeological evidence that would allow us to link

Table 7.1. (Continued.)

Sample code	Lab. code	Material	Radio-carbon age BP	±	AMS $\delta^{13}\text{C}$	F ¹⁴ C	±	Cal. age ranges 2σ	Cal. age ranges BP 2σ	Probability
<i>Palynological sites</i>										
PDHCOL1 161-163	UBA-8126	Charcoal	972	28				AD 1075–1154 AD 1065–1075 AD 1016–1059	891–934 875–885 796–875	0.399 0.020 0.581
PDHCOL1 265.5-271.5	UBA-8127	Charcoal	92	31				AD 1683–1735 AD 1806–1930 AD 1955–1955	215–267 20–144 –5– –5	0.279 0.720 0.001
PDHCOL1 324-326	UBA-8128	Charcoal	190	26				AD 1654–1687 AD 1730–1809 AD 1926–1955	263–296 141–220 –5–24	0.218 0.572 0.210
PDHCOL1 360	UBA-8129	Charcoal	1180	32				AD 919–962 AD 769–902 AD 728–736	988–1031 1048–1181 1214–1222	0.095 0.893 0.011
PDH 212 31	UBA-10584	Charcoal	43	17		0.9946	0.0021	AD 1707–1719 AD 1825–1832 AD 1884–1913 AD 1955–1956	231–243 118–125 37–66 –6– –5	0.051 0.024 0.872 0.053
PDH 212 95-97	UBA-12735	Wood	329	23				AD 1607–1641 AD 1486–1604	309–343 346–464	0.211 0.789
PDH 212 193-194	UBA-10585	Charcoal	2655	23				842–795 BC 888–882 BC	2744–2791 2831–2837	0.991 0.009
PDH 223 144–146	UBA-10593	Charcoal	1751	19	–23.0			AD 237–342	1608–1713	1.0
PDH 223 178–182	UBA-10594	Charcoal	1867	18	–28.0			AD 82–215	1735–1868	1.0
PDH 223 275–278	UBA-10595	Charcoal	2308	18	–28.3			402–371 BC	2320–2351	1.0
BPG 89	UBA-8130	Charcoal	5692	43				4623–4449 BC 4682–4632 BC	6398–6572 6581–6631	0.930 0.070
BPG 152-154	UBA-9305	Charcoal	6177	23				5213–5055 BC	7004–7162	1.0
BPG 156-158	UBA-9308	Charcoal	5396	27				4195–4175 BC 4334–4230 BC	6124–6144 6179–6283	0.045 0.955
BPG 170-172	UBA-9309	Charcoal	5495	24				4291–4266 BC 4365–4321 BC	6215–6240 6270–6314	0.124 0.876
BPG 192-194	UBA-9306	Charcoal	5633	23				4423–4372 BC 4528–4442 BC	6321–6372 6391–6477	0.185 0.815

these fires with human activity. Hence it is very likely that people were foraging in the Kelabit Highlands leaving little trace of their passing much earlier than our first clear indications of human presence.

The ensuing record of human activity can be divided into four main phases.

Phase 1: 6200–4200 years ago; possible clearance for foraging-arboriculture

The first stage in the sequence is marked by phytoliths, pollen and charcoal in core BPG taken in a riverine

deposit at Pa’Buda in the southern Highlands (Fig. 7.6). The two basal dates in the borehole are in stratigraphic order, suggesting that the three higher, older dates are on recycled material or derived from charcoal from older wood. Phytoliths in the core are consistent with hot fire and the spread of grass-based vegetation that are associated elsewhere in Australasia and Island Southeast Asia with anthropogenic clearance. The first canopy-opening episode in the core was followed by pollen evidence for palm trees, including the sago palm (*Caryota*), fruit trees and grassy areas in an

Table 7.1. (Continued.)

Sample code	Lab. code	Material	Radio-carbon age BP	±	AMS $\delta^{13}\text{C}$	F ¹⁴ C	±	Cal. age ranges 2σ	Cal. age ranges BP 2σ	Probability
BIO16 13-13.5	UBA-9993	Charcoal	2426	25	-24.9			551–405 BC 665–645 BC 744–687 BC	2354–2500 2594–2614 2636–2693	0.789 0.045 0.166
BIO16 21-22	UBA-9994	Charcoal	1594	48	-29.9	0.8199	0.0050	AD 380–573 AD 351–367	1377–1570 1583–1599	0.985 0.015
BIO16 32.5-33	UBA-9995	Charcoal	2428	42	-28.3			594–403 BC 669–611 BC 753–681 BC	2352–2543 2560–2618 2630–2702	0.670 0.118 0.211
BIO16 140-141	UBA-9997	Charcoal	1473	25	-24.3	0.8324	0.0027	AD 550–640	1310–1400	1.0
BIO16-A 190 cm	UBA-10592	Charcoal	49	26	-26.0	0.9939	0.0033	AD 1695–1726 AD 1813–1839 AD 1841–1854 AD 1867–1918 AD 1955–1956	224–255 111–137 96–109 32–83 -6–-5	0.011 0.594 0.032 0.152 0.211
Ba 29–31 cm	UBA-15637	Peat	1433	23				AD 585–653	1297–1365	1.0
Ba 32.5–33 cm	UBA-9995	Charcoal	2428	42				594–403 BC 669–611 BC 753–681 BC	2352–2543 2560–2618 2630–2702	0.670 0.118 0.211
Ba 47–49 cm	UBA-10000	Wood	1719	25	-25.5	0.8073	0.0026	AD 310–388 AD 252–308	1562–1640 1642–1698	0.598 0.401
Ba 59–65 cm	UBA-10001	Wood	4841	29	-25.2	0.5473	0.0020	3581–3533 BC 3672–3630 BC 3695–3677 BC	5482–5530 5579–5621 5626–5644	0.287 0.658 0.054
PPP10	Beta-292528	Organic mud			-30.5	1.038	0.005	AD 1955.3–1956.2 AD 1956.7–1957.7 AD 2007.9–2008.5 AD 2009.0–2009.5	-6.2–-5.3 -7.7–-6.7 -58.5–-57.9 -59.5–-59.0	0.092 0.660 0.122 0.126
PPP40-42	UBA-25831	Organic mud	10808	49		0.2604	0.0016	10,824–10,709 BC	12,658–12,773	1.0
PPP60-62	UBA-25832	Organic mud	2532	25		0.7296	0.0023	646–549 BC 687–664 BC 795–739 BC	2498–2595 2613–2636 2688–2744	0.439 0.136 0.425
PPP90	UBA-292529	Organic mud	4480	40	-28.5			3068–3026 BC 3348–3082 BC	4975–5017 5031–5297	0.083 0.917
BIO5-1	UBA-19805	Charcoal	227	32	-30.9	0.9721	0.0039	AD 1532–1536 AD 1636–1683 AD 1734–1806 AD 1929–1956	414–418 267–314 144–216 -6–-20	0.005 0.420 0.420 0.156
BIO5-2	UBA-19806	Charcoal	245	64	-27.4	0.9699	0.0078	AD 1470–1697 AD 1725–1815 AD 1835–1877 AD 1917–1956	253–480 135–225 73–115 -6–-33	0.603 0.261 0.034 0.102
BIO5-3	UBA-19807	Charcoal			-30.0	1.5020	0.0054	AD 1963.0–1963.5 AD 1968.5–1968.6 AD 1969.7–1971.2 AD 1971.6–1972.3 AD 1973.6–1973.7	-13.5–-13.0 -18.6–-18.5 -21.2–-19.7 -22.3–-21.6 -23.7–-23.6	0.095 0.004 0.448 0.446 0.007

abnormal—delayed—regeneration sequence (S. Jones *et al.* 2013b). This is perhaps broadly consistent with the evidence compiled by Hunt & Rabett (2014) for the

presence of people practising extensive, low-density, foraging-arboricultural lifeways, with starchy plants being grown in fairly short-lived forest clearings

Table 7.1. (Continued.)

Sample code	Lab. code	Material	Radio-carbon age BP	±	AMS $\delta^{13}\text{C}$	F ¹⁴ C	±	Cal. age ranges 2σ	Cal. age ranges BP 2σ	Probability
BIO7-C 20-19 cm	Beta-396778	Organics	8520	30				7591–7534 BC	9483–9540	1.0
BIO7-A 52 cm	UBA-19812	Wood	23521	175	–26.7	0.0535	0.0012	26,719–25,937 BC	27,399–27,929	1.0
BIO7-B 67 cm	UBA-19813	Wood	3606	35	–27.9	0.6384	0.0028	2039–1883 BC 2118–2097 BC	3832–3988 4046–4067	0.972 0.028
BIO50-A	UBA-19808	Plant fragments			–29.5	1.0634	0.0046	AD 1957.6–1957.9 AD 2003.1–2003.4 AD 2004.0–2009.1 AD 2009.5–2009.5	–7.94– –7.7 –53.4– –53.1 –59.1– –54.0 –59.6– –59.5	0.041 0.006 0.949 0.004
BIO50-B	UBA-19809	Plant/charcoal fragment	1457	29	–28.2	0.8341	0.0030	AD 558–648	1302–1392	1
BIO51-A	UBA-19810	Plant fragments	26835	262	–31.6	0.0354	0.0011	29,591–29,013 BC	30,599–31,288	1
BIO52-C	UBA-19811	Charcoal	9517	43	–26.6	0.3058	0.0016	8932 – 8719 BC 9132–8978 BC	10,668–10,881 10,927–11,081	0.574 0.426
BIO53-13/1	UBA-19815	Charcoal			–28.2	1.0000	0.0027	AD 1895–1904 AD 1955–1956	46–55 –7– –5	0.171 0.829
BIO53-14/2	UBA-19816	Charcoal	103	30	–26.4	0.9873	0.0037	AD 1682–1737 AD 1757–1761 AD 1803–1936 AD 1955–1955	213–268 189–193 14–147 –5– –5	0.284 0.006 0.708 0.001
BIO53-15/4	UBA-19818	Charcoal	102	29	–23.4	0.9874	0.0035	AD 1682–1736 AD 1759–1760 AD 1804–1936 AD 1955–1955	214–268 190–191 14–146 –5– –5	0.284 0.001 0.714 0.001
BIO53-16/10	UBA-19823	Charcoal	193	29	–27.6	0.9762	0.0035	AD 1649–1690 AD 1729–1810 AD 1925–1955	260–301 140–221 –5–25	0.235 0.559 0.205
BIO53-17/5	UBA-19824	Charcoal	227	29	–29.1	0.9722	0.0035	AD 1640–1682 AD 1737–1758 AD 1761–1804 AD 1936–1956	268 – 310 192–213 146 –189 –6–14	0.439 0.039 0.372 0.150
BIO54-A	UBA-19825	Charcoal	1192	28	–27.7	0.8621	0.0030	725–738 768–895 928–941	1212–1225 1055–1182 1009–1022	0.023 0.957 0.020

alongside rivers. Unfortunately, there is no strong evidence to verify that the palm trees were being managed for their edible sago: the sago palm (*Caryota*) only shows a sporadic appearance, whilst *Eugeissona* (the main sago palm managed today) is not present at all in the sequence. Given such tentative evidence of human activity, the possibility of a climatic event wholly or partly causing the palaeoecological signal should not be ignored, although palaeoclimate investigations in lowland Sarawak suggest that the period between 7000 and 4000 cal. BP was marked by a hot, very wet climate (Cole *et al.* 2015).

Phase 2: 4200–2000 years ago—living in the forest with Eugeissona sago and tubers

A little more than 4000 years ago, a more definite and widespread human presence is manifested by occupation evidence on a river terrace site at Rumah Ma’ on Dakah, Long Kelit, including a large post-hole and earthenware potsherds, a polished stone fragment and burnt stones (Barker *et al.* 2016). This site is broadly contemporaneous with the occurrence of pollen of ‘hill sago’ (*Eugeissona*) in colluvial sediments underneath a stone mound called Perapun Paya Telipa (S. Jones, unpublished) and of taro (*Colocasia*) in peat in Bore-

