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EARLY HUMAN OCCUPATION OF THE EAST KALIMANTAN RAINFOREST (THE UPPER BIRANG RIVER REGION, BERAU)

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IV. THE PREHISTORY OF BORNEO

4.1 The First Human Occupation of Borneo

Geologically, Borneo is part of the continental shelf extension of Mainland Southeast Asia that is termed Sundaland. This was a vast land that emerged when the sea level dropped to about 120 metres during the glacial periods of the Pleistocene, connecting the Malay Peninsula, Sumatra, Borneo, Java and Bali. This happened several times during the Pleistocene, with the last full exposure during the Last Glacial Maximum about 21,000 years ago (Hanebuth et al. 2000:1034). During the interglacial periods, when the sea level rose to about the present level, the land bridge that connected Mainland Southeast Asia and these islands became drowned, leaving the islands as they are today.

Presumably, the first human occupation of Borneo occurred during one of these glacial periods. Unlike Java, where early human fossils of Homo erectus are present in large number, Borneo has none at all. Bellwood suggested that “Perhaps in Borneo no bone could survive in the hot, wet and acidic conditions, but it is also possible that early humans simply did not inhabit the equatorial rainforest and preferred the more open and drier environments of Java.” (Bellwood 1992a:8). So far, the oldest human remains found in Borneo belong to a modern human, known as the “deep skull”, which was associated with charcoal radiocarbon dated to 39,600 ± 1000 years BP (Kennedy 1977:33). The Niah Cave Project has recently dated the skull more securely to c. 43-44,000 BP (Barker et al. 2002a:153; 2002b:97). This skull, which was found in the West Mouth of Niah Cave, showed close morphological affinities of cranial structure with recent Tasmanian and Australian groups (Brothwell 1960:339).

The deep skull was not the only human material found in Niah. There are more than 200 other burials that belong to later periods (Majid 1982:23). These burials can be divided into two groups: first a series of flexed, seated, and fragmentary burials (14,000 – 3,500 BP) and second, extended burials in coffins or mats (possibly from 4,000 BP – less than 2,000 years ago) (Bellwood (1997b:84). The first group do not seem to represent recent Southern Mongoloids, while the second appear to be more closely related to them.
Based on these human remains, it can be said that Niah suggests the presence of an Australo-Melanesian population in the island which was replaced gradually by a Southern Mongoloid population after about 3,000 years ago (Bellwood 1997b:85). This phenomenon is in accord with what happened in the western and northern regions of the Indo-Malaysian archipelago in general.

4.2 The Austronesian Expansion

The earliest traceable groups of Austronesian speakers originated in Southern China and Taiwan prior to 5,000 years ago (Bellwood 1997b). The Austronesian linguistic expansion is regarded as so successful that no indications remain of the earlier languages supposed to have been spoken in western or central Indonesia. However, Adelaar has claimed possible evidence of an Austroasiatic substratum, related to the Aslian languages of Peninsular Malaysia, in the Bidayuh (Land Dayak) language of western Sarawak (Adelaar 1995).

Both linguistic and archaeological evidence has been used to reconstruct the Austronesian expansion. By 5,000 BP, initial Austronesian settlement had occurred in the island of Taiwan (Bellwood 1997b:117). From there, Austronesian languages were spread by population movements all over the Indo-Malaysian archipelago. Bellwood suggested that Austronesian colonisation occurred about 4,500 BP in the Philippines, followed by fairly rapid movement to Borneo and Sulawesi by about 4,000 BP (Bellwood 1997b:119). Further, Bellwood suggested that expansion to the west, including the Malay Peninsula, occurred later on, about 3,500 – 3,000 BP. The expansion to the east to the Moluccas might have occurred earlier, about 4,500 BP (Spriggs 1990:57), although at present there are no reliable dates in excess of 3,500 BP.

This Austronesian expansion into Taiwan, the Philippines and Borneo is usually recognised archaeologically by the introduction of pottery, pigs, dogs and rice agriculture, none of which were known before in the region. The rice agriculture did not spread beyond the eastern regions of Indonesia. Recent archaeological research in Sarawak has produced the oldest evidence for rice agriculture in Borneo, based on a radiocarbon date of c.4,500 BP from a carbonized rice grain embedded in pottery from Gua Sirch in Sarawak (Bellwood 1997b:117).

4.3 The Languages and Tribal Groups of Borneo

The languages of Borneo belong to the Western Malayo-Polynesian division of the Austronesian family, together with those of the Philippines, southern Vietnam
(Chamic), Madagascar, Peninsular Malaysia, Sumatra, Java, Sulawesi, Bali, Lombok, western Sumbawa, and two languages - Palauan and Chamorro - of western Micronesia (Bellwood 1997b:105).

Within Borneo, Hudson has classified the languages into seven endo-Bornean groups (Land Dayak, Rejang-Baram, Kenyah-Kayan, Apo Duat, West Barito, Barito-Mahakam and East Barito) and three exo-Bornean groups (Malayic Dayak, Tamanic and Sabahan) (Adelaar 1995:77). These language groups have also various dialects that are spoken by many different populations.

The differences in language in Borneo are also reflected by the presence of many different ethnic groups. Besides the Malays, who generally speak an early historical immigrant language confined to coastal areas, the local inhabitants are better known as Dayaks. There are hundreds of Dayak tribal groups, and many have not yet been studied by anthropologists. Riut classified Dayak people into seven major tribes (Ngaju, Apu Kayan, Iban/Heban or Sea Dayak, Klemantan or Land Dayak, Murut, Punan, and Ot Danum), which he then further subdivided (Riut 1979:213-29).

The presence of differentiated language groups that share relations of common ancestry across Borneo suggests that there has been a lot of movement of people in the past, encompassing treacherous mountains and remote interior rainforest regions. Most of these movements were probably along the rivers by boat, a much faster and easier method of travel in many cases than travel by land. Ethnographic studies also suggest that migrations of people within the island have occurred continuously for various reasons. Some movements, such as those of the Iban of Sarawak, involved quite long distance travel. Many such migrations have been recorded dating back to several centuries ago, but most details naturally belong to the past few decades (Guerreiro & Sellato 1984a & b; Anau 1999; Egenter 1999; Lawai 1999). Since such migrations have occurred so frequently in recent times it is also likely that they formed a major aspect of the prehistoric past, and thus should be recognisable in the archaeological record, at least to a degree.

4.4 Archaeological Sites in Borneo

Most archaeological research in Borneo has been carried out in Sarawak and Sabah, both of which have revealed many important sites. Unfortunately, almost nothing was done in Kalimantan until the last decade, and little research has been done in Brunei (Map 1.3).
The nature of the archaeological sites in this island is largely determined by the environment. Although it is expected that sites should be found everywhere, in reality most are caves and rock shelters in limestone formations. This is understandable, since organic remains would not survive long without protection in the tropical rainforest environment. The acidity of the soil and the humidity contribute to rapid deterioration of organic remains. The speed of vegetation growth makes it difficult to locate open sites, even stone artefacts. So far, there are few open sites known in Borneo from the period prior to the introduction of Chinese ceramics; examples include Tingkayu in Sabah (Bellwood & Koon 1988), Putai River/Ulu Balez in Sarawak (Chin & Nyandoh 1975), and Nanga Balang in West Kalimantan (Soejono 1991). Apau Ping and other villages in the upper Bahau River, East Kalimantan, can be added to the list (Arifin & Sellato 1999a).

In the Tingkayu Valley in Sabah, seven open sites previously covered by thick secondary forest were recorded in 1980-81 and 1987 after the establishment of an oil palm plantation (Bellwood & Koon 1988:38). Two of these sites, TIN1 and TIN2, contained a bifacial stone tool industry believed to date on environmental grounds to between 28,000 and 18,000 years ago (Bellwood & Koon 1988:49), although no direct dates for the tools have ever been recovered.

The Putai River/Ulu Balez site is located on a hill at the junction between the Putai and Batang Ulu Balez rivers. This was the first open site ever reported in Sarawak, and contained stone tools associated with earthenware pottery (Chin & Nyandoh 1975). The stone tools comprised quadrangular adzes made of river pebbles, together with chert, agate and quartz flakes. Other artefacts found included a barkcloth beater, metal objects (brass earrings, bangle fragments and fragments of iron knives and spears), and beads (Chin & Nyandoh 1975).

Nanga Balang is located by the Kapuas River, approximately four metres above the river level. The archaeological deposits contain quadrangular adzes (including unfinished adzes), pounding stones, stone anvils, grinding stones, pottery and glass beads (Soejono 1991). Soejono concluded that Nanga Balang was a Neolithic dwelling place dating from ca 1000 BC to AD 200 (Soejono 1991:18).

Apau Ping and several other surrounding villages in the upper Bahau River revealed hundreds of quadrangular adzes, mostly polished. They were collected from the surface by the local people. Fifteen settlement sites have so far been recorded in the upper Bahau River area (Arifin & Sellato 1999a:398). However, they are not very old,
only several hundreds of years, and are presumably contemporary with the megalithic remains found in this area.

The coastal open sites reported in Borneo so far mainly belonged to more advanced societies that imported foreign elements, mostly of Chinese but also Indian origin, that reflect intensive contact with overseas communities. Such sites include Santubong on the Sarawak River Delta in Sarawak (Harrisson & O’Connor 1970), and Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981) in Brunei. Santubong has at least six important sites, dating back to at least AD 800. However, it was not until the second half of the 14th century AD that the sites showed remarkable activity, especially associated with “the collection, smelting, and export of iron (and probably steel), but also richly with trade in Chinese ceramics, western glass beads, gold of local origin and much else.” (Harrisson & O’Connor 1970:3). Although the Santubong sites reflect strong foreign influence, activities of the local people are represented by paddle-impressed pottery and by a half life-sized spread-eagle figure carved on a sandstone boulder, known as Batu Gambar, located at Sungai Jaong. Further clearing of the surrounding area revealed many other engravings on at least 30 large boulders (Harrisson & O’Connor 1970:111).

The open sites in Brunei, such as Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981), belong to a later period with an abundance of Chinese and Indo-Chinese stoneware and porcelain. These sites were not previously occupied by Neolithic populations, although paddle-impressed earthenware pottery in the same tradition as that commonly made by pre-metal people elsewhere in Southeast Asia was present.

Megalithic remains are mostly limited to the central part of Borneo, for instance around the Kelabit highlands in Sarawak (Schneeberger 1979); at Kerayan, Long Pujungan, and Malinau in East Kalimantan (Schneeberger 1979; Baier 1987; 1992; Ariffin & Sellato 1999a); and in upper Kayan (Apo Kayan) in West Kalimantan (T. Harrisson 1959a; Whittier & Whittier 1974; Tillema 1989; Baier, 1992; 1995). Others occur at Tomani in south-west Sabah (T. Harrisson 1973b); and in coastal areas such as Santubong (above) and in the coastal flood plain of western Sabah.

The megalithic remains from the Kelabit region probably have more variation in structure than the other sites. They comprise rock carvings, cut stones, seats, stone mounds (parapun), dolmens (table stones), slab graves, uprights, stone burial urns, dams, walls, and little grottos cut into small cliffs (Schneeberger 1979; T. Harrisson 1973c:127; 1974a). The neighbouring area of Kerayan, located south of Kelabit, shows
a similar tradition. In Long Pujungan on the upper Bahau River there are about 70 sites, mostly uprights, dolmens and urn-dolmens,¹ and rock carvings (Arifin & Sellato 1999). The upper Kayan basin has sarcophagi, uprights and rock carvings (Sierevelt 1929; Whittier & Whittier 1974; Tillema 1989; Baier 1995). Kuala Bekuku in southwest Sabah has incised and pecked figures on rock, similar to those found in the Kelabit highlands and Sungai Jaong (T. Harrisson 1973b; 1973c:128). Unlike most of the megalithic sites in Borneo, which are located inland, the Kadazan area of Sabah is a coastal region where unshaped sandstone uprights can be found scattered in the rice fields (T. Harrisson 1973c:125). Some of these are associated with imported Chinese stonewares from the Ming or Qing periods.

In the Kelabit highlands, a megalithic tradition was still practised until the second half of the 20th century. It is not clear when this tradition started. Harrisson mentioned that there is no evidence that the megaliths date back more than about a millennium (T. Harrisson 1973c:133). Those from Kerayan remain undated.

Based on ethnohistoric traditions, the megalithic remains around Long Pujungan in the upper Bahau River area were made by Ngorek people prior to the early 19th century AD. Based on ethnohistoric research those in the upper Kayan are presumed to have been made during the 17th or 18th centuries (Arifin & Sellato 1999a:399).

Caves and rock shelters, in which organic remains can be preserved much better, are the most promising sites to find remains of earlier prehistoric human habitation. However, limestone outcrops where such caves and rock shelters can be found are limited to certain areas, and often exist in very remote places. The most extensive research to date has been done in the Niah caves complex and several other sites in Sarawak (Gua Sireh, Lubang Angin, the Sarang Cave Complex and the Ulu Kakus Complex), and in southeastern Sabah (the Madai and Baturong caves and the rock shelter of Bukit Tengkorak, the latter of volcanic origin).

The Niah Caves are located in the Gunong Subis limestone massif, approximately 16 km from the South China Sea. The Great Cave at Niah has several openings, with the largest called the West Mouth. The other main mouths are Lobang Angus, Gan Kira, Lobang Tulang (Cave of Bones), Tahi Manimbun, and Lobang Bulan. The last two are of minor importance and not much has been published on them. Other caves around the Gunong Subis limestone massif that contain archaeological remains are Lobang Jeragan, Kain Hitam, Upisuings and Magala.

¹ The megalithic remains from Long Pujungan were first reported by Schneeberger in the 1930s. He defined urn-dolmens as large stone urns supported by four river boulders or two stone slabs, and covered
The earlier excavations conducted in the Niah Caves by Tom and Barbara Harrisson\(^2\) between 1954 and 1967 caused a number of interpretative problems, in part because Tom Harrisson was not a trained archaeologist and published little of a precise archaeological nature about the Niah sites, although Barbara Harrisson (1967) did publish the burials in considerable detail. Zurainma Majid later integrated all the material found at West Mouth for her PhD thesis (1979; 1982). She analysed all the data collected from the Harrisson excavations as well as her own, as well as the Harrisons’ published and unpublished reports. Although Majid’s research provided valuable additional information on Niah, major uncertainties of the Harrisson excavations were left still unresolved (Barker et al. 2000:113).

In 2000, an inter-disciplinary programme of archaeology and environmental science termed “The Niah Caves Project” was established in the UK to “reinvestigate the cave stratigraphies to clarify their integrity and chronology; to establish the climatic and environmental contexts in which human activities took place; and to reanalyse the Harrisson finds within this new framework.” (Barker et al. 2000:113). The project, which is still continuing, also aims to elucidate three major areas of debate in the prehistory of Southeast Asia: “The timing of initial settlement by anatomically modern humans; the means by which they subsisted in the late Pleistocene and early Holocene; and the timing, nature, and causation of the transition from foraging to farming.” (Barker et al. 2002:147).

The Niah Caves, especially the West Mouth, revealed thick human habitation deposits. During the long span of human occupation in the late Pleistocene, the Gunong Subis limestone massif experienced several sea level changes which “resulted in marked environmental changes around the caves at these various times.” (Majid 1982:32). Majid (1982:31-2) suggested that from 40,000 to 11,000 years ago the massif must have been further inland than now. The sea level then rose about 11,000 years ago and by about 5000 years ago it was slightly higher than today, at which time the limestone massif may have been very close to the coastline. Since 5000 years ago the sea level has fallen and now the coast is about 25 km from the limestone massif. The fluctuations in glacial and post-glacial climate also resulted in quite significant changes in the flora and fauna of the region.

\(^2\) Harrisson conducted the first excavation in the West Mouth in 1954 but no detailed report was ever published (Solheim 1983:41). Due to financial difficulties, further excavations could only be started in 1957 and continued until 1962 under Tom Harrisson’s direct supervision. Barbara Harrisson was later in charge until 1967, although Tom Harrisson still supervised the program indirectly (Solheim 1983:41).
The enormous amount of animal bone from Niah showed a local extinction of some of the animals, such as the giant pangolin (*Manis palaeojavanica*), which is now totally extinct, and the tapir (*Tapirus indicus*), which is locally extinct on Borneo (Medway 1964b:35). Evolutionary changes also occurred in the body sizes of species as shown by the reduction of dental size in some mammals, such as orang-utan, leaf monkey, long-tailed macaque, several species of bats, oakling deer, Muller’s rat and long-tailed giant rat (Medway 1964b:36). Changes in mean body size of species suggest progressive alteration towards warmer and wetter environmental conditions that occurred from the end of the Pleistocene into the early Holocene (Medway 1964b:36). Further, Medway pointed out that “the presence in Pleistocene levels of two other mammals, the Lesser Gymnure and the Ferret-badger, both today characteristically submontane in distribution, gives some indication of the nature of this alteration.” (Medway 1964b:36).

From her extensive analysis of the archaeological deposit of the West Mouth, Majid recognised five phases of human occupation (Majid 1982:134). The description of these phases below is abstracted from Majid (1982:134-40).³

Phase I ran from about 40,000 to 20,000 years ago. The environment around Niah Caves at this time consisted of a more open forest than today, which supported a large variety of fauna and flora, including the extinct and extirpated species *Manis palaeojavanica* and *Tapirus indicus*. The most common animals hunted in this phase were pigs, monkeys and porcupines. Phase I lithic artefacts consisted of flakes without clear-cut typological characteristics. A few were identified as semi-lunar in shape, a form more common in the following two phases.

Phase II started about 20,000 BP and contained thinner deposits than Phase I, as well as fewer material remains spread presumably over a much shorter duration. This phase was characterised by the introduction of the chopper and axe-adze types of pebble tools and the use of secondary retouch or trimming.

Phase III dates towards the end of the Pleistocene, around 15,000 years ago. This period has much more numerous archaeological remains than the earlier ones. The lithic

³ Tom Harrisson also established a cultural sequence for the site, which he revised from time to time. His chronology was based on the assumption that depth-age correlations were uniform across the site, an assumption that now seems unwarranted (Majid 1982:38). It seems that Harrisson’s cultural sequence came from general observation of the excavated remains, especially the stone artefacts. But Majid (1982:131) states that “analysis of the total lithic collection indicates that the diagnostic features Harrisson selected to characterize each phase are not representative.” Therefore, only Majid’s cultural sequence will be discussed here.
assemblage is characterised by a large variety of pebble implements and several new flake artefact types, such as scrapers, notched scrapers and pointed flakes (Majid 1982:97), although the lithic artefact types from the previous phase continued to be used. The use of quartz increased, and the use of haematite for red pigment became common. Faunal remains showed that the first part of the phase was dominated by large animals, such as rhinoceros and bear. The later part produced a smaller range of species, and mostly ones small such as squirrel and ferret-badger. In addition, fewer species of shellfish were present in this phase.

Phase IV marked the beginning of the Holocene, with continuing rise of sea level and further increases in temperature and rainfall, resulting in dense rainforest like today (Majid 1982:138). Such an environment is not suitable for large mammals, which preferred more open forest. The faunal remains thus include mainly small species, although bearded pig, monkey and orang-utan were still hunted, together with fish and shellfish, mostly from freshwater and estuarine habitats. Rising sea level reduced the distance to the coastal area and made the estuarine fauna more accessible. Majid also suggested that the lowland forest would have held many plant resources.

According to Majid (1982:139), describing the Niah lithics, “the lithic artifacts here lack formal types and are multi-functional – they record a series of discrete processes which have acted on them.” (Majid 1982:139). The lithic assemblage of Phase IV shows an increase in occurrence of axe-adze pebble tools, pounders, hammerstones, and haematite, the latter used in burial rituals. The first mortars appeared and the earliest type of artefacts, the semi-lunar and pointed flakes disappeared. Edge-ground pebble axes also appeared (Bellwood 1997b:173).

Phase V saw the first pottery and a decrease in numbers of pebble and flake tools and implements, with no significant changes in technology. Pottery was found scattered all over the excavated area, but was mainly associated with burials. Decoration is mainly carved paddle impression with squares, rectangular or diamond patterns, and bound paddle impression with cord or basketry-marking. Double-spouted vessels are found in association with burials and presumably date between 3500 and 1000 years ago (T. Harrisson 1971:370-1). The most intricately decorated pottery is Niah Three Colour Ware, decorated by painting in red and black and by zonal incision (Solheim et al. 1961:229).

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Majid differentiated pebble tools and pebble implements. She explained “A pebble tool or core tool is a pebble stone which has been modified through flaking and trimming prior to use into an intended form, while a pebble implement or core implement is an unmodified pebble stone not flaked into an intended shape prior to use but modified through use.” (1982:56).
Many of the West Mouth burials are not associated with ceramics but with stone
and bone tools, often covered with red ochre (haematite) and regarded as Mesolithic (B.
Harrisson 1967:133). They consist of flexed, seated, and mutilated (disturbed
fragmentary remains. Those found with ceramics (Neolithic and later burials) are
associated with a polished quadrangular adze, a chip from a pebble tool, “phallic
pebbles”, a polished point, polished bone rings, a wooden armlet, a fragmented shell
anklet, an oval shaped wooden disk, and a glass bead (B. Harrisson 1967:155-7). Burial
with bronze object was rarely found (B. Harrisson 1967:159). Most corpses were
individually wrapped into wooden mats or textile and remains of such materials often
found (B. Harrisson 1967:151). The burials consist of extended, multiple, cremated and
burnt burials, variously placed in coffins, jars or baskets (B. Harrisson 1967).

The extent of the archaeological remains in West Mouth has made the cave the
best known archaeological site in Borneo, with the longest duration of human habitation
in Southeast Asia (Majid 1982:1). The site gives a clear picture of climatic change
during the Last Glacial Maximum and makes a great contribution to the archaeology
and environmental history of Southeast Asia. The Deep Skull is securely dated to c. 43-
44,000 year ago (Barker et al. 2002a: 153), and prior to that date only sporadic visits to
the site can be documented. The date of first human presence is not yet known. The new
research has given striking evidence of effective foraging strategies in a mosaic
landscape (Barker et al. 2002a:160), and has indicated that the site was inhabited
intensively in the late Pleistocene. During the Neolithic period the cave was used
intensively for burials, as so clearly documented by the Harrissons, and a better
recognition of their complexity and density has been obtained (Barker et al. 2002a:160).

However, the current Niah Cave Project has also demonstrated that any claim
for a continuous sequence of occupation over the past 40,000 years at Niah would be
rather exaggerated:

the site was clearly used at very different levels of intensity, and in very different
ways, at different times in the past; in some periods, perhaps of long duration, it
may have been more or less abandoned. However, the evidence for rather
sophisticated tropical foraging systems from the first arrival of modern humans,
and the complexity and highly variable nature of the archaeological record of the
different phases of occupation at Niah from then to the present day, may also be
more typical of cave use in tropical rainforest in south-east Asia and Oceania than
the Harrisson model. (Barker et al. 2002a:161).

The archaeological remains of the other caves in the Niah complex are not as
rich as in the West Mouth. Lobang Angus contained animal and human bones, food
shells, bone tools, and stone tools. The animal remains are similar to those found in the
West Mouth. Limestone tools seems to be the major feature in this cave (T. Harrisson
66
1966:216), but the lack here of the sophisticated ornamental artefacts of bone and animal teeth associated with Neolithic and later cultures elsewhere at Niah (Medway 1966:193-4) suggests that occupation in this mouth is mainly Palaeolithic (Medway 1966:194).

Lobang Tulang revealed earthenware and polished stone tools, together with imported ceramics, glass (beads and bangles), iron (parangs, knives, spearheads, rings and bangles, bird’s-nesting tools), bronze (fishhooks, bells, bangles, beads and lids), brass (bangles and earrings), gold fragments, Chinese copper and iron coins, worked bone and teeth, worked shells, and fragments of textiles (B. Harrisson 1958:601; 1959). Harrisson concluded that the site was mainly used for Neolithic and Metal Age burials of high-class people with mainland connections (B. Harrisson 1959:178). Gan Kira also produced burials and artifacts of relatively recent date (Yim 1963:177), with stone tools and animal bones in the lower levels.

Other cave sites in Sarawak, such as Lobang Jeragan, Kain Hitam, Upiusing, Magala, and the Sarang⁵ and Ulu Kakus cave complexes⁶, were not as rich in finds as the Niah Caves. Perhaps the most important one is Gua Sireh (or Sirih) in the Serian District, more than 50 km inland from Kuching,⁷ a cave that was used for quite a long period. Ipoi Datam’s excavation revealed that the site had been visited occasionally by hunter-gatherers since 20,000 years ago (Datam 1993: 163).

Gua Sireh is most important for its mid-Holocene record of the introduction of rice and dogs, as well as pottery and polished adzes. Dog bones from Gua Sireh are estimated to be of late Neolithic date, while no clear date for the introduction of domesticated pig is available. Pottery initially appeared between 3500 and 4500 years ago and belonged indicated to a fairly uniform and continuous tradition dominated by paddle impression. Some of the potsherds contain rice grains and husks. Some of the geometrically stamped pottery is related stylistically to that found in other sites in Sarawak, such as the nearby sites of Tanjong Kabor and Gua Bungoh, as well as the Niah caves and Kupang in Brunei (Datam 1993:164).

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⁵ Sarang Hill consists of two outcrops of limestone, located in the middle of an extensive swamp, about 80 km southwest of Niah (Harrisson & Reavis 1966:249). In 1966 a Sarawak Museum team recorded 14 caves. The most important ones, Liang Batu Puteh and Liang Ringen, were excavated. The archaeological remains indicated three different uses for these sites: long term habitation, burial and temporary camping (as practiced until very recently by the Penan of the area).

⁶ A Sarawak Museum team conducted a survey in Ulu Kakus in 1966 and recorded 45 caves, mostly unsuitable for human habitation (Reavis 1966:269-70). Seven caves were excavated, three of them burial sites, two habitation sites, and the rest archaeologically sterile.

⁷ The first excavation of this cave was conducted by Solheim and Harrisson in 1959, but no full report has ever been published. Zuraina Majid excavated further in the cave in 1977, Edmund Kurui in 1980 and Ipoi Datam in 1989.
About 2000 years ago Gua Sireh was also being used for human burials with monochrome glass and carnelian beads, cupreous and iron objects and later on, gold beads. The imported glass and carnelian beads perhaps came from South India or Thailand, while the metal objects could have been produced locally at e.g. Santuhong for iron and Bau for gold (Datan 1993:164). Around 1500 AD, Chinese ceramics were imported into Gua Sireh and it seems that the site was continually utilised until the last century (Datan 1993:164).

Gua Sireh also has charcoal drawings on the back wall of the cave. Most of them are simple stick or straight-line human figures, with a few imaginary beings, but they are so far undated.

In southeastern Sabah, several important cave sites have been excavated in the Madai and Baturong limestone complexes. The Harrisons recorded at least 25 caves at Madai, most being dark and damp bird’s-nest bearing caves, sometimes with ancient wooden coffins (Harrison & Harrisson 1971). Agop Atas and Pusu Samang Tas were excavated in 1968. Later, a Sabah Museum team under the direction of Peter Bellwood and Peter Koon excavated three sites at Madai: MAD1 (Agop Atas), MAD2 (Agop Sarapad), and MAD3 (Agop Alag), in 1979 – 1980. These sites, together with Pusu Samang Tas (MAD4), provide an important occupation record for the early Holocene (11,000 to 7000 years ago) and for the last 3000 years, with a hiatus in occupation in-between (Bellwood 1988:97).

The Baturong limestone massif is now about 30 km from the coast, but during the Last Glacial Maximum it might have been as much as 100 km inland. During the lake-full period of Lake Tingkayu that apparently ended by 18,000 years ago this limestone massif was an island (Bellwood 1988:25). As in Madai, wooden coffins were found in some of the rock shelters. The Harrisson’s visited five shelters in 1966 and excavated in two - Lobang Tingalan and Pusu Serap Gaya (Harrison & Harrisson 1971). The Sabah Museum team excavated the main shelter of Hagop Bilo (BAT1) and another subsidiary shelter termed BAT2 (Bellwood 1988).

Bellwood concluded that there were three main blocks of human occupation in these sites. The oldest is the Bilo-Sarapad Period (17,500 – 7000 BP), second is the

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8 Agop Atas was the first site to be excavated in Madai and the importance and antiquity of this shelter for further archaeological research was recognised immediately. The excavation at Pusu Samang Tas produced a wide range of earthenware pots, with iron knives, glass beads, animal bones, food shells, as well as human burials (Harrisson & Harrisson 1971:94-5).
9 Hagop Bilo is still used by the Idahan people for shelter. It was under the water of Lake Tingkayu when it was a true lake, but when the lake drained prior to 18,000 years ago the rock shelter became suitable for human occupation (Bellwood 1988:28).
Atas Period (3000 – 1000 BP) and the youngest is the Idahan Period (400 BP onwards). No data are available for the period between 7000 and 3000 BP. He summarised:

...the Bilu-Sarapat Period reveals fairly intensive exploitation of stone, animal and shellfish resources in all sites. The Atas Period shows a dramatic decrease in the use of stone for tools, but continuing strong reliance on shellfish and hunted animal foods. Pottery is in intensive use throughout the Atas Period, as are tools of copper/bronze and iron from MAD1 layer 10 (c. 2,200 BP) upwards. The Idahan Period, finally, lacks any major primary association with stone tools, and shellfish appear to have been consumed only rarely in the period of the birds'-nesters' village. By this time the bulk of the meat consumed at Madai came from imported marine fish (Bellwood 1988:131).

It should be noted that some of the pottery, especially that from MAD1 layer 11a (c. 2,800 BP), has similarities with the earliest red-slipped pottery from Leang Tuwu Mane’e in the Talaud Islands, and Bellwood suggested that both sites may have had a common pottery tradition, although there was not necessarily any direct contact between them (Bellwood 1988:178). In more recent publication Bellwood added Bukit Tengkorak early phase and Uattamdi, on Kayoa Island, to the west of Halmahera as having similar red-slipped pottery as MAD1 (Bellwood 1997b:229). The incised and impressed pottery from the layers above layer 11a was very similar to that found at Buidane (Talaud Islands), dating from the Early Metal Period.10

Another important site in Sabah which contained artefacts originating from far away is Bukit Tengkorak, a volcanic rock shelter located on top of a volcanic crater overlooking the Sulawesi Sea and the end of the Sulu Island chain, approximately 5 km from Semporna.11 The 1987 excavation here revealed two distinct archaeological layers belonging to an Early and a Later Phase. The considerable differences in pottery style between these phases suggested that the site was occupied at different stages, but presumably by the same cultural group (Bellwood 1989:128). Based on the radiocarbon dates, Bellwood concluded that the total time span of occupation ran from the early first millennium BC to the early first millennium AD, with a change-over period dating to about 300 BC (Bellwood 1989:130).

An outstanding vessel-and-lid combination with sophisticated decoration was recovered from the Early Phase and presumably was imported. To some extent it resembles the contemporary Lapita assemblages of the western Pacific. In general the Early Phase pottery at Bukit Tengkorak is very similar to the Early Atas Phase red-

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10 Indicated by intricate incised decoration on pottery, notched or scalloped rims and carinations, pedestals and bottle-necked flasks (Bellwood 1988:187).
11 There are several rock shelters at Bukit Tengkorak. Shelter 1 was excavated by the Muzium Sabah team in 1987 under the direction of Peter Koon and Peter Bellwood. In 1994 and 1995 a joint research team from the Centre for Archaeological Research Malaysia and Muzium Sabah excavated further in Shelter 1, and in another shelter about 20 metres away.
slipped pottery at Agop Atas and that from Leang Tuwo Mane’e in Talaud and Uattamdi in the Moluccas (Bellwood 1989:136; 1997b:229)

Some of the incised Late Phase decoration shows similarities with the ‘three-colour ware’ assemblages from the Niah Caves and Lobang Angin (Mulu National Park) in Sarawak, Manunggul Chamber A on Palawan, Kalumpang in west-central Sulawesi, and the Nansay Resort site on Saipan in western Micronesia (Bellwood 1989:136).

Bukit Tengkorak stone tools include trapezoidal-sectioned stone adzes, agate microblade used as drill points for working shell, and tiny obsidian flakes and chips. The latter were only found in the Early Phase, while stone adze and agate microblades were found in both phases. The stone adzes belong to the common Sabah untanged and trapezoidal-sectioned type which was also found in Tapadong Cave, Hagop Bilo shelter, from sites on Mindanao and elsewhere in the Philippines (Bellwood 1989:142). The agate microblades have non-specific parallels in north-eastern Indonesia, the Philippines and the neighbouring regions of mainland Asia, but the parallels are not precise and the industry is quite unique in the Southeast Asian context (Bellwood 1989:148). Nevertheless, sites with similar industries date approximately between 5500 and 2000 years ago. The obsidian industry is perhaps the most surprising in terms of the western Melanesian location of two of its three sources. Group A matches the Kutau/Bao obsidian source in Talasea, New Britain; group B matches obsidian artefacts from the Talaud Islands (the geological source is unknown), and group C matches the obsidian sources in the Admiralty Islands to the north of New Guinea (Chia 1997:136-7).

The 1994 and 1995 excavations at Bukit Tengkorak revealed a similar archaeological record to that in 1987. Based on further radiocarbon dates, stratigraphy, and the spatial and temporal distributions of artefact types, Chia differentiated three occupational phases at Bukit Tengkorak quite different from those suggested by Bellwood: (1) Early Phase, 4340 – 1285 BC; (2) Middle Phase, 1200 – 900 BC; and (3) Late Phase 900 – 50 BC (Chia 1998:2). The existence of Chia’s Early Phase date is doubted by Bellwood, since the earliest date comes from a level at the base of the artifact distribution, and seems to relate to undocumented preceramic activity in the site (Bellwood, pers. comm.)

Since archaeological research in Kalimantan is still very limited, almost no record is available on cave sites from this region. In the upper Mahakam, Chazine recorded almost 20 caves, especially along the Cihan and Kasau Rivers. The most common items found in these caves are earthenware sherds, stone tools, animal bones
and freshwater shells (Chazine 1994). Only Gua Babi in South Kalimantan has been excavated. The excavations revealed three occupational layers, with the middle being richest in shells, lithics, sherds, bone tools and animal bones. The lithic artefacts are mostly flake debitage. Many flakes and blades with sharp edges were used directly without being retouched. Bone artefacts were not as prominent in quantity as lithic ones and were mainly made from animal long bones. They include unipoints, bipoints and spatulae. 23% of the sherds have paddle impression with corded and check-stamped motifs, and one sherd has lip incision. The animal bones include pig, deer, bear and monkey.

Borneo also contains a large amount of rock art, especially in caves. That from Sarawak and Sabah has been under documentation since the beginning of archaeological research in the region. Such sites include Kain Hitam, Gua Sireh, and Liang Batu Puteh and Liang Ringen in the Sarang Caves complex. In Kalimantan, recent records of rock art come from Kaung Cave, located in the upper Kapuas catchment in the Muller Mountains of Central Kalimantan (Chazine 1993a; 1993b; 1994); from Batu Cap Cave (Ketapang) in West Kalimantan (Yondri 1996; Prasetyo 1997); from Tengkayu, Batu Bakil and Batu Kadok Caves at Sungai Sungkung Village (Sambas), near the Sarawak border, West Kalimantan (Prasetyo 1997:46); from Mardua III rock shelter in the limestone formation of Sangkulirang, Kutai, East Kalimantan (Prasetyo 1997); and from another 20 rock art sites in the Sangkulirang area (Chazine et al. 2001).

4.5 The Characteristics of Archaeological Sites in Borneo

Most of the early occupational sites in Borneo are found in caves, some occupied since the late Pleistocene. These include the West Mouth at Niah, Gua Sireh, and Baturong. Such sites were often occupied intermittently over very long periods and most were still being used until recently.

In the West Mouth, where human occupation layers commenced at least 40,000 years ago and continued to a few hundred years ago, not only can changes in cultural patterns be recognised, but also changes in environment. Climatic changes during the late Pleistocene can be documented by changes in animal body sizes and species distributions (Cranbrook 2000:89-91). By the beginning of the Holocene, the more open

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12 Balai Arkeologi Banjarmasin in collaboration with the National Research Centre of Archaeology (Jakarta), Balai Arkeologi Yogyakarta and Bidang Musikala Kanwil Depdikbud South Kalimantan, have conducted five excavations in this cave. A report on the first two excavations has been published (Wildianto et al. 1997).
forest of the Niah surroundings had gradually changed into a dense rainforest, at the
same time as sea level rose and temperatures and rainfall increased. Human occupation
of humid rainforest may have been rather difficult for Palaeolithic hunter-gatherers. It
has been argued that, while rainforest may be the most productive terrestrial ecosystem
on earth in terms of pure biomass, it may still be a food-poor environment for hunter-
gatherers (Headland & Bailey 1991). Therefore, it can be expected that only groups of
limited size could have occupied such areas. However, it should be noted that even
though the occupation of interior rainforests was sporadic at best during the pre-
Neolithic, by the beginning of the Holocene there are some sites that were being
occupied quite intensively, such as the Madai Caves (Bellwood 1988:131; 1997b:180).

The arrival of groups of Austronesian-speaking people in Borneo between
approximately 4500 and 3500 years ago may have changed the situation. These
agriculturalists were equipped with technologies of pottery and polished stone, and
practiced cultivation that could support a larger population than the previous hunter-
gatherers. Bellwood suggests:

The Austronesians who entered Borneo, perhaps via Sabah from the southern
Philippines, brought with them a Neolithic material culture of polished stone
adzes, pottery, raised-floor houses and clothing of beaten bark-cloth. They
tattooed themselves, used the bow and arrow, and travelled in canoes, probably
with outriggers and sails. They also had domestic dogs, pigs and chickens, and a
range of crops including rice, millet, sugar cane, greater yam and taro. A number
of other crops such as banana, breadfruit and coconut were probably brought
under cultivation more locally within the equatorial zone, to which they are
native (Bellwood 1985). As far as Borneo is concerned it seems likely that these
cultivators expanded rapidly around the coasts and up the rivers with little
resistance from the existing but sparse foraging populations, although the latter
may have contributed much to subsequent cultures in terms of their
environmental knowledge (Bellwood 1992a:10-11).

Neolithic assemblages (4500 – 2000 years ago) are reported from Niah, Lubang
Angin, Gua Sireh, and Bukit Tengkorak. Pottery grave goods at Niah and Lubang
Angin include the beautiful pottery commonly named ‘three-colour ware’, decorated by
painting and incision, and double-spouted vessels. The Neolithic burials at Niah were
placed in extended postures in wooden coffins or bamboo caskets, sometimes wrapped
in textiles. Jar burials and cremations are also reported (B. Harrison 1967). The burials
at Lubang Angin were simpler than the Niah ones. Only extended or flexed postures
were found, with bark cloth wrappings (Datun 1993:103). Three-colour ware and
double-spouted vessels also occurred here, together with paddle-impressed pottery,
monochrome glass beads and marine bivalve shells.

72
At Gua Sireh, presumed Austronesian influence is marked by the appearance of pottery between 3500 and 4500 years ago (Datan 1993:163). The younger carved-paddle-impressed ribs, herringbones, diamond motifs and crossed patterns from Gua Sireh are similar to those found at Tanjong Kabor on the west coast of Sarawak and Gua Bungoh in the southwest. The older cord- and basked-marked decoration and incised and impressed circle motifs have close affinities with the Niah Neolithic pottery.

The presence of pottery with rice fragments at Gua Sireh is important for Borneo, since there is no other direct evidence of rice agriculture from this period, back to about 4300 years ago. The lowest such pottery found has a calibrated date of 4835-4096 BP (ANU 7049) (Datan 1993:116). From about 2000 years ago (Datan 1993:164), highly fragmented burials at Gua Sireh include monochrome glass and carnelian beads, cupreous and iron objects and gold beads (Datan 1993:164).

The introduction of iron and bronze metallurgy from the mainland of Southeast Asia to Borneo approximately 2000 years ago created additional changes (Bellwood 1992a:12). The Dong Son culture, which originated in Vietnam and was characterised by massive bronze drums, influenced almost all of the Southeast Asian Archipelago (Bellwood 1997b:269). Simple iron and bronze tools and weapons dating from about 2000 years ago have been found at Madai and Gua Sireh (Bellwood 1992a:12).

Approximately at the same time as the introduction of metal into Borneo, Indian influence started to appear in the archipelago. However, actual epigraphic evidence for an Indian presence in the island falls a little later, around AD 400. It is represented by seven Sanskrit inscriptions issued by King Mulawarman found at Muara Kanam, Kutei, East Kalimantan.\textsuperscript{13} Although these inscriptions are the oldest written records found in Indonesia, Indian influence in Borneo was never as strong as in Java and Bali. However, contact with other areas, such as China, become much more intense during the second millennium AD, as shown by the abundance of glazed ceramics mainly found in coastal or riverside sites such as Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981) in Brunei, and Santubong in the Sarawak River delta (Harrisson & O’Connor 1970).

The coastal area was also shows Islamic influence, marked the presence of an Islamic sultanate in Brunei, with the first Sultan embracing the religion in the early 15\textsuperscript{th} century AD (Omar 1981:2). However, a minor presence of Islam seems to have

\textsuperscript{13} Hindu artefacts have been found in various places in Kalimantan, but are not discussed further in this chapter.
occurred much earlier, as indicated by a Muslim Chinese tombstone dating from 1264 in Bandar Seri Begawan (Omar 1981:2).

4.6 Current Issues in Borneo Prehistory

There are several major issues concerning Bornean prehistory that need to be examined by future research. The first was put forward by Tom Harrisson in 1978, when he noted that no fossil hominids or early Palaeolithic sites had been found in the island. This remains true today. Since Charles Darwin published his Origin of Species in 1859, the concept of human evolution inspired other scientists to look for the ancestors of modern humans in the tropical regions. In 1869, Alfred Russel Wallace wrote that the remains of the first anthropoids could be expected to appear in Sumatra and Borneo, where the orangutan still lives today (Sémah et al. 1990:7). For the very same reason, Eugene Dubois went to Sumatra to find this missing link. Although he found the ancestor of modern man, which he called Pithecanthropus erectus, not in Sumatra but in Java, there has always been an expectation that similar fossils should one day be found in Borneo. But they have not, and Harrisson once concluded:

... it is possible that a significant segment of the larger, terrestrial, herbivorous mammal fauna failed especially to populate effectively heavily humid, forested terrain, including much of Borneo and Sumatra. Perhaps H. erectus was primarily dependent on these and had ecologically similar habits, ill-adapted to the equatorial jungle which H. sapiens slowly mastered with new techniques of craft and wit (T. Harrisson 1978:51).

Therefore, hominid fossils can be expected to be found in more open forest and savannah, similar to the environments in which Homo erectus lived in Java. Harrisson suggested that to find such sites, pollen analysis should be applied to detect possible past savannah landscapes. He proposed south-eastern Kalimantan as a likely place to start because of its relatively dry climate (T. Harrisson 1978:52).

The lack of hominid fossils and Early Palaeolithic tools in Borneo brings us to the second issue, concerning the debate over the origins of the nomadic hunter-gatherers in the tropical rain forests of Borneo and other parts of Southeast Asia. Bailey and Headland (1991) postulated that hunter-gatherers never lived in interior tropical rainforest without direct or indirect access to cultivated foods. They stressed that hunter-gatherers could only have occupied interior tropical forests with the advent of agriculture. However, Baturong and Gua Sireh were both inland caves during the late Pleistocene, Baturong about 100 km from the sea (Bellwood & Hughes 1988:7). The site was frequented by hunter-gatherers who mainly consumed pigs as well as deer, and
freshwater and terrestrial chelonians (Cranbrook 1988b:153). Gua Sireh was located 500 km inland about 20,000 years ago, and was visited occasionally by hunter-gatherers (Datun 1993:163).

In the northern and central regions of Peninsular Malaysia, similar evidence is also present, especially for the early Holocene. About nine interior limestone caves and shelters were occupied by Hoabinhian hunter-gatherers, commencing perhaps 10,000 years ago (Endicott & Bellwood 1991:174-6).

Thus, there is no doubt that the rainforest of Borneo was exploited to some degree by pre-agricultural communities during the Late Pleistocene. However, there are indications that some of this rainforest might have been drier than today, and more open during the Late Pleistocene. The apparent absence of human habitation in the heart of the island during the Late Pleistocene probably indicates that this deep interior region was always covered by dense rainforest unsuitable for hunter-gatherers.

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14 For a detailed description of this debate see Chapter 1.
V. THE EXCAVATIONS

5.1 Kimanis Cave

Kimanis is a large cave, with a big rock shelter in front of it, located at 2° 27’ 4” North and 117° 24’ 38” East. It lies about 160 m west of Lubang Payau (Map 1.2). At the time of excavation the Basap people had long since ceased to use the rock shelter. This was probably because people from Tanjung Redeb had been exploiting the bird’s-nests of this cave heavily for more than two decades. The Basap claimed that they used the rock shelter a long time ago.

Inside the cave, not far from the entrance, a decayed ulin plank (ironwood, Eusideroxylon zwageri) was found on the floor. According to the bird’s-nest collectors this plank had fallen from a cavity in the ceiling. Probably it was part of a lungun (wooden burial construction). It was impossible at the time of my visit to reach the cavity since it was too high above the cave floor, but there should be another entrance to the chamber where the ulin fell from. However, the bird’s-nest collectors have not found it yet. If the ulin pole was part of a lungun, the burial must have belonged to non-Basap people since the Basap are not reported to have buried their dead in this fashion. The timber is unlikely to have been part of an ancient climbing structure for collecting bird’s-nest since it was found in an area of the cave without nests. Besides, ulin are not used for scaffolding since the wood is too heavy; bamboo is more preferable.

The exploitation of the bird’s-nests in this cave started a long time ago. At the beginning of last century, Spaan explained that the region was under the sovereignty of the Berau Sultan and his family (Spaan 1902a, 1903b). Therefore, they had the right to exploit the forest products of the region, including the bird’s-nests. By that time, bird’s-nests had become a valuable commodity and had to be protected from thieves. The Sultan of Gunung Tabur appointed a group of Basap people who lived along the

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1 The location was plotted by using a hand-held GPS. Only Kimanis could be located by this instrument, as Lubang Payau and Liang Gobel were covered by quite dense forest and no signal could be detected from satellites.

2 Lungun are commonly used for burial by various tribes in Kalimantan. However, they are normally used by settled people, not by nomadic people such as Punan or Basap.
Totoong River, the most upstream Basap group in the Birang River area, to guard the caves from thieves coming from Bulungan, an area further north over the mountains (Spaan 1903b:667). Today, Kimanis produces the largest quantity of black bird’s-nests in the region, more than one ton per year.

The bird’s-nest collectors previously occupied the rock shelter at the entrance to the cave during harvest times. They built their huts from wooden poles, elevated above the ground. Recently they moved their huts into the cave for better protection of the bird’s-nests from thieves.

The rock shelter forms a spacious dry area, with its surface sloping slightly to the west, towards the entrance of the cave (Figure 5.1). This habitable area is about 22 x 8 metres and is located 230 metres above sea level. Tillema, who visited Kimanis Cave in 1927, mentioned that the Basap used to spend the night in this big rock shelter and he saw their fresh hearth remains (1937:258).

The area surrounding the rock shelter is covered by collapsed rock from the ceiling. The entrance to the cave is reached by climbing over a five-metre-high pile of rock at the west end of the habitable area, and then steeply descending about 20 metres to a flat area, before the final climb into the darkness of the cave. This flat area is very humid and with little sunlight. It is likely that this area was never occupied in the past, so the excavation was conducted in the dry rock shelter area.

The cave proper consists of a long and complex tunnel system with a river flowing in it, emerging as the Birang River about 240 metres south-east of the rock shelter. The cave mouth where the river flows out is called Liang Aput. When it rains heavily the surface of the water in the cave rises and becomes muddy, as does the Birang River. However, the rock shelter in front of the cave is always dry, no matter how heavy the rain.

Three squares were excavated in this site. The test pit (KMS/TP) was excavated during the first period of fieldwork to assess the reliability of the site for further research.

Only earthenware sherds, lithics and human bones were analysed from this test pit. The animal bones were only sampled, and not included in the statistical analyses.

The other two squares were excavated during the main excavation period. On this second fieldwork visit the rock shelter was laid out with a two-metre grid and two squares, C4 and C8, were excavated. However, due to time limitations, only half of each 2 x 2 metre square was excavated.
Figure 5.1 Plan and section of Kimanis Cave

LEGEND

- Excavation pit
- Cave wall and ceiling
- Roof fall
- Soil surface
- Soil surface
- Vertical projection of the cave ceiling
- Drip line
5.1.1 The Kimanis Test Pit

A single preliminary test pit one metre square was located near the eastern end, at the highest point of the shelter (Figure 5.1). The excavation was done in spits, each 5 cm thick. The soil was very fine and loose and it was rather difficult to separate different layers. At the completion of the excavation five layers could be differentiated based on colour and soil texture (Figure 5.2). Identification of soil particles and colours was conducted by M. Fadhlan from the Centre for National Archaeological Research in Jakarta.

The deposits excavated were divided into two cultural units (Figure 5.2). Unit I (spits 1 – 10) comprised several layers with earthenware sherds. Unit II (spits 11 – 27) did not have earthenware sherds and contained lithic items, vertebrate and invertebrate remains.

From Layers A to D the soil texture was the same, being ashy soil, but colours were different. Layer A was brown (5YR 4/4), Layer B dark yellowish-brown (10YR 4/4), Layer C brown (10YR 3/3), and Layer D dark brown (7.5YR 3/2). Layer E had a different texture, being a brown (7.5YR 4/3) ashy silty soil.

Layer A, the topsoil, was an even layer about 2 cm thick. It was very compact and hard. It contained chipped wood, plastic wrappers, a metal beer bottle top, charcoal particles, and some shell and bone fragments. A wooden pole, remains of a bird’s-nester’s sleeping platform, was found near the north-west corner.

Layer B was also a thin layer, but with variable thickness, between 3 and 20 cm. This fine and loose soil was mixed with chipped wood, charcoal particles and many fine long bones of bats, as well as shells, lithic material, earthenware sherds, and *damar* (tree resin) particles.

Layer C was 10 to 35 cm thick. The thickest part could be seen in the east wall and probably represents a small pit. The soil was fine and loose and mixed with vertebrate bone fragments, mainly of bats, some of which were burnt. Ash lenses could be seen in the west wall. Shells, lithic artefacts, earthenware sherds, *damar* particles, and some small pieces of limestone shatter were also found in this layer.

Layer D had very uneven thickness, from 20 to 50 cm, of loose soil, which becomes compressed when stood upon. In this layer bat bone fragments were rarer. Some of the vertebrate bones were burnt and charcoal particles were found scattered randomly. Ash lenses, as in layer C, could be seen in the west wall. Lithic material, earthenware sherds, shell, charcoal and *damar* particles were also mixed in this layer,
together with calcareous sandstone shatter from the roof fall. Some of the pieces were quite large, about 15 x 15 x 10 cm.

Layer E had an uneven thickness, from 40 to 75 cm. It may have been thicker, since when the excavation stopped in spit 21 this layer still continued downward. Layer E was rather damp, but very loose and became compressed when stood upon. In this layer the calcareous sandstone shatter and boulders became more abundant, some of them quite large, and clearly represented rock fall from the shelter roof. Bat bone fragments were much less than in the layer above, but bone fragments from bigger vertebrates increased in number. Many of the shells were fragmentary. Earthenware sherds and damar particles were no longer present in this layer. The test pit excavation stopped when it hit a flexed burial at about 130 cm from the surface (Figure 5.3).

In the upper layers, bats dominated the vertebrate bone assemblage. Gradually downwards they reduced in number and bigger vertebrate bone fragments became more abundant in lower layers. However, since the test pit was dug to assess the possibility for further excavation of the site, the bones were only sampled selectively. Therefore, no statistical analysis can be conducted for the vertebrate bones found in this test pit. Apart from bats, taxa represented include bovids, deer, suids, rhinoceros, sun bear, civet, mongoose, weasel, badger or otter, rats/mice, squirrels, monkeys, shrews, snakes, turtles and monitor lizards, as discussed in Chapter VI.

The invertebrate fauna was dominated by various molluscan taxa, including freshwater and marine taxa, and only one Crustacean, the true fresh water crab. Many of the molluscs found in this test pit were crushed or very fragmentary. The most common mollusc was the freshwater gastropod, Brodia sp. (Chapter VI).

Lithic artefacts consisted of 310 specimens, made from 11 different stone materials, most of small size. (Chapter IX). Bone points made from mammalian long bones were discovered in Unit II. Shell artefacts consisted of four marine bivalve scraper fragments, two from Unit I and the other two from Unit II. Ornaments made from cowrie shells were found in Units I and II, each one specimen. (Chapter X).

Earthenware sherds occurred only in the upper layers, from spits 2 to 5. There were 44 sherds and most were plain body fragments, with only five rim fragments. The pottery was made by a paddle and anvil technique. (Chapter XI).
Figure 5.3 Flexed burial from KMS/C4

LEGEND
HR  Human remains
FW  Fossilized wood
♀♂  Roof fall
Figure 5.4 Flexed burial from KMS/C4

PLAN

SECTION A - A'

LEGEND

HR  Human remains

Roof fall

0 (230.00 m asl)

0  50 cm

A

A'

HR

0 (230.00 m asl)

-0.25 m

-0.50 m

-0.75 m

-1.00 m

-1.25 m

-1.50 m

-1.75 m

-2.00 m

-2.25 m

-2.50 m

-2.70 m
5.1.2 KMS/C4

As mentioned earlier, only the eastern half of square C4 was excavated, covering an area 1 x 2 m². KMS/C4 was located six metres east of KMS/C8 and 1.5 m west of the Test Pit (Figure 5.1). The surface here sloped down to the north, with the north-east corner lowest and south-west corner as the highest point. The height difference across the surface was about 35 cm. The excavation reached a depth of 300 cm below the surface at the north-west corner, at spit 62. However, from spit 32 downwards only half of the square, an area of one by one metre, was excavated.

In spit 30 a flexed burial was found (Figure 5.4). Since the process of exposing the skeleton would have taken a long time and might have stirred the curiosity of the bird’s-nest collectors, and since the time left was very limited, the skeleton was covered by a plastic sheet and thin soil. It was later exposed at the end of the excavation and reburied. Meanwhile, excavation continued only in the southern part of the square, in an area of 1 x 1 m². The decrease in the size of the excavation meant that work could be done much faster. The target of the excavation was to reach the basal rock, in order to determine a complete chronology of human occupation for the site.

After completion of the excavation, five units were distinguished (Figure 5.5). Unit I (spits 1-10; 0<×≤50 cm) contained the pottery layers. Unit II (spits 11-23; 50<×≤105 cm) contained relatively few animal remains compared to the spits below. This unit also contained large amounts of roof fall. Unit III (spits 24-34; 105<×≤160 cm) contained the most abundant lithics and animal remains (vertebrates and invertebrates), indicating the most intensive occupation of the site. Unit IV (spits 35-42; 160<×≤200 cm) had fewer lithics and animal remains, but still plenty of shells, especially Brotia sp. The soil in this unit contained some ash lenses, not common in the upper units. Unit V (spits 43-61; 200<×≤295 cm) contained fewer lithics and animal remains, but ash lenses are more prominent than in Unit IV above. This unit also contained large rocks which finally stopped the excavation.

Eleven layers of different colour and soil texture could be distinguished (Figure 5.5). Layer A was thin topsoil of a dark brown (10YR 3/3) ashly silt. It was dry, hard and compact, 3 to 10 cm thick, mainly containing modern materials such as wooden chips,

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3 The discovery surprised the bird’s-nest collectors who thought this could disturb the spirit of the cave and bring bad luck to their work. The spirits were appeased by sacrificing a white chicken at the cave entrance at the end of the excavation. However, the occasion created uneasiness among the collectors and delayed excavation at Kimanis on the second visit. To prevent such awkwardness it was decided not to let the collectors know about the discovery of the other human skeletons in the site.

5 The roof fall in Kimanis has been tested in the Department of Geology at ANU. It consists mostly of calcareous sandstone.
Figure 5.5 Sections through the KMS/C4 deposits

LEGEND

A  Dark brown ashy silt
B  Dark yellowish brown sandy silt
C  Brown ashy silt
D  Dark brown silt
E  Dark brown ashy silt
F  Very dark greyish-brown silty sand
G  Dark greyish-brown silty ash
H  Brown ashy silt
I  Dark greyish-brown silt
J  Dark brown ash
J1  Reddish yellow ashy silt
*  Secondary burial
**  Ash lenses from human activities
#  Roof fall
DP  Datum point (altitude above sea level)
*  Charcoal sample
#  Fresh water shell sample
corroded tin, plastic rope and charcoal, but also including lithic material, earthenware sherds, vertebrate and invertebrate faunal fragments.

Layer B was a dark yellowish-brown (10YR 3/4) sandy silt. It was also thin, 3 to 10 cm thick, similar to Layer A. Cultural materials in this layer consisted of earthenware sherds, lithic material, vertebrate and invertebrate fauna, charcoal and damar particles.

Layer C was a loose, brown (7.5YR 4/3) ashy silt of uneven thickness, 10 to 55 cm, with the eastern side being thicker. This layer contained earthenware sherds, lithic material, vertebrate faunal fragments (especially long bone fragments of bats), small quantities of invertebrate fragments (molluscs and fresh water crabs), and some scattered charcoal and damar particles. A charcoal sample collected from this layer (spit 11) was submitted to the ANU Radiocarbon Dating Laboratory (see Radiocarbon Dating section).

Layer D consisted of a very loose dark brown (7.5YR 3/2) silt, which tended to become compressed if stood upon. Its thickness varied from 40 to 80 cm and it contained many roof fall blocks of varying size. Some of these showed signs of deliberate flaking. Layer D also contained a secondary burial (only the skull and some other bones) located in the northern part of the west wall. Earthenware sherds and damar particles were absent, vertebrate bone fragments increased in the lower part of this layer and molluscs were relatively scarce. Lithic materials reached their peak density. Two charcoal samples, from spits 20 and 24, were radiocarbon dated (see Radiocarbon Dating section).

Layer E consisted of a loose, dark brown (10YR 3/3) ashy silt. This layer was much thinner than Layer D, between 6 and 35 cm. Lithic materials were fewer than in Layer D, but vertebrate bone fragments were more abundant and the mollusc remains, especially the fresh water snail, Brotia, increased significantly in the lower part of the level. A flexed human burial was found in this layer.

Layer F consists of a loose, very dark greyish-brown (10YR 3/2) silty sand, from 18 to 40 cm thick. Lithic materials and vertebrate bone fragments reduced in quantity, but Brotia increased significantly. A charcoal sample from this layer (spit 34) was radiocarbon dated (see Radiocarbon Dating section).

Layer G consisted of dark greyish-brown (10YR 4/2) ashy silt, 8 to 20 cm thick. Lithic material and vertebrate bone fragments were reduced in number, but again Brotia were abundant. This layer was covered by whitish-grey ash lenses mixed with small charcoal particles that covered the whole excavation unit, scattered like islands within the dark soil. In some places the ash was cemented.
Layer H was a brown (10YR 4/3) ashy silt, 8 to 22 cm thick. In this layer, the ash lenses were mixed with tiny charcoal particles. Lithic material and vertebrate bone fragments were only found in small numbers and *Brotia* were also rarer.

Layer I consisted of a dark greyish-brown (10YR 4/2) silt with a thickness of 20 to 40 cm. The soil was rather wet, sticky and difficult to sieve. Ash lenses mixed with tiny charcoal particles occurred scattered all through the excavation unit. Several small accumulations of shattered calcareous sandstone, mostly from the roof fall, some of gravel size, occurred especially in the lowest part of the layer. Cultural remains are rare.

Layer J was a dark brown (7.5YR 3/3) ashy soil, with a thickness of 20 cm. Calcareous sandstone gravel and ash lenses mixed with tiny pieces of charcoal and charred vertebrate bones (especially bat long bones) occurred throughout this layer. The ash was especially concentrated in the south-east corner. One of the calcareous sandstone pieces showed some flaking scars. At the bottom of this layer there were large calcareous sandstone boulders fallen from the shelter roof, which caused the excavation to stop. Excavation of the last three spits (60-62) could be done only in a small boulder-free area in the south-east corner of the pit.

Layer J₁ consists of a reddish yellow (7.5YR 6/6) ashy silt about 5 cm thick, beneath the large calcareous sandstone boulders. No archaeological remains were found in this layer.

Animal bones found in this square were very fragmentary and difficult to identify to species level. More than half of the assemblage could not be identified and those that could were dominated by mammals (302 individuals/91%), followed in importance by reptiles (24 individuals/7%), birds and fish (each had two individuals/0.6%), and amphibian (one individual/0.3%). (Chapter VI). The invertebrate fauna was dominated by various molluscan taxa, including freshwater and marine taxa, and only one Crustacean, the true fresh water crab. The molluscs were dominated by *Brotia* (95%). (Chapter VI).

The lithic material consisted of 347 specimens, made from 12 different raw materials, mainly of small size (Chapter IX). Bone and shell artefacts were scarce and scattered mainly in the upper layers. The bone artefacts consist of two points and two spatulae, and the shell artefacts comprised six ornaments made from cowrie shells and 12 scrapers from marine bivalves (Chapter X).

Earthenware sherds were found from spits 3 to spit 10, a total of 58 fragments. Forty-nine are plain body fragments, only seven were rims, and there are two bases.
Most of the sherds are small and eroded. They were made by a paddle and anvil technique (Chapter XI).

5.1.3 KMS/C8

KMS/C8 was situated six metres west of KMS/C4 (Figure 5.1). Only the eastern half of square C8 was excavated, covering an area of 1 x 2 m². The excavation had to stop at a depth of 130 cm below the surface because of time limitations.

At completion of excavation, two units were distinguished (Figure 5.6). They were quite similar to the first two units in KMS/C4. Unit I (spits 1 – 10) contains the pottery layers with vertebrate and invertebrate remains and some lithic items, and Unit II (spits 11 – 27) contains more vertebrate and invertebrate remains than Unit I. It also contained much roof fall.

Four layers could be distinguished (Figure 5.6). These layers showed different soil colours, but the same texture. They were all ashy soil with slightly different colours: Layer A brown (7.5YR 4/4); Layer B dark yellowish-brown (10YR 3/4); Layer C dark brown (7.5YR 3/3); Layer D very dark brown (10YR 2/2).

Layer A was the topsoil, about 5 cm thick and very compact and hard. Most of the archaeological remains from this layer belonged to recent bird’s-nest collecting activities.

Layer B was a loose soil of uneven thickness, 5 to 35 cm, which tended to be thinner in the west wall but thicker in the east wall. This layer contained lithic material, earthenware sherds, small numbers of vertebrate (mostly bat) and invertebrate (mostly mollusc) faunal remains, charcoal and damar particles.

Layer C was also loose but darker than the layer above it. This layer had an uneven thickness, thicker than layer B, between 10 and 50 cm. Lithic material, earthenware sherds, vertebrate and invertebrate remains were excavated from this layer. They increased in number in the lower part of the layer, except for the damar and the earthenware sherds. The latter completely disappeared below spit 10, the bottom of this layer.

Layer D contained very loose soil, which tended to become compressed if stood upon. Its thickness varied from 40 to 80 cm. This layer was similar to Layer D in KMS/C4 and had a thickness between 65 and 85 cm. It may have been thicker, since when the excavation stopped in spit 27, this layer still continued downward. It contains many boulders of various sizes from roof fall, some of them bearing clear marks
Figure 5.6 Sections through the KMS/C8 deposits

LEGEND
A  Brown ashy soil
B  Dark yellowish-brown ashy soil
C  Dark brown ashy soil
D  Very dark brown ashy soil
RF  Roof fall with flaking marks
   Cave wall and roof fall
asl  above sea level
of deliberate flaking by humans, and the lithic, vertebrate and invertebrate remains were more numerous than in the upper layers.

KMS/C8 produced pottery and lithic artefacts, bone and shell artefacts, sherds, faunal and human bone remains, shells, charcoal, and damar particles. The lithics consisted of 294 specimens (Chapter IX). Only one bone point was found in KMS/C8. Shell artefacts were also rare and consisted of seven ornaments made from cowrie shells and five scraper fragments from marine bivalves. (Chapter X). Earthenware sherds were only found in the upper layers, between spits 2 and 10, and consisted of 56 sherd fragments, six decorated with paddle impressed patterns. (Chapter XI).

Vertebrate bones were dominated by non-identifiable fragments (54%). Identified remains were dominated by mammals (121 individuals/88%) followed by reptiles (11 individuals/8%), birds (two individuals/1%), and fish (three individuals/2%). (Chapter VI).

The invertebrate fauna consisted of molluscs (gastropods, bivalves and Cephalopoda) and Crustacea. The molluscs were dominated by Brotia sp., which was present in all spits except spit 2, and tended to gradually increase into the lower layers. Other molluscs were scarce and usually found individually in different spits. They included the fresh water snail, Paludomus broti and fresh water bivalve, Pseudodon vondenbuschianus, and five land snail species including Cyclophorus borneense, Pterocyclos termilabium, Leptopoma geotrochiforme, Amphidromus sp. and an unidentified species. Marine molluscs were represented by one bivalve, Polymesoda erosa, and a Cephalopod, Nautilus sp. Crustacea were represented by the fresh water crab (Brachyura) (Chapter VI).

5.2 Lubang Payau Site

The location of Lubang Payau could not be plotted by the GPS since it was covered by quite dense forest and no satellite signal could be detected. The cave was located between Kimanis and Liang Gobol, Kimanis being 160 m to the west and Liang Gobol 60 m to the southeast (Map 1.2).

Lubang Payau was a commercial bird’s-nesting cave, but much smaller than Kimanis Cave (Figure 5.7). The entrance chamber covered approximately 10 x 20 metres with a flat platform at the entrance, gradually sloping down inside. The cave has two tunnels, both of them leading to the same underground river. The left one was a much shorter tunnel than the right. The cave was always very wet, especially at the back
Figure 5.7 Plan and section of Lubang Payau Cave

LEGEND
- Excavation pit
- Cave wall
- Roof fall
- Soil surface
- Vertical projection of the ceiling
- Drip line
- Line section
of the entrance chamber. Water was always dripping from the ceiling. At the entrance to the right tunnel there was a small pool.

The front of the cave was quite open, therefore in the morning it was bathed with sunlight. However, the sunlight does not penetrate deeply into the cave, and since the cave was humid the soil surface near the entrance is covered by green moss.

The excavation in this cave was based on a grid system. Two squares were excavated: C3 (2 x 1 m) at the entrance of the cave and D5 (2 x 2 m) further inside (Figure 5.7). The thickness of each spit in C3 was 5 cm, while in D5 it was 10 cm. The reason D5 was excavated with the thickness of 10 cm per spit was because the soil was very hard from calcification. Use of a 5 cm spit unit was considered too time consuming and not practical, since flattening the surface to an even elevation at the bottom of the spit required more time in such hard and lumpy soil.

5.2.1 LPY/C3

LPY/C3 was located at the highest point of the cave (Figure 5.7). The surface here was relatively flat with the lowest part at the north-east corner and the highest part at the south-west corner; the vertical difference between the two points was about 26 cm. No archaeological remains were observed on the green moss-covered surface before excavation.

LPY/C3 has three units: Unit I (spits 1 – 8), Unit II (spits 9 – 18) and Unit III (spits 19 – 32) (Figure 5.8). The first unit consists of several thin stratigraphic layers, which contain pottery. Potsherds were actually found down to spit 21, however those found below spit 8 appear to have trickled down from the upper layers. The north wall stratigraphy showed a post-hole extending down to spit 22, and most probably the potsherds were from this. Unit II consisted of two stratigraphic layers. The upper one contains the densest archaeological deposit of this square, and the lower has less. Unit III also consisted of two stratigraphic layers, with the upper layer being a continuation from Unit II above. Very little archaeological deposit it was present.

The excavation revealed seven layers of different soil texture and colour, labelled Layer A (top), B, C, D, E, E1, and F (bottom) (Figure 5.8). Layer A was a thin topsoil, approximately 5 cm thick, consisting of a dark brown (7.5YR 3/2) sandy silt which was compact and wet. In this layer recent artefacts from bird’s-nest collecting were found, such as a torch bulb, a battery, plastic bags, earthenware sherds, shells, and animal bone fragments.
Figure 5.8 Section through the LPY/C3

LEGEND
A  Dark brown sandy silt
B  Very dark greyish-brown sandy silt
C  Brown ashy silty clay
D  Dark brown ashy silt
E  Dark greyish brown ashy silt
E.1 Brown ashy silt
F  Yellow ashy silt
bed rock and roof fall
asl above sea level
Layer B consisted of a very dark greyish brown (10YR 3/2) sandy silt. It was less compact than Layer A. This was also a thin layer, a little thicker than Layer A, with an uneven thickness of 5 to 15 cm. Lithic material, earthenware sherds, shells, animal bones and charcoal particles were found in this layer.

Layer C, a brown (7.5YR 4/3) ashy silty clay, was not visible everywhere in the square, being absent in the east wall. In the north wall only a thin long lens, approximately 5 cm thick, was present. In the south wall this layer was about 5 to 10 cm thick and 60 cm long. This damp, loose soil layer contained lithic material, earthenware sherds, shells, animal bones and charcoal particles.

Layer D was a loose, damp, dark brown (7.5YR 3/2) ashy silt with an uneven thickness of approximately 10 to 20 cm. It contained similar archaeological deposits to the layer above.

Layer E had an uneven thickness (approximately 20 to 50 cm), tending to be thicker in the north wall area. It was a dark greyish brown (10YR 4/2) ashy silt, very loose, and with similar archaeological materials to Layer D, although with much denser shell remains, especially *Brotia*.

Layer E₁ was similar to Layer E, but of slightly different colour. This brown (10YR 5/3) ashy silt was also damp and very loose. It had an uneven thickness (approximately 10 to 50 cm). At approximately 80 cm from the surface (measured from the north-west corner of the square) the excavation hit a large limestone boulder, which covered the west and south sides of the square, therefore only the north and east parts could be excavated further. The area to be excavated became very small, so a part of the boulder in the south-west corner had to be broken and removed. This was done in spit 18, about 80 cm (90 CM IF 5x18) below the surface. At this level the soil still belonged to Layer E₁, which continued further down in the middle of the north side of the square, creating a shallow, roughly round pit up to 60 cm deep. The quantity of archaeological material decreased significantly from the upper to the lower part of Layer E₁.

Layer F was very different in colour compared to the layers above. It was a damp, rather sticky, yellow (10YR 7/6) ashy silt, about 30 to 40 cm thick. The archaeological materials found in this layer were dramatically fewer compared to Layer E₁, and finally disappeared altogether. The last spit (spit 33) was therefore sterile when it reached solid rock at 165 cm from the surface.

The archaeological remains found in LPY/C3 included lithic material, earthenware sherds, bone and shell tools, animal bones and shells, as well as charcoal particles, ochre and *damar*.
The earthenware sherds were mainly small fragments, mostly eroded, and were only found in the upper layers of the square, from spit 1 to 13, although they were absent from spits 9 and 12. One isolated earthenware sherd was found in spit 21. There were 367 earthenware sherds altogether.

There were 240 lithic artefacts made of various rock materials, mainly chert, but also sedimentary rock, volcanic rock, microgranodiorite, calcareous sandstone, quartz, limestone and sandstone. Most were flakes without modification, followed in abundance by debitage, flake fragments, heat shattered pieces, flake shatter, multidirectional cores, and a bipolar core. These lithic materials occurred from spits 2 to spit 30, with greatest concentration between spits 6 and 17 (Chapter IX).

Bone and shell artefacts were very rare. There were three bone artefacts, found in spits 2, 5, and 15. The first two were points made from mammalian long bone fragments and the last one was an unknown object made from a mammal skull fragment. Shell artefacts were found in spits 3, 6 and 10, one from each spit. They were broken scrapers made from fragments of marine bivalves (*Polymesoda erosa*) (Chapter X).

Earthenware sherd decoration was mainly by carved paddle-impression (checked pattern) or cord-marking (84 potsherds in total were decorated). In addition there are two potsherds which have incised marks. In most cases the checked pattern was eroded, unlike the cord-marks which could still be seen clearly. The earthenware sherds were made by a paddle and anvil technique and some of the potsherds contain impressions of rice husks (identified by Jill Thompson) (Chapter XI).

Vertebrate and invertebrate faunal remains were found in all spits except the bottom one (33). More than 80% of the vertebrate faunal bones could not be identified anatomically. Those that could be identified comprised 39 individuals, mostly (87%) mammal, with a few reptiles (13%) and birds. Most of the faunal remains were found between spits 5 and 9. Below spit 9 vertebrate bones were scarce, especially below spit 19 (Chapter VI).

The bones were very fragmented, therefore identification to species was difficult. Only six species were identified: bearded pig (*Sus barbatus*), bear cat (*Arctictis binturong*), sun bear (*Helarctos malayanus*), orang utan (*Pongo pygmaeus*), Bornean gibbon (*Hylobates muelleri*), and lutung (*Trachypithecus cristatus*). Most of the vertebrate faunal assemblage was only identified to family, including bovids, deer, mouse-deer, pig, rhinoceros, Mustelidae, Viverridae, Muridae, monkeys, bats, snakes,
monitor lizards, turtles, and birds. A few fragments of human bone were found, scattered in different spits.

The invertebrate fauna consisted of molluscs and crustacea. The molluscs were dominated by *Brotia* (80%). The apex of this shell had almost always been broken to allow the whole animal to be sucked out. *Brotia* were concentrated in the upper layers, between spits 4 and 18, with a peak in spit 10. Other molluscs were rarer than *Brotia* and consisted of freshwater snails and bivalves, terrestrial snails, and one species of marine gastropod and three bivalves. The only crustacean present was the fresh water crab, *Brachyura* (Chapter VI).

Ochre or haematite particles were scattered in small fragments in almost every spit between 1 and 25.

5.2.2 LPY/D5

LPY/D5 was located on a slope, two metres inside from and almost one metre lower than LPY/C3 (Figure 5.7). The light here is dimmer than in LPY/C3 and the surface is always wet from dripping water. Therefore, the soil was calcified and hard to dig. Shells were scattered on the surface, many of which may have originally been deposited further up the slope inside the cave. Several limestone boulders also lay on the surface.

LPY/D5 consisted of 10 spits, but only the first six that contained archaeological deposits. Spits 7 to 10 are sterile. Only spit 6 lacked pottery, but lithics, bones and shells were still present, although in lesser quantity. Since spit 1 to 6 lie within one stratigraphic layer, they all regarded as one unit.

At the end of the excavation, 9 layers of different soil colours could be identified (Figure 5.9). They were labelled Layers A, A₁, A₂, A₃, B, B₁, C, C₁, and D, from top to bottom.

Layer A, the topsoil, consisted of compact, wet, brown (10YR 5/3) sandy silty clay. It was a thin layer of relatively even thickness, between 4 to 8 cm, thickest in the south-east corner of the square. It contained lithic materials, earthenware sherds, animal bones and shells.

Layers A₁, A₂, and A₃ were thin lenses only visible in the north-west corner of the square. Layer A₁ was a brown (10YR 5/3) sandy silt, very thin (approximately 2 cm). Layer A₂, which consisted of yellowish brown (10YR 5/8) silty sandy soil was of uneven thickness (approximately 2 to 10 cm). Layer A₃ had a similar soil texture to
Figure 5.9 Sections through the LPY/D5

LEGEND
A  Brown sandy silty clay
A.1 Brown sandy silt
A.2 Yellowish brown silty sand
A.3 Brown silty sand
B  Dark reddish-brown sandy silt
B.1 Dark reddish-grey sandy silt
C  Brownish-yellow sandy silt
C.1 Brownish-yellow silty sand
D  Brownish-yellow sandy silty clay
s  Bed rock and roof fall
asl Above sea level
layer A₂, but was of different colour (7.5YR 4/3) and only visible in the north wall of the square. It had a thickness of 1 to 4 cm.

Layer B consisted of dark reddish-brown (5YR 3/4) sandy silt of uneven thickness (1 to 24 cm). It was a wet and sticky soil, with some parts calcified and hard to dig. It contained lithic materials, earthenware sherds, bones and shells. Layer B₁ contained thin small lenses, about 2 cm thick and 8 to 38 cm long, scattered horizontally between Layers B and C. It had the same soil texture as Layer B (sandy silt) but was of a different colour, being dark reddish-grey (5YR 4/2).

Layer C consisted of a brownish-yellow (10YR 6/8) sandy silt with an uneven thickness of approximately 7 to 30 cm. Much of this layer was also calcified and difficult to dig. Lithic materials, earthenware sherds, bones and shells were found in this layer. Layer C₁ consisted of a brownish-yellow (10YR 6/8) silty sand with an uneven thickness of approximately 5 to 40 cm. Almost no artefacts were found in this layer.

Layer D consisted of a brownish-yellow (10YR 6/8) sandy silty clay, with a thickness approximately between 5 and 35 cm. No archaeological remains were found in this layer.

The excavation of LPY/D5 hit basal rock at 45 cm depth on the north side and about one metre on the south side. Depth measurements were taken from the surface at the south-west corner of the square.

The archaeological remains from LPY/D5 consisted of lithic materials, bone and shell artefacts, earthenware sherds, vertebrate and invertebrate faunal remains, human bone fragments, ochre, charcoal and damar, similar to LPY/C3. They were concentrated within the top 6 spits, while the four lower spits were archaeologically sterile. Spit 6 had the fewest archaeological remains and spit 4 the most.

The lithic materials consisted of 109 specimens, dominated by flakes, followed in abundance by flake fragments, flake shatter, heat shatter, utilised and retouch flakes, core fragments, a utilised flake, a multidirectional core, and a manuport. They were made from various rocks, including chert, sedimentary rock, microgranodiorite, volcanic rock, milky quartz, limestone and calcareous sandstone (Chapter IX). There were two bone unipoints made from long bones, but no shell artefacts (Chapter X).

Earthenware sherds were only found in the first 5 spits. The 258 sherds recovered were mainly small fragments. Most were plain, but decorated potsherds were also present (30 sherds), mostly very eroded. The decoration was made by carved paddle-impression giving a check pattern, and also by incision. The earthenware sherds were made by a paddle and anvil technique. Rice-husk impressions were found in several sherds,
although the density of impressions was insufficient to imply the use of husks as a deliberate temper (Chapter XI).

Vertebrate bone fragments were dominated by non-identifiable specimens (62%). The others consisted of 208 specimens from 19 individuals, mostly mammals followed by reptiles, amphibians and fish (Chapter VI). The vertebrate fauna was very fragmentary and difficult to identify to species level. Only two species were identified, Malayan tapir (*Tapirus indicus*), and sun bear (*Helarctos malayanus*). Non-specific elements included members of the following taxa: bovids, deer, pigs, Viverridae, porcupines, squirrels, Cercopithecidae, *Macaca* sp., snakes, turtles, and monitor lizards, frog and fish. Fragments of human bone were also found but were very rare and distributed randomly in different spits.

The invertebrate faunas were overwhelmingly represented by molluscs, with few crustacea. The most common molluscs were the fresh water snails, *Brota* (76%), most with their apices broken off. Other molluscs included freshwater snail *Paludomus broti*, freshwater bivalves *Pseudodon vondenbuschianus*, four terrestrial snail species, two marine bivalves and three marine gastropods. Crustacea were represented by fresh water crab (*Brachyura*) (Chapter VI).

### 5.3 Liang Gobel

This small rock shelter (8 x 5 m) was located 60 m southeast of Lubang Payau (Map 1.2). It was situated within a steep limestone cliff wall about 5 m high, a few metres from the path that led to Lubang Payau (Figure 5.10). Since earthenware sherds and shells were found on the dry surface of this rock shelter, a test pit, LGB/TP (1 x 2 m) was opened to recover archaeological remains for comparison with those found in Kimanis and Lubang Payau.

The area around this rock shelter covered by trees, which formed an interlocking canopy. However, some open patches allowed sunlight all through the day since this rock shelter faced south.

LGB/TP has a shallow archaeological deposit, which lie on an uneven basal rock. The excavation revealed 11 spits, which in this analysis treated as one unit.

The depth of the single test pit was only about 20 cm, down to an uneven basal rock floor (spit 11). Three stratigraphical layers can be differentiated: A, B, and C (Figure 5.11). Layer A, the top soil, consisted of greyish brown (10YR 5/2) ashy soil, about one to two cm thick. Layer B consisted of dry and loose brown (7.5YR 5/3) ashy silt. Most of the archaeological remains were found in this layer. Layer C was only
Figure 5.10 Plan and section of Liang Gobel rock shelter
Figure 5.11 Sections through the LGB/TP deposits

LEGEND
A  Greyish brown ashy soil
B  Brown ashy silt
C  Yellowish brown ashy silt
Bed rock
found in the middle area of the bottom of the pit. It was yellowish brown (10YR 5/4) ashy silt soil, about 3 cm thick. No artefacts found in this layer. Only two bone fragments from Suidae and Testudinidae were present in this layer. The test pit yielded scarce lithic material, earthenware sherds, vertebrate and invertebrate faunal remains. Lithic materials were not abundant, with only seven small flakes from spits 3 to 7 but none from spit 5. They consisted of flakes, flake fragments, flake shatter, utilised flakes, a bipolar flake, and heat shattered material (for descriptions of lithic types see Appendix 9.3). They are described in Chapter IX. No bone or shell artefacts were discovered in this site.

Earthenware sherds occurred in every spit except spits 1, 9 and 11. Twenty nine potsherds were recovered (16 decorated), some quite large compared to the small potsherds found in Kimanis and Lubang Payau. They were also not as eroded as those from Lubang Payau and Kimanis. The only decoration was carved paddle-impression (checked pattern) and the vessels were made by the paddle and anvil technique.

Vertebrate bones were found from the top to the bottom of the test pit, but were absent from spits 3 to 5. They were dominated by bone fragments of bearded pig (Sus barbatus), although only one individual was present in the MNI calculation. Other vertebrate faunal fragments, all representing one individual for each taxon, included bovid, deer, carnivore, sun bear (Helarctos malayanus), rodent, rats/mice, monkey, bat, snake, turtle and frog (Chapter VI).

Invertebrate faunal remains were dominated by molluscs, especially Brotia, but crustacea were also present (Brachyura). The other molluscs consisted of a freshwater snails, three terrestrial snails, and the marine Polymesoda erosa (Chapter VI).

5.4 Radiocarbon Dating

Seven radiocarbon samples from KMS/C4 and three from LPY/C3 were submitted to the ANU Radiocarbon Laboratory (see table 5.1). Six were on charcoal pieces and the dates were calibrated with the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program Rev. 3.0. 1993. The other four samples were freshwater shells for which the dates cannot be calibrated, except by comparison with the charcoal dates from the same horizon.

Charcoal was not abundant and occurred mainly as small particles concentrated in the upper layers of KMS/C4 and LPY/C3. Since no charcoal samples were enough for dating from the lower layers of the sites, fresh water shells (Brotia sp.) were used. However, fresh water shell is known to produce much older dates owing to
contamination from ancient calcium carbonate dissolved in rivers and groundwater in limestone environments. Therefore, two shells from each trench were dated, one from the same horizon that produced the charcoal radiocarbon date as a comparison and the other one from a much lower layer. From KMS/C4, a sample of freshwater shell dated to 13,100±140 BP (ANU 11260) was derived from the same layer (Spit 24, 105 – 110 cm below the surface) as a charcoal sample dated to 10,030±260 BP (ANU-11150). As suspected, the freshwater shell date was much older than the charcoal one, with the difference between them being more than 3000 years. The dates from LPY/C3 showed a greater difference between the charcoal and freshwater shell. Spit 6 (25 – 30 cm below surface) produced a charcoal radiocarbon date of 4610±110 BP (ANU-11152) but a freshwater shell date of 13,100±140 BP (ANU-11260), a difference of almost 8,500 years.

With such variation, it is difficult to rely on the freshwater shell radiocarbon dates, especially if the freshwater radiocarbon dates from the lower layers are used to date the oldest human occupation of the sites. Elsewhere, freshwater shell radiocarbon dates have always revealed much older dates than stratigraphically equivalent samples from charcoal. Bellwood suggested approximately 500 years too old for freshwater shell dates from Madai (1988:120), while Spriggs showed that freshwater shell could be 1500 years to old (1989:598). From Gua Sireh, Ipoi Datan suggested a 500 year increase in real age from freshwater shell (1993:17).

In the case of the upper Birang the difference is much greater than the dates mentioned above. Such a great difference also occurred for radiocarbon dates obtained by Adi Taha from Ulu Kelantan in Peninsular Malaysia (Adi 2000:121). Adi used three parallel dates from charcoal and freshwater shell from Trenches 1 and 2 in Gua Chawas and from Trench 1 in Gua Peraling. He mentioned that:

The parallel dates indicate that the shell dates are much older than the charcoal dates. However, the difference in dates between the charcoal and shell dates varies among the three trenches. At Trench 1, the difference between charcoal and shell dates are substantial amounting to 4,880 years, at Gua Peraling a difference of 3,350 years while in Gua Chawas Trench 2 the difference is reasonable with a difference of 1420 years (Adi 2000:121).

The Upper Birang freshwater shell radiocarbon dates showed the same trend as those from Ulu Kelantan. The difference is even greater at Lubang Payau, almost 8,500 years. However, the stratigraphy here does not show any disturbance and the dates are all in sequence if charcoal and shell are considered separately. But since the freshwater
shell radiocarbon dates are clearly questionable, in the following analyses only the charcoal radiocarbon dates will be used.

<table>
<thead>
<tr>
<th>SQUARE/SPIT</th>
<th>SAMPLE DEPTH (CM)</th>
<th>MATERIAL</th>
<th>LAB. NO.</th>
<th>CONVENTIONAL AGE (BP)</th>
<th>CALIBRATED DATE (BP), ONE SIGMA RANGE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMS/C4/Spit 8</td>
<td>35 -40</td>
<td>Charcoal</td>
<td>ANU-11311</td>
<td>1270 ±240</td>
<td>1220, 1180</td>
</tr>
<tr>
<td>KMS/C4/Spit 11</td>
<td>50 - 55</td>
<td>Charcoal</td>
<td>ANU-11148</td>
<td>4650 ± 90</td>
<td>5440, 5430, 5320</td>
</tr>
<tr>
<td>KMS/C4/Spit 20</td>
<td>98</td>
<td>Charcoal</td>
<td>ANU-11149</td>
<td>8840 ± 250</td>
<td>9880</td>
</tr>
<tr>
<td>KMS/C4/Spit 24</td>
<td>105 -110</td>
<td>Charcoal</td>
<td>ANU-11150</td>
<td>10030 ± 260</td>
<td>11330, 11300, 11250, 11220, 11170, 11140</td>
</tr>
<tr>
<td>KMS/C4/Spit 24</td>
<td>105 -110</td>
<td>Freshwater shell</td>
<td>ANU-11258</td>
<td>13860 ± 180</td>
<td></td>
</tr>
<tr>
<td>KMS/C4/Spit 34</td>
<td>155 - 160</td>
<td>Charcoal</td>
<td>ANU-11151</td>
<td>11270 ± 220</td>
<td>13180</td>
</tr>
<tr>
<td>KMS/C4/Spit 59</td>
<td>280 -285</td>
<td>Freshwater shell</td>
<td>ANU-11259</td>
<td>23630 ± 480</td>
<td></td>
</tr>
<tr>
<td>LPY/C3/Spit 6</td>
<td>25 - 30</td>
<td>Charcoal</td>
<td>ANU-11152</td>
<td>4610 ± 110</td>
<td>5310</td>
</tr>
<tr>
<td>LPY/C3/Spit 6</td>
<td>25 - 30</td>
<td>Freshwater shell</td>
<td>ANU-11260</td>
<td>13100 ± 140</td>
<td></td>
</tr>
<tr>
<td>LPY/C3/Spit 23</td>
<td>110 - 115</td>
<td>Freshwater shell</td>
<td>ANU-11261</td>
<td>17730 ± 250</td>
<td></td>
</tr>
</tbody>
</table>

*University of Washington Quaternary Isotope Lab. Radiocarbon Calibration Program 1993 Rev.3.

One possibility is that ancient shells have been mixed upwards into higher layers that contain pottery. This can happen very easily in caves and would not necessarily require visible disturbance of the deposits. Excavation of small postholes for sleeping platforms would be sufficient, or even crab burrows. If this happened, then the shell dates could be almost “right” for the shells themselves, but not for the layers in which they were found.
IV. THE PREHISTORY OF BORNEO

4.1 The First Human Occupation of Borneo

Geologically, Borneo is part of the continental shelf extension of Mainland Southeast Asia that is termed Sundaland. This was a vast land that emerged when the sea level dropped to about 120 metres during the glacial periods of the Pleistocene, connecting the Malay Peninsula, Sumatra, Borneo, Java and Bali. This happened several times during the Pleistocene, with the last full exposure during the Last Glacial Maximum about 21,000 years ago (Hanebuth et al. 2000:1034). During the interglacial periods, when the sea level rose to about the present level, the land bridge that connected Mainland Southeast Asia and these islands became drowned, leaving the islands as they are today.

Presumably, the first human occupation of Borneo occurred during one of these glacial periods. Unlike Java, where early human fossils of *Homo erectus* are present in large number, Borneo has none at all. Bellwood suggested that “Perhaps in Borneo no bone could survive in the hot, wet and acidic conditions, but it is also possible that early humans simply did not inhabit the equatorial rainforest and preferred the more open and drier environments of Java.” (Bellwood 1992a:8). So far, the oldest human remains found in Borneo belong to a modern human, known as the “deep skull”, which was associated with charcoal radiocarbon dated to 39,600 ± 1000 years BP (Kennedy 1977:33). The Niah Cave Project has recently dated the skull more securely to c. 43-44,000 BP (Barker et al. 2002a:153; 2002b:97). This skull, which was found in the West Mouth of Niah Cave, showed close morphological affinities of cranial structure with recent Tasmanian and Australian groups (Brothwell 1960:339).

The deep skull was not the only human material found in Niah. There are more than 200 other burials that belong to later periods (Majid 1982:23). These burials can be divided into two groups: first a series of flexed, seated, and fragmentary burials (14,000 – 3,500 BP) and second, extended burials in coffins or mats (possibly from 4,000 BP – less than 2,000 years ago) (Bellwood (1997b:84). The first group do not seem to represent recent Southern Mongoloids, while the second appear to be more closely related to them.
Based on these human remains, it can be said that Niah suggests the presence of an Australo-Melanesian population in the island which was replaced gradually by a Southern Mongoloid population after about 3,000 years ago (Bellwood 1997b:85). This phenomenon is in accord with what happened in the western and northern regions of the Indo-Malaysian archipelago in general.

4.2 The Austronesian Expansion

The earliest traceable groups of Austronesian speakers originated in Southern China and Taiwan prior to 5,000 years ago (Bellwood 1997b). The Austronesian linguistic expansion is regarded as so successful that no indications remain of the earlier languages supposed to have been spoken in western or central Indonesia. However, Adelaar has claimed possible evidence of an Austroasiatic substratum, related to the Aslian languages of Peninsular Malaysia, in the Bidayuh (Land Dayak) language of western Sarawak (Adelaar 1995).

Both linguistic and archaeological evidence has been used to reconstruct the Austronesian expansion. By 5,000 BP, initial Austronesian settlement had occurred in the island of Taiwan (Bellwood 1997b:117). From there, Austronesian languages were spread by population movements all over the Indo-Malaysian archipelago. Bellwood suggested that Austronesian colonisation occurred about 4,500 BP in the Philippines, followed by fairly rapid movement to Borneo and Sulawesi by about 4,000 BP (Bellwood 1997b:119). Further, Bellwood suggested that expansion to the west, including the Malay Peninsula, occurred later on, about 3,500 – 3,000 BP. The expansion to the east to the Moluccas might have occurred earlier, about 4,500 BP (Spriggs 1990:57), although at present there are no reliable dates in excess of 3,500 BP.

This Austronesian expansion into Taiwan, the Philippines and Borneo is usually recognised archaeologically by the introduction of pottery, pigs, dogs and rice agriculture, none of which were known before in the region. The rice agriculture did not spread beyond the eastern regions of Indonesia. Recent archaeological research in Sarawak has produced the oldest evidence for rice agriculture in Borneo, based on a radiocarbon date of c.4,500 BP from a carbonized rice grain embedded in pottery from Gua Sireh in Sarawak (Bellwood 1997b:117).

4.3 The Languages and Tribal Groups of Borneo

The languages of Borneo belong to the Western Malayo-Polynesian division of the Austronesian family, together with those of the Philippines, southern Vietnam
(Chamic), Madagascar, Peninsular Malaysia, Sumatra, Java, Sulawesi, Bali, Lombok, western Sumbawa, and two languages - Palauan and Chamorro - of western Micronesia (Bellwood 1997b:105).

Within Borneo, Hudson has classified the languages into seven endo-Bornean groups (Land Dayak, Rejang-Baram, Kenyah-Kayan, Apo Duat, West Barito, Barito-Mahakam and East Barito) and three exo-Bornean groups (Malayic Dayak, Tamanic and Sabahan) (Adelaar 1995:77). These language groups have also various dialects that are spoken by many different populations.

The differences in language in Borneo are also reflected by the presence of many different ethnic groups. Besides the Malays, who generally speak an early historical immigrant language confined to coastal areas, the local inhabitants are better known as Dayaks. There are hundreds of Dayak tribal groups, and many have not yet been studied by anthropologists. Riut classified Dayak people into seven major tribes (Ngaju, Apu Kayan, Iban/Heban or Sea Dayak, Klemantan or Land Dayak, Murut, Punan, and Ot Danum), which he then further subdivided (Riut 1979:213-29).

The presence of differentiated language groups that share relations of common ancestry across Borneo suggests that there has been a lot of movement of people in the past, encompassing treacherous mountains and remote interior rainforest regions. Most of these movements were probably along the rivers by boat, a much faster and easier method of travel in many cases than travel by land. Ethnographic studies also suggest that migrations of people within the island have occurred continuously for various reasons. Some movements, such as those of the Iban of Sarawak, involved quite long distance travel. Many such migrations have been recorded dating back to several centuries ago, but most details naturally belong to the past few decades (Guerreiro & Sellato 1984a & b; Anau 1999; Egenter 1999; Lawai 1999). Since such migrations have occurred so frequently in recent times it is also likely that they formed a major aspect of the prehistoric past, and thus should be recognisable in the archaeological record, at least to a degree.

4.4 Archaeological Sites in Borneo

Most archaeological research in Borneo has been carried out in Sarawak and Sabah, both of which have revealed many important sites. Unfortunately, almost nothing was done in Kalimantan until the last decade, and little research has been done in Brunei (Map 1.3).
The nature of the archaeological sites in this island is largely determined by the environment. Although it is expected that sites should be found everywhere, in reality most are caves and rock shelters in limestone formations. This is understandable, since organic remains would not survive long without protection in the tropical rainforest environment. The acidity of the soil and the humidity contribute to rapid deterioration of organic remains. The speed of vegetation growth makes it difficult to locate open sites, even stone artefacts. So far, there are few open sites known in Borneo from the period prior to the introduction of Chinese ceramics; examples include Tingkayu in Sabah (Bellwood & Koon 1988), Putai River/Ulu Baleh in Sarawak (Chin & Nyandoh 1975), and Nanga Balang in West Kalimantan (Soejono 1991). Apau Ping and other villages in the upper Bahau River, East Kalimantan, can be added to the list (Ariffin & Sellato 1999a).

In the Tingkayu Valley in Sabah, seven open sites previously covered by thick secondary forest were recorded in 1980-81 and 1987 after the establishment of an oil palm plantation (Bellwood & Koon 1988:38). Two of these sites, TIN1 and TIN2, contained a bifacial stone tool industry believed to date on environmental grounds to between 28,000 and 18,000 years ago (Bellwood & Koon 1988:49), although no direct dates for the tools have ever been recovered.

The Putai River/Ulu Baleh site is located on a hill at the junction between the Putai and Batang Ulu Baleh rivers. This was the first open site ever reported in Sarawak, and contained stone tools associated with earthenware pottery (Chin & Nyandoh 1975). The stone tools comprised quadrangular adzes made of river pebbles, together with chert, agate and quartz flakes. Other artefacts found included a barkcloth beater, metal objects (brass earrings, bangle fragments and fragments of iron knives and spears), and beads (Chin & Nyandoh 1975).

Nanga Balang is located by the Kapuas River, approximately four metres above the river level. The archaeological deposits contain quadrangular adzes (including unfinished adzes), pounding stones, stone anvils, grinding stones, pottery and glass beads (Soejono 1991). Soejono concluded that Nanga Balang was a Neolithic dwelling place dating from ca 1000 BC to AD 200 (Soejono 1991:18).

Apau Ping and several other surrounding villages in the upper Bahau River revealed hundreds of quadrangular adzes, mostly polished. They were collected from the surface by the local people. Fifteen settlement sites have so far been recorded in the upper Bahau River area (Ariffin & Sellato 1999a:398). However, they are not very old,
only several hundreds of years, and are presumably contemporary with the megalithic remains found in this area.

The coastal open sites reported in Borneo so far mainly belonged to more advanced societies that imported foreign elements, mostly of Chinese but also Indian origin, that reflect intensive contact with overseas communities. Such sites include Santubong on the Sarawak River Delta in Sarawak (Harrisson & O’Connor 1970), and Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981) in Brunei. Santubong has at least six important sites, dating back to at least AD 800. However, it was not until the second half of the 14th century AD that the sites showed remarkable activity, especially associated with “the collection, smelting, and export of iron (and probably steel), but also richly with trade in Chinese ceramics, western glass beads, gold of local origin and much else.” (Harrisson & O’Connor 1970:3). Although the Santubong sites reflect strong foreign influence, activities of the local people are represented by paddle-impressed pottery and by a half-life-sized spread-eagle figure carved on a sandstone boulder, known as Batu Gambar, located at Sungai Jaong. Further clearing of the surrounding area revealed many other engravings on at least 30 large boulders (Harrisson & O’Connor 1970:111).

The open sites in Brunei, such as Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981), belong to a later period with an abundance of Chinese and Indo-Chinese stoneware and porcelain. These sites were not previously occupied by Neolithic populations, although paddle-impressed earthenware pottery in the same tradition as that commonly made by pre-metal people elsewhere in Southeast Asia was present.

Megalithic remains are mostly limited to the central part of Borneo, for instance around the Kelabit highlands in Sarawak (Schneeberger 1979); at Kerayan, Long Pujungan, and Malinau in East Kalimantan (Schneeberger 1979; Baier 1987; 1992; Arifin & Sellato 1999a); and in upper Kayan (Apo Kayan) in West Kalimantan (T. Harrisson 1959a; Whittier & Whittier 1974; Tillema 1989; Baier, 1992; 1995). Others occur at Tomani in south-west Sabah (T. Harrisson 1973b); and in coastal areas such as Santubong (above) and in the coastal flood plain of western Sabah.

The megalithic remains from the Kelabit region probably have more variation in structure than the other sites. They comprise rock carvings, cut stones, seats, stone mounds (parapun), dolmens (table stones), slab graves, uprights, stone burial urns, dams, walls, and little grottos cut into small cliffs (Schneeberger 1979; T. Harrisson 1973c:127; 1974a). The neighbouring area of Kerayan, located south of Kelabit, shows
a similar tradition. In Long Pujungan on the upper Bahau River there are about 70 sites, mostly uprights, dolmens and urn-dolmens, and rock carvings (Arifin & Sellato 1999). The upper Kayan basin has sarcophagi, uprights and rock carvings (Sierevelt 1929; Whittier & Whittier 1974; Tillema 1989; Baier 1995). Kuala Bekuku in southwest Sabah has incised and pecked figures on rock, similar to those found in the Kelabit highlands and Sungai Jaong (T. Harrisson 1973b; 1973c:128). Unlike most of the megalithic sites in Borneo, which are located inland, the Kadazan area of Sabah is a coastal region where unshaped sandstone uprights can be found scattered in the rice fields (T. Harrisson 1973c:125). Some of these are associated with imported Chinese stonewares from the Ming or Qing periods.

In the Kelabit highlands, a megalithic tradition was still practised until the second half of the 20th century. It is not clear when this tradition started. Harrisson mentioned that there is no evidence that the megaliths date back more than about a millennium (T. Harrisson 1973c:133). Those from Kerayan remain undated.

Based on ethnohistoric traditions, the megalithic remains around Long Pujungan in the upper Bahau River area were made by Ngorek people prior to the early 19th century AD. Based on ethnohistoric research those in the upper Kayan are presumed to have been made during the 17th or 18th centuries (Arifin & Sellato 1999a:399).

Caves and rock shelters, in which organic remains can be preserved much better, are the most promising sites to find remains of earlier prehistoric human habitation. However, limestone outