New evidence from East Timor contributes to our understanding of earliest modern human colonisation east of the Sunda Shelf

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New dates by which modern humans reached East Timor prompts this very useful update of the colonisation of Island Southeast Asia. The author addresses all the difficult questions: why are the dates for modern humans in Australia earlier than they are in Island Southeast Asia? Which route did they use to get there? If they used the southern route, why or how did they manage to bypass Flores, where Homo floresiensis, *the famous non-*sapiens *hominin known to the world as the 'hobbit' was already in residence? New work at the rock shelter of Jerimalai suggests some answers and new research directions.*

Keywords: Pleistocene, Island Southeast Asia, East Timor, *Homo sapiens*, *Homo floresiensis*, human colonisation

Introduction

This paper reports new finds from Timor, where a habitation site dated to >42 000 cal BP (38 255 ± 596 bp) provides the earliest evidence for migration by modern humans east of the Sunda Shelf into Island Southeast Asia. Until now there has been a major discrepancy between the dates for earliest occupation in Australia and those from Island Southeast Asia, with the earliest dated sites from Australia being significantly older than the oldest sites from any of the potential stepping stone islands en route (even relying purely on the radiocarbon chronology) (Bellwood 1998; O'Connor & Chappell 2003; summarised on Figure 1). Although a southern route through the Lesser Sunda islands (including Flores and Timor) has usually been proposed as the most parsimonious for maritime passage to Sahul (the ancient continent that encompassed Australia and New Guinea) (Birdsell 1977; Butlin 1993: 15, 44-51), the lack of early dated evidence on any of the stepping stone islands of this group has led some authors to propose alternative routes (albeit equally lacking in evidence for early colonisation).

Perhaps the greatest recent challenge to the southern route has been posed by the recent finds from Flores, Timor's western neighbour island, where modern humans apparently failed to colonise prior to the Holocene (Brumm *et al.* 2006). The new dates and data from

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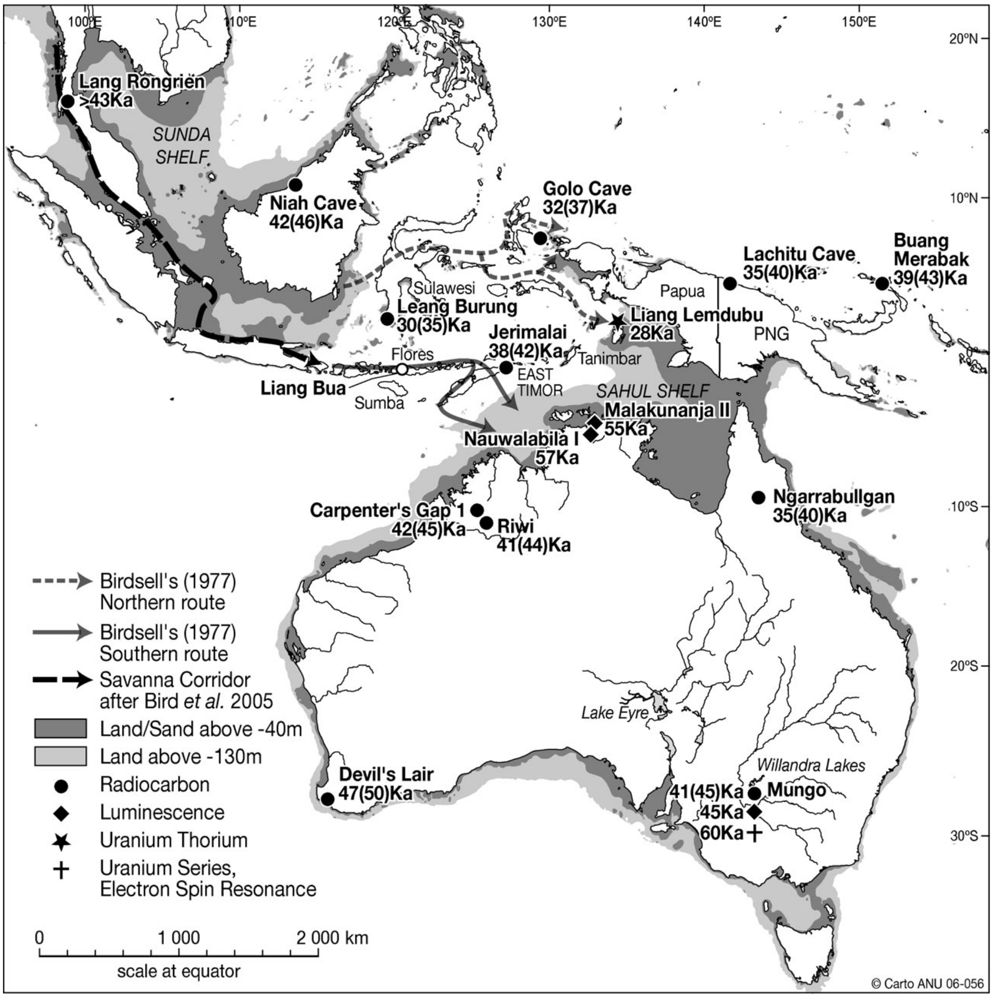

Figure 1. Location map showing Sunda Shelf, Wallacea and Sahul Shelf and sites, with associated chronometric ages mentioned in the text. The map also shows Birdsell's (1977) proposed northern and southern migration routes from Sunda to Sahul and Bird et al.*'s 2005 proposed 'savannah corridor in Sundaland'.*

Jerimalai shelter in East Timor redresses this situation, and indicate that the southern route is still a strong contender for the earliest seafaring passage to Sahul. With moderns humans firmly ensconced in Australia by this time, it would not previously have been considered necessary to argue the case that a site of this age was the product of modern human behaviour; especially one on an island requiring a water crossing to reach it (Davidson & Noble 1992; Brumm & Moore 2005: 159). But the fact that a non-modern hominin was present on Flores until 12 000 years ago changes this. In the absence of human skeletal remains, the nature of the occupation evidence from Timor is evaluated in order to demonstrate that it is qualitatively different from the assemblage produced by non-moderns from the late Pleistocene context at Liang Bua, as well as for its significance in contributing to our understanding of the types of adaptations made at this early date on route to Sahul.

Dating colonisation

The date for initial human peopling of Australia is now widely accepted to have occurred between 50 000 and 60 000 years ago (Roberts *et al.* 1990; 1994; 1998; Thorne *et al.* 1999; O'Connor & Chappell 2003). However it should be kept in mind that the early dates have been achieved by the use of techniques such as TL, OSL and ESR which have rarely been applied in archaeological contexts in Southeast Asia (Roberts *et al.* 2005). Relying exclusively on the radiocarbon chronology, dates in the order of 40 000-47 000 BP have been obtained for occupation sites in both northern and southern Australia (Turney *et al.* 2001; O'Connor & Chappell 2003) and islands to the east of New Guinea requiring further water-crossings were also first settled by at least 40 000 BP (Leavesley & Chappell 2004). However, islands on potential migration routes between Sunda and Sahul have until now failed to produce dates for modern human colonisation approaching this antiquity (Bellwood *et al.* 1998; O'Connor *et al.* 2005).

Although a southern route into Sahul through the Lesser Sundas (including Flores and Timor) has usually been proposed as the most parsimonious due to minimum distances between island hops and greatest intervisibility between islands (Birdsell 1977; Butlin 1993: 15, 44-51), early dates have not been forthcoming. Flores, the first island target of any size east of the Sunda Shelf must have been passed through, or by, if a southern route to Sahul was taken. However, while it has produced early dated sites, these were demonstrably not occupied by modern humans until the Holocene (Brown *et al.* 2004; Morwood *et al.* 2004; 2005; Brumm *et al.* 2006). Lua Meko, a cave site on Roti, the small island west of Timor, has a date of 24 000 BP associated with very low numbers of stone artefacts (Mahirta 2003: 99). Early research efforts in East Timor produced dated sequences back to 13 000 bp but recent excavations at Lene Hara Cave further extended dated occupation back to 35 000 bp (Glover 1986; O'Connor *et al.* 2002)

The lack of early sites on any of the southern route islands led some authors to propose alternative routes, such as the northern one through Borneo, Sulawesi, and thence into northern Maluku and the Bird's Head of Papua (formerly Irian Jaya) (Figure 1). Dates of 42 000 bp have been forthcoming from Borneo on the mainland Sunda Shelf (Barker *et al.* 2001), but excavations in Halmahera and Sulawesi have so far failed to find evidence of settlement earlier than 32 000 and 30 000 years bp[1], respectively (Glover 1981: 16; Bellwood *et al.* 1998). Sites in the Aru Islands, which the author and colleagues investigated in order to test an alternative northern route onto the Sahul Shelf via Buru, Seram and the Kei Islands (Birdsell's 1977 Route 2B), produced earliest dates for human occupation of 28 000 calendric years (O'Connor *et al.* 2005). There have even been suggestions that the patterning of dates may be real and reflect 'back colonisation' of Maluku and the Lesser Sundas by a movement of people from Sahul west (Bellwood 1998). This would have followed 10 000 to 20 000 years after initial west – east colonisation by an as yet undiscovered route.

More recently the finds from the small island of Flores have presented perhaps the greatest challenge to the southern route, as well as challenging almost all of our existing

[1] *This age is based on the Conventional age of the oldest sample from Leang Burung 2 of 31 260 ± 330 (Gr-N-8649) with a freshwater shellfish correction factor of 1350 years subtracted (29 910 ± 330) (Glover 1981: 16). Calibrated using CalPal this gives a calendric age of 35 166 ± 409 with a 68 per cent range of 34 757-35 575 cal BP.*

paradigms regarding the cognitive capacity of early hominins. It appears that sometime before 840 000 years ago a decidedly non-modern hominin managed a water crossing to the island of Flores[2], where it successfully adapted its hunting skills to the specialised and depauperate small island fauna such as pygmy *Stegodon* and Komodo monitor lizards, utilising a simple stone technology that nonetheless involved producing and finely retouching flakes (Brumm *et al.* 2006). Even more amazingly this hominin, or rather its ancestors, survived until about 12 000 years ago doing much the same thing (Brumm *et al.* 2006: 627). Apparently no modern humans reached Flores until about 10 000 years ago, or if they did they have not yet been identified in archaeological contexts and they did not replace *H. floresiensis* in the Pleistocene. The case for the absence of modern humans on Flores until the Holocene has been made on the basis of the nature of the cultural material discarded in the sites (Brumm *et al.* 2006) as well as, and independently from, the presence of skeletal material of *H. floresiensis* and the absence of skeletal material identified as modern prior to the Holocene. The skeletal evidence at Leang Bua indicates that *H. floresiensis,* presumed to be the ancestor of the Lower Pleistocene hominin who left the stone artefacts in the Soa Basin, stood around 106cm or less (Morwood *et al.* 2005: 1016) and had a cranial capacity of merely 400cc (Brown *et al.* 2004; Falk *et al.* 2005).

Renewed support for the presence of a north-south 'savannah corridor' in Sundaland during the Last Glacial Period (LGP) also favours a southern route for modern human dispersal. As modelled by Bird *et al.* (2005) it constitutes a narrow land-bridge with open vegetation which would have been exposed between Peninsular Malaysia and Sumatra and along the north coast of Java, at all times when sea level was – 40 or more below present level (Bird *et al.* 2005). This open savannah corridor would have facilitated rapid dispersal by modern humans through this region, prior to the water-crossings required to reach the Lesser Sunda islands. Although it is feasible that parts of western Borneo were occupied by tracts of savannah, north-eastern and southern Borneo were likely densely forested (Bird *et al.* 2005: 12) creating a barrier to human dispersal east, via this more northern route into Sulawesi, before the onset of the much drier conditions of the LGM.

The most recent genetic research also contributes to the story. It indicates a time lag of 10 000 years between first occupation of PNG and subsequent movement onward into Island Melanesia (Friedlaender *et al.* 2005). As we know that the latter occurred by 40 000 radiocarbon years it would seem that the genetic data supports the longer chronology for first migration into Sahul, such as is reflected by the optical luminescence dates. The genetic data also suggests rapid population dispersal in Sahul followed by almost complete (female) genetic isolation between the populations of PNG and Australia (Friedlaender *et al.* 2005: 1514).

An alternative scenario that would accommodate the lack of post-establishment contact between PNG and Australia suggested by the genetic research, would be a single population that split at a point prior to entry into Sahul, with colonisation proceeding independently via northern and southern routes. The point of split may have occurred in the savannah region between Java and Borneo. If spread through the islands was rapid, colonisation would appear to be 'archaeologically instantaneous' along both routes (i.e. not detectably different within two standard deviations of the dates). If subsequent to arrival there was little movement

2 *Colin Groves (pers. comm.) however believes that the faunal cline from Java into the Lesser Sundas is sufficiently gradual to suggest that the Strait of Lombok could be a post-Pliocene formation.*

of females between the northern (New Guinean) and southern (Australian) populations this would be compatible with the genetic data. Unfortunately the genetic research is not forthcoming about where the first migrants into Sahul might derive from.

While such a rapid dispersal for an early colonising population entering empty landmasses may seem surprising, recent re-evaluation of the radiocarbon dates and new developments in the methodology of radiocarbon dating have shown that initial expansion of modern human populations across Eurasia was far more rapid than previously believed (Mellars 2006). As Mellars (2006: 3) has recently noted, the sharp divergence of radiocarbon ages from true ages has had a dramatic impact on our perception of rates of change and the speed of human dispersal events in prehistory. It is well known that radiocarbon ages diverge from calendrical ages and that this divergence occurs unevenly due to fluctuations in the atmospheric carbon isotope composition over time (Gillespie 1998: 171). Whereas this uncertainty can be controlled by calibration of dates younger than 25 000 BP, in the absence of a reliable means of calibration for dates older than 25 000 they are always quoted in Conventional radiocarbon years. The new calibration 'estimates' provided by CalPal and NotCal04 best estimation calibration curve indicate that a measured radiocarbon date of 42 000 yr bp equates with a calendrical age of 45 500 cal BP, whereas a radiocarbon date of 35 000 yr bp equates into a calendrical age of about 40 500 yr (see Mellars 2006: 3). Calibration of old dates using such best estimate curves serves to close up the gaps and reduce the disparity between the age of the early Australian and PNG sites and those from Island Southeast Asia.

When calibrated, the radiocarbon dates from Jerimalai (see below) are of the same order of antiquity as the oldest dates from Papua New Guinea from the Huon Peninsula (O'Connor & Chappell 2003) and only marginally younger than the oldest ^{14}C dates from sites such as Carpenter's Gap 1 (O'Connor & Fankhauser 2001: 289) and Riwi and in the Kimberley region of north-west Australia (Balme 2000) (Figure 1). It is also worth bearing in mind that most of the older Australian dates have been achieved using the ABOX wet oxidation stepped-combustion technique which successfully eliminates small amounts of contamination, producing both older and more reliable charcoal age estimates (Bird *et al.* 1999)[3]. With few exceptions the dates from Island Southeast Asia are on marine shell, and therefore not amenable to ABOX-SC treatments. It is notable that the exception is Niah where the dates of *c*. 42 000 BP for charcoal in sediments thought to be associated with the 'Deep Skull' were also achieved by use of the ABOX-SC technique. As Roberts *et al.* (2005: 296) emphasise, there is a crying need for the application of *'new and improved dating strategies'* and *'a variety of techniques that are founded on different physical principles'* at sites in Island Southeast Asia.

Jerimalai shelter

Jerimalai is a shelter formed in a limestone terrace less than 1km from Lene Hara Cave, reported in this journal in 2002 (O'Connor *et al.* 2002). The shelter is much less imposing

[3] *As recently pointed out by Mellars (2006) a mere 1 per cent of modern carbon in a sample which is actually 40 000 years old would reduced the measured age of the sample by more than 7000 years and this effect doubles with every additional half-life (5730 years) in the age of the sample.*

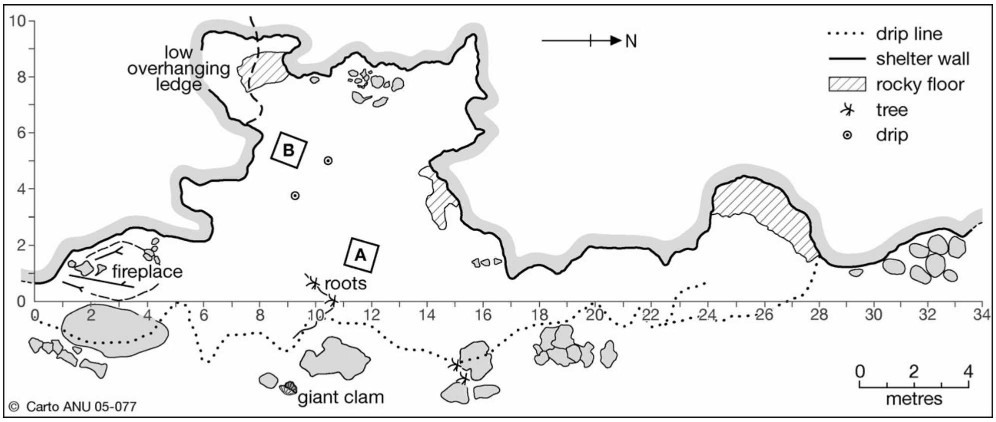

Figure 2. Plan of Jerimalai shelter showing Test Pits A and B and a fireplace used by contemporary hunters.

and spacious than Lene Hara or indeed many of the large solution caves in this area of uplifted Pleistocene limestone reef. It was located in 2004 and selected for test excavation primarily because of its proximity to the current shoreline and the fact that it had a lot of evidence of contemporary use in the form of hearths, wooden storage or drying racks and other structures (Figure 2). In July 2005, two 1 × 1m square test pits were excavated in the eastern and central area of the shelter (Squares A and B) (Figure 2). Analysis of the cultural materials recovered is ongoing but the radiometric dating of the lower levels has demonstrated that it is the oldest modern human occupation site in Island Southeast Asia, east of the Sunda Shelf. The lowest sample from Test Pit A is dated at 38 255 ± 596 bp (Wk-17831). For Test Pit B the oldest date obtained is 37 267 ± 453 bp (Wk-17833). Neither of these dated samples is from the basal excavation levels. When calibrated[4] these samples place first occupation at Jerimalai at greater than 42 000 cal BP (Square A, 42 696 ± 435 BP with a 68 per cent range of cal BP 42 260-43 131 and Square B, Unit 66, 42 140 ± 261 BP with a 68 per cent range cal BP 41 878-42 401). Dates obtained so far for Square B are shown against the section (Figure 3).

The Jerimalai excavation has an upper ceramic-rich and a lower aceramic horizon (Figure 2). The deposit was excavated in approximate 2-5cm units within stratigraphic units, where such could be identified. In the lower level much of the cultural material and sediment was heavily cemented and was removed with a geological hammer and thus unit depths were less controlled. Wet screening of all cultural deposits through fine mesh (1.5mm) ensured good recovery of small finds, including lithic microdebitage and shell beads. Pottery occurred in the top 50cm of the deposit along with stone artefacts, shell and

[4] *The dates are on marine shell. All shell samples were tested for recrystallisation prior to dating and only samples composed of aragonite were dated. They were calibrated using CalPal 2005 – SFCP online, after first deducting 400 years from the raw Conventional ages for the marine reservoir correction. It should be noted that 400 years is an extremely conservative correction value. It is a generalised value that was calculated for marine shellfish in Australian middens (Gillespie & Temple 1977). This conservative value was used because Reimer and Reimer's (2000) global ΔR values database which has largely superseded the earlier work of Gillespie and Temple (1977) contains no data points for Timor. The weighted mean ΔR for the two closest localities to Timor for which data points exist, Java, Indonesia and Port George in Western Australia suggests a ΔR of 110 ± 98 might be a better estimate.*

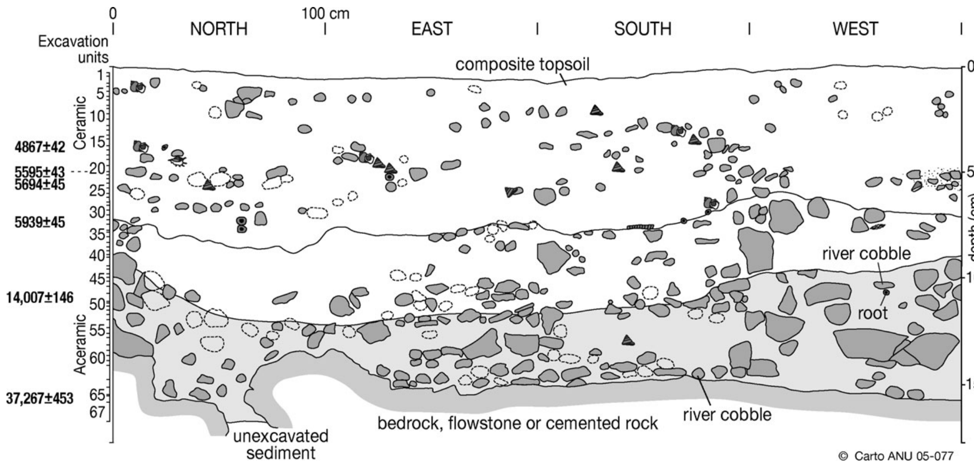

Figure 3. Jerimalai sections Test Pit B showing distribution of radiocarbon age estimates for human occupation.

bone. Despite flotation of all excavated sediment little or no charcoal or uncharred seeds or plant material was recovered below the upper 20cm of the deposit. Jerimalai proved to be extremely rich in shell artefacts including beads of several different types and other decorative pierced pieces, shell fish hooks and scrapers made on operculums of large *Turbo* sp.. Assemblages this rich and diverse in shell artefacts are rare in Island Southeast Asia outside of Taiwan and the Philippines (Bellwood 1997). The ceramic horizon contains a sizeable assemblage of earthenware sherds and small amounts of bone from introduced domesticates such as pig and dog as well as stone artefacts and shell. Earthenware pottery first appears in the sequence at the surprisingly early date of 5500 years BP but may have been subject to vertical downward displacement in the deposit and direct dating of the lower sherds using TL is planned for the future to clarify this issue.

The stone artefact assemblage reflects opportunistic use of variable quality cherts derived from small nodules. No specific sources have been located but locals state that it can be found as secondarily deposited material in stream and creek beds. The artefacts are mostly small flakes, cores and simple retouched flakes. Jerimalai has a higher proportion of cores, retouched flakes and small flakes derived from retouching or rejuvenation than was recovered from Lene Hara but the assemblage contains no repetitively produced or specialised forms (types) and would not be out of place alongside the Lower Pleistocene-aged assemblage from Mata Menge or the artefacts from the Pleistocene levels at Liang Bua also believed to have been produced by *H. floresiensis* (Brumm *et al*. 2006). The early to middle Holocene lithic assemblage at Liang Bua, believed to be the product of modern human discard, record some slight 'changes'. There is a shift in raw material preference from metavolcanics to chert, edge-glossed flakes and possibly grinding stones appear and there is an increase in the transport of cobbles into the cave (Moore 2005). Other than these minor changes and additions, the reduction sequence continues with little modification: the technological structure of stone knapping at Liang Bua essentially remains the same from the Pleistocene and throughout the early Holocene levels (Moore 2005). At Jerimalai shelter even these slight changes are not evident in the lithic assemblage. There is technological continuity in the flaked lithic assemblage from the Pleistocene through to the ceramic bearing levels. This raises serious questions about the sensitivity of stone artefacts in terms of reflecting changes in human cognitive ability. *Contra* Foley (1987; also Foley & Lahr 1997) it would appear that there is no relationship between the complexity of stone artefact technology and levels of behavioural modernity and that stone artefacts cannot be used to inform on hominin phylogeny; at least not in this part of the globe.

As the newly discovered site from East Timor lacks human skeletal material, the possibility has to be considered that the assemblage could have been produced by a non-modern hominin. This seems particularly important in view of the fact that skeletal remains of *Homo floresiensis* have been found in association with a small blade and flake-based stone tool assemblage containing delicately retouched implements, in the terminal Pleistocene levels at Liang Bua. While there have been some voices raised about the identity of the hominin responsible for making and using the Liang Bua stone tools (Lahr & Foley 2004), the excavators have argued that it was *H. floresiensis* on the basis that the assemblage is technologically indistinguishable from those found in the Early Pleistocene Mata Menge assemblage in the Soa Basin, where the age precludes their production by modern *sapiens* (Brumm *et al.* 2006). However, the Jerimalai stone artefacts also have little to distinguish them from those in the Pleistocene levels of Liang Bua, and without a discussion of other characteristics of the assemblage it might be claimed that the Jerimalai assemblage could equally be the product of *H. floresiensis*.

The strongest argument that the Pleistocene levels of Jerimalai are in fact the work of modern humans is based on the faunal assemblage which in view of the age of the deposit and the small size of the excavated area is abundant and well preserved. The fauna from the Pleistocene horizon at Jerimalai is predominantly from marine turtle and fish. Much of the turtle bone from the lower levels is heavily cemented with calcium carbonate but on the basis of size it is likely to be from the Green Turtle, *Chelonia mydas*. Removal of bone from the 'breccia' is still ongoing and bone weights are not presented as they are not meaningful due to the amount of carbonate and cemented sediment adhering to them. Marine shell is found throughout the sequence and is almost exclusively rocky platform taxa such as *Nerita* spp., *Strombus* spp., *Trochus* spp., *Turbo* sp. and chiton and shows little variability in composition during this long period of sea level fall and rise in the Pleistocene. While such early dates for marine shell may seem unusual, this is consistent with the steep offshore profile in this region. The north coast of Timor drops steeply to the continental shelf and during the time span of human occupation Jerimalai would never have been further than 5km in straight line distance from the coastline, although between 30 000 and 18 000 BP it would have been higher above the time-equivalent shorelines than is the case today – by up to 120m. The radiocarbon age-estimates for deposit sequence accumulation at Jerimalai (Figure 3) show significant increase in net deposition rates from 6000 BP; well prior to the aceramic-ceramic transition. The onset of sedimentation rate increase correlates temporally with the period when marine transgression slowed and coastal resources would have stabilised close to, but downslope of, the site. This suggests strong coupling between site use and local geomorphic coastal adjustment to sea level rise (Figure 3).

Fish accounts for a large proportion of the bone by MNI and NISP and includes jaws and vertebrae from large individuals of pelagic species such as tuna, as well as a wide variety of inshore reef species. It is suggested that the pelagics could only have been captured in the deeper waters offshore using hooks, and probably also watercraft. Only two partial fish hooks have been recovered amongst the shell artefacts at Jerimalai and the earliest occurs in a level dated to the early Holocene. This early date is consistent with the single piece fish hook recovered at nearby Lene Hara Cave and dated to 9741 ± 60 (NZA1700) (calibrated range 10 205 to 11 128 (2 sigma, 100 per cent of area) (O'Connor & Veth 2005). The presence of deepwater species such as tuna, which require high degree of planning and complex technology to capture, is widely accepted as constituting evidence of modern human behaviour (McBrearty & Brooks 2000: 510; Henshilwood & Marean 2003: 629).

The only terrestrial species available to the inhabitants of Timor 40 000 years ago were large and small rodents, lizards and snakes. While two species of pigmy *Stegodon*, a giant extinct land turtle *Geochelone atlas* and a Komodo dragon-sized monitor have been recovered from Pleistocene-aged deposits in Timor (Hooijer 1971), there is no evidence, like that now established for Flores, that these extinct taxa ever coexisted with the first human colonists in Timor (O'Connor 2002), although this issue certainly merits more detailed investigation. It appears that the megafauna of the Lesser Sunda group had very different extinction histories on the different islands where they occurred, and that those on Timor had vanished by 42 000 BP. This is not based solely on Jerimalai shelter: no elements of the large extinct species have been found in five other cave and shelter sites with Pleistocene-aged deposits (Uai Bobo 2, Lene Hara, Matja Kuru 2, Telupunu and Bui Ceri Uato) which have been investigated, despite similarly good preservation of bone.

In Timor the large murids dominating the terrestrial fauna in the Pleistocene levels of the sites were approximately the size of small cats. All large murids are now extinct and our excavations indicate they disappeared late in the archaeological record of the region; probably in the Metal Age, at least in the coastal areas investigated. Glover (1986) reported four genera of large murid in the Baucau and Venilale cave excavations; *Coryphomys buhleri* (Schaub) (Glover 1986: 224, Plate 48) and three others which are still taxonomically undescribed. The large murid remains from Jerimalai have not yet been fully analysed but *Coryphomys buhleri*, the largest of the Timor murids (Hooijer 1965) is definitely present. Bats also formed a small component of the diet and small flying birds were no doubt available, although the latter are not conspicuous in the species lists from the Timor sites. Timor lacks large ground-dwelling avifauna (no doubt an evolutionary outcome of the large murine rodent radiation).

With the exception of small murids and reptiles such as the lizards and snakes, all the 'wild' terrestrial species hunted in Timor today, such as the marsupial cuscus, the civet cat, the monkey and the deer, are introduced from the Asian mainland to the west or from PNG to the east. Most of these introductions have occurred in the past 1000 years or much more recently. The exception is the marsupial cuscus *Phalanger orientalis* which first appears in the fauna assemblages about 9000 years ago (O'Connor 2006). This species of phalanger must be a human introduction and probably brought directly from New Guinea, as this is its nearest natural distribution to Timor today. Further, no specimens have been recovered from archaeological contexts elsewhere in Island Southeast Asia. The domestic pig, dog and goat appear in the mid-Holocene but very small sample sizes are found in most of the cave sites and the timing of the appearance of pottery had been used as a proxy for the date of their introduction as well as for agriculture more generally.

As opposed to the Liang Bua site, where the excavators identify a marked qualitative difference in the Holocene assemblages from levels associated with anatomically modern skeletal material, the cultural remains from the Jerimalai shelter do not differ substantially from first occupation in the Pleistocene through to the early to mid Holocene. There are more decorative artefacts such as shell beads in the Holocene levels but ochre occurs throughout and the fish and turtle indicate a consistent emphasis on marine subsistence requiring complex technology from the time of first occupation in the Pleistocene.

Discussion

The antiquity of Jerimalai makes this site significant at a world level as it currently stands as the earliest evidence for modern human colonisation in Island Southeast Asia, east of the Sunda Shelf. It is also very telling that in the space of a few years, a few small test pits have extended the known prehistory of Timor by almost 30 000 years. Additionally, a better understanding of the fluctuations in the original ^{14}C content of the Earth's atmosphere allow us to better evaluate the dates that we have, indicating that the dates for modern human spread through this region are not as 'spread' as they may appear from the conventional radiocarbon ages. While we still cannot reliably calibrate dates of this age, calibration using CalPal or NotCal04 closes up many of these gaps in Australasia and will revolutionise the southern human dispersal story, just as it has in Eurasia (Mellars 2006).

When we calibrate the early dates it is apparent that our previous patterning, with the earliest age estimates in Sahul, is less extreme than it appeared based on conventional ages. This bias was also accentuated by inadequate sampling and dating and restricted use of a range of dating techniques in Southeast Asia. We anticipate that earlier sites will be discovered with future research in this region and with the application of dating techniques such as OSL and U-Series dating which can reliably date materials that are older than 40 000 years old.

The data and dates from the Jerimalai site also raise a number of important questions. If modern humans made the water crossing to Timor by 40 000 BP then we must assume that they passed through or by Flores. The fact that modern human remains have not been recovered from Liang Bua or other sites in Flores prior to the Holocene suggests that our archaeological picture is still very incomplete. Did modern sapiens coexist with the diminutive *H. floresiensis*, or was *H. floresiensis* somehow able to deter or repel settlement by anatomically modern humans? It is clear that this region warrants a great deal more study.

Australia may have presented challenges to the early colonists in terms of the unfamiliar nature of the marsupial fauna, but it had an extremely rich and diverse fauna compared with some of the Lesser Sunda Chain. Large fauna were available in Flores but apparently not in Timor where Pleistocene colonists would have had to subsist almost solely on a diverse range of marine resources. The water gap between Timor and Flores was an order of magnitude greater than the distance between Bali and Flores, but perhaps an even greater accomplishment than the water crossing for early moderns was the ability to switch their subsistence strategy from one that relied on large game to one that was based almost wholly on a diverse range of small fauna, particularly marine foods.

Conclusion

The recent finds from Jerimalai shelter in East Timor demonstrate that modern humans did breach the Wallace Line using a southern route over 42 000 cal BP. These new finds and dates suggest that our current patterning for colonisation of the region is suffering from both limited sampling of field sites, inadequate application of a variety of different dating methods at most of the sites excavated and uncertainties in the calibration curve at this age and that more intensive sampling and the application of alternative dating techniques will produce even older dates for this southern route and possibly close up some of the gaps. They also raise the important question as to how and why modern humans successfully reached and settled the island of Timor by 40 000 BP, but failed to colonise Flores.

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