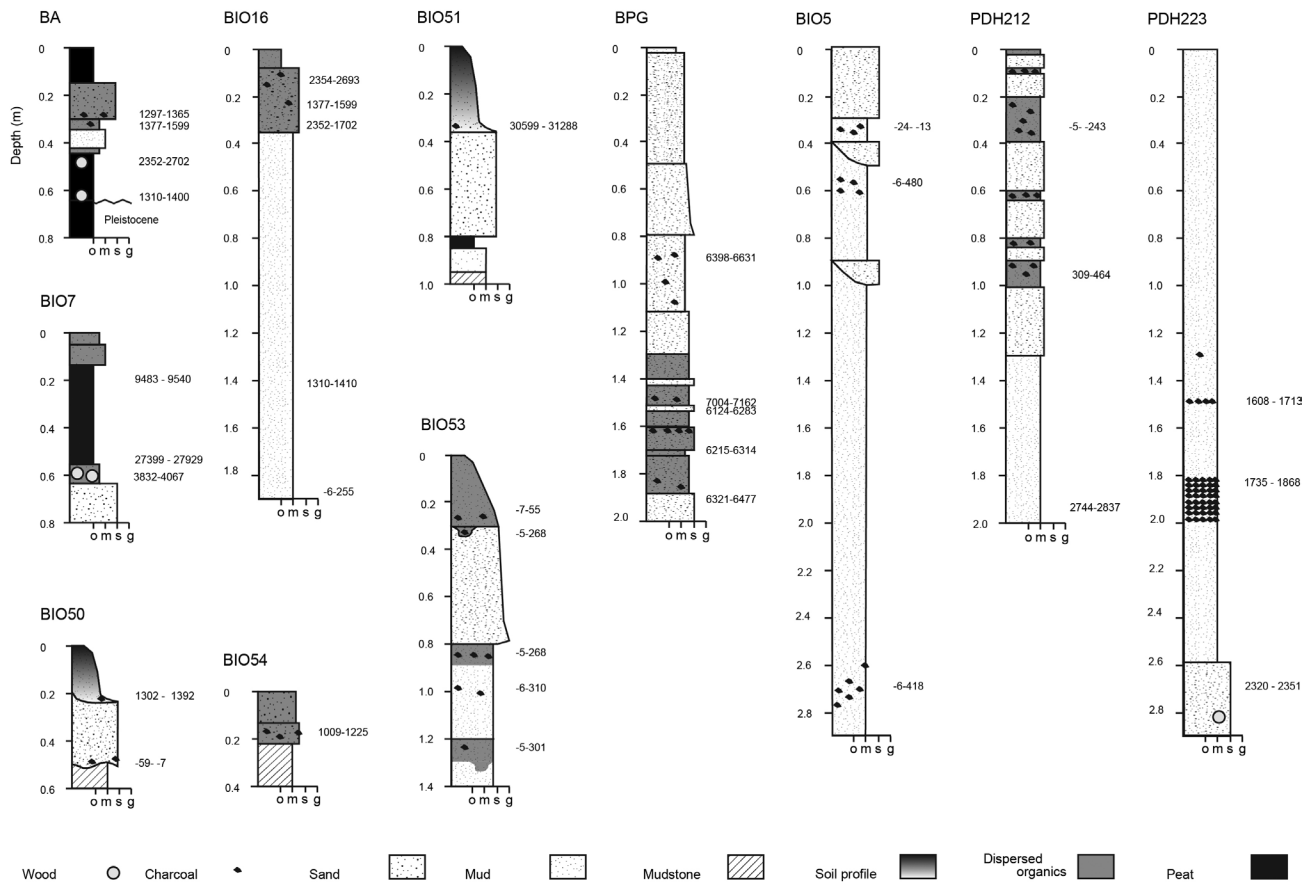


Figure 7.6. Stratigraphic summaries of the cores and geoarchaeological sites investigated by the Cultured Rainforest Project, with calibrated BP radiocarbon dates. (Illustration: Chris Hunt.)

hole BIO7 near Bario (Barker *et al.* 2016; O'Donnell 2016). Pollen of open-ground plants in layers below the appearance of *Eugeissona* suggests that the forest around Perapun Paya Telipa had been disrupted around 5000 years ago, but the level of disturbance indicators rose significantly with the appearance of *Eugeissona* and continued at this site until sub-recent times. It is difficult to make much of the evidence, except to say that human activity was probably very sparse and ephemeral at any given location, and based on a combination of vegiculture, arboriculture and foraging. The long-term nature of the pollen record for sago at Perapun Payo Telipa suggests the tending of this resource over several millennia.

Phase 3: 2000–600 years ago — *Eugeissona* and rice in tandem

Construction of stone mounds seems to have started a little more than 2000 years ago on the evidence of cremated bone at Perupun Raya Pa'Lungan (Lloyd-Smith 2012). A remarkable and substantial open site, Ruma Ma'on Taa Payo, consisting of stone-built structures on

a riverside promontory enclosed by a ditch, dates from 1600–1400 years ago (Barker *et al.* 2016; Lloyd-Smith *et al.* 2010). The appearance of these monuments could suggest that populations were sufficiently dense that people felt the need to mark key sites in the landscape, and indeed the rising density of activity is mirrored by the spread of *Eugeissona* and a more continuous pattern of radiocarbon dates (Fig. 7.5). The denser populations supported themselves by a mixture of hunting (burnt medium-sized fragments of animal bone were recovered by Tom Harrisson at Perapun Rayeh Pa'Lungan: Lloyd-Smith 2012), foraging and using starchy plants. *Eugeissona*, although less sweet than *Caryota*, provides significantly greater quantities of starch (Kedit 1982). It may be that it was at this stage that a more sedentary lifestyle developed tied to the exploitation of *Eugeissona* sago-palm groves in the manner of the present-day Penan. Related to this, perhaps the trend towards the modern Kelabit differentiation between 'women's forest' used for foraging and untouched 'men's forest' reserved for hunting developed at this time. The large quantity of

cremated animal bone at Perapun Rayeh Pa'Lungan (Lloyd-Smith 2012) may also be evidence for an *irau*-like feast of the kind practised by the Kelabit today. In other respects, though, the pattern of landscape use differed from that of today and of recent memory, as *Eugeissona* was grown in valley-floor sites, whereas today it is mostly on ridge tops.

The first indications of rice cultivation consist of extremely rare rice phytoliths in core PDH212 at Pa'Dalih. These occur in an area where there was established, though episodic, sago growing with a return interval of around 400 years. The rice phytoliths are associated with one of the peaks of sago pollen, around 1800 years ago (S. Jones *et al.* 2013a). It is possible that rice was eaten alongside sago, although sago and perhaps other root crops likely remained the preferred choice of food (or at least the necessary staple) until the historic period, with rice remaining extremely rare (Barton 2012). Rice is difficult and laborious to grow, and it does not make ecological sense to grow it in tropical rainforest alongside the wealth of other plant resources in the forest (Barton & Denham 2011). Also, growing significant quantities of rice requires efficient tools to clear land for fields, and the rarity of iron in the Highlands may have contributed to the high status of both rice and the iron tools needed to cultivate it on any scale. In this phase, therefore, rice cultivation and consumption may have been a means by which some groups started to differentiate themselves in a form of conspicuous display alongside monument building.

Phase 4: 600 years ago to the very recent past—a busy landscape

In this phase archaeological sites become more widespread, with stone jar cemeteries, former longhouse sites and ridge-top settlements known, and in the palynological record there is consistent evidence for a dramatic increase in the scale, extent and frequency of clearance activities (Barker *et al.* 2016; S. Jones *et al.* 2013b; 2016). Rice and sago spread into new locations, and stratigraphic and dating evidence indicates a shortening to around 60 years of return periods to fields after the cycle of clearance, use and fallow ('abandonment'), the pattern recorded ethnographically. In combination these changes suggest that there was a need to bring more land into use, and intensify the use of fields, to feed an increasing population.

The ways in which people marked the landscape with new monuments such as stone jar cemeteries and *perupun*, and reused existing monuments, may have been related to the same phenomenon: in an increasingly crowded landscape, there may have been a need to mark sections of it as belonging to particular groups.

One aspect of the use of these monuments after around 400 years ago is the deposition of 'exotic' materials, particularly Chinese ceramics. The presence of these 'exotic' goods suggests the connection, however indirect, of the populations in the Kelabit Highlands with the emerging global commercial system of the period and the development of distant markets for forest products, such as dammar resin (Ewart 2009). Presumably some Highland people could display prestige and extra-regional connections through their conspicuous disposal of 'exotic' goods into monuments.

It is likely that it was this more competitive, as well as crowded, landscape of recent centuries that provided the context in which rice transitioned from being a prestige food to a staple food, as precursor Kelabit communities began to identify themselves both through cultural practices such as living communally in longhouses and making 'marks' on the landscape and through distinctive dietary practices focused on rice growing. It would have been a way of life increasingly separate from precursor Penan communities combining foraging with managing sago on the margins of the rice-growing areas.

Discussion and conclusion

One of the major themes running through the long landscape history that can now be proposed for the Kelabit Highlands is the evidence, both palynological and archaeological, for the rainforest being a repository of memory of past generations. Human activity returned over long periods, sometimes millennia, to the same favoured places in the landscape. This may imply the sheer suitability of some of these sites for the activity that happened on them, but it is consistent with a memory of important places in the landscape being transmitted over the generations. This memory was undoubtedly augmented by both purposeful and inadvertent changes to the plant communities of these sites, even in the absence of visible monuments. Informants told us about longhouses being abandoned and rebuilt on sites at approximately 60-year intervals. At PDH212, the site of a longhouse abandoned approximately 60 years ago, the presence of five distinct burning horizons within the last 400 years suggests a similar timing of return through this period. A repeated pattern of return and clearance over the last 300 years may also be suggested by pits and two palaeosoils interbedded with colluvium at BIO53, a site recently cleared for residential and agricultural activity. Further back in time, the pattern of return seems to have been longer, for instance about 400 years between sago-growing phases around 2000 years ago at PDH212. The pattern of episodic return is

also shown by the chronological evidence of ^{14}C dates and artefact typology of sites such as Perapun Rumah Pa'Lungan (Lloyd-Smith 2012), Rumah Ma'on Dakah, Long Kelit and Menatoh Long Diit (Barker *et al.* 2016), where people re-used these structures several hundred years after their first use.

At other times it is possible that the return interval was much longer (although the 'gap' between dates may also reflect that preservation of evidence on some sites was patchy). A good example is BIO54, a site with huge durian trees, which were apparently planted over 100 years ago, but also bearing clear cultivation ridges from the cultivation of beans, which ceased around 1970. Underlying the cultivation ridges was a palaeosoil rich in charcoal that gave a ^{14}C date of around 1100 years ago. Sites such as BIO16 and BIO50 yielded charcoal with dates not in stratigraphic order, pointing perhaps to earlier human activity, although erosive processes have disrupted sedimentary sequences. The current Pa'Dalih longhouse site seems to have been a focus for activity including burning, sago arboriculture and rice cultivation intermittently since around 2330 years ago, from the evidence of boreholes PDH223 and PDH212. Earlier dates of human arboriculture are more tentative and possibly blurred with the impacts of climatic episodes. Pa'Buda, for example, shows a major canopy-opening episode, followed by abnormal regeneration flora, around 6200 years ago, that may well be representative of low-intensity arboriculture. Climate-induced aridity oscillations in the period 8000–6000 BP have been reported in Java and Kalimantan (Sémah *et al.* 2004; Stuijts 1993), although the closest record, in Sarawak, shows this to be a period of high rainfall and without hydrological stress (Cole *et al.* 2015).

After 4000 cal. BP, arboriculture seems to have provided stable focal points in the landscape over extended periods. In recent times the durians and other fruit trees at BIO 56 and PDH 212 provided markers for earlier episodes of human activity and places to harvest desirable fruit. The stability of the pollen signal for *Eugeissona* over nearly 700 years (2340–1655 years ago) at PDH223 and over 4000 years at Perupun Paya Telipa suggests the maintenance of this arboricultural resource over a very extended time, since the sago trees would have been overwhelmed by taller vegetation without consistent management.

Another theme regarding the enculturing activities of past rainforest populations is plant translocations. *Eugeissona* (apart from a single occurrence in Bario), *Caryota* and *Colocasia* have not been recognized in Pleistocene or Early Holocene records in the Kelabit Highlands (S. Jones *et al.* 2013b; 2014; 2016), so may all be introductions from the lowlands, where all three

taxa were part of the group of plants exploited at Niah during the Late Pleistocene (Barton *et al.* 2016). *Eugeissona* and *Caryota* were also present in the Loagan Bunut core during the Early Holocene (Hunt & Premathilake 2012). It is noticeable that there is a broad chronological coincidence between the occurrences of cultivated rice at Gua Sireh and Niah on the lowlands and the appearance of *Eugeissona* and *Colocasia* in the Kelabit Highlands, but at the moment we can only speculate whether the translocation of the latter starchy plants into the Highlands accompanied the movement of people in response to the growth of rice using on the lowlands, or was accomplished by some other mechanism. *Eugeissona* seems to have spread slowly through the Highlands, being present in valley-floor deposits at Pa'Dalih around 2320 years ago and at Bario around 1300 years ago (S. Jones *et al.* 2013a,b). These occurrences suggest that the locations in which people practised propagation in the past were more varied than the current hilltops and ridges where the sago groves exploited by the Penan are mostly located.

There seems to be a period of about 2000 years between the first documented presence of domesticated rice varieties on the coast and their appearance in inland Borneo. A very similar pattern is evident in Sulawesi, where rice is thought to have arrived on the lowlands around 4000–3500 years ago, but was only present in the Besoa Valley in upland Sulawesi around 1870 years ago (Kirleis *et al.* 2011). There is a similar sequence of disjunctures in upland Sumatra: forest-disturbance episodes occur from about 7500 years ago, the first recognizable use of a starchy species seems to have been the appearance of the sago *Arenga* around 4000 years ago, and systematic rice cultivation is evidenced in the palynological record only in the last few centuries, as in the Kelabit Highlands (Flenley 1988). It is possible that these delays reflect in part the time necessary for rice to become adapted to the montane climate, but there is also mounting evidence that many foragers and vegiculturalists actively resisted using it as a food staple (Barton 2012; Barton & Denham 2011).

For the Kelabit and Penan of today and living memory, very different concepts of the forest and humans' relationship to it underpin the former's celebration of rice fields and rice cultivation as the principal way of marking themselves out as forest domesticators and the latter's reluctance to separate themselves from the forest and its benevolent spirits. The palynological and archaeological data collected by the Cultured Rainforest Project suggest that this conceptual divide between rice-growing, sago-avoiding Kelabit and rice-avoiding, sago-managing Penan may only have an antiquity of a few centuries (our Phase 4). Before that, in our Phase 3, the rainforest people

of the Highlands appear to have combined elements of both ways of life in ways that do not have modern analogues: foraging, managing sago and perhaps cultivating rice on a small scale, the latter perhaps undertaken or organized by emergent elites to produce a luxury food for *irau*-type feasts as a means of conspicuous display. Whether rising populations and/or social competition and/or trading opportunities drove the accelerating commitment to rice farming by the ancestral populations of the present-day Kelabit, what is most striking is that rice's 'need for people to grow it' went hand-in-hand with entirely new ways of living in communal longhouses that provided both protection from external aggressors and a very public arena for social actions and display. Intriguingly, the foods of the forest that accompany rice in most Kelabit meals today are willingly shared between neighbouring hearth groups in the longhouse, but not rice. Rice 'is the glue that holds a community together and which to a large extent dictates the roles which people take vis-à-vis each other' (Janowski 2003, 51). In the rainforests of the Kelabit Highlands we can begin to discern a shifting web of domesticatory relationships in which people, plants and animals were implicated in different ways at different times and with different trajectories. The complex history of rice in Borneo, from its first appearance several millennia ago to its adoption as a food staple in recent centuries, and of the equally complex history of sago, underlines the challenges that archaeologists face in trying to model foraging/farming transitions in a deep past unencumbered by post-Enlightenment rationality.

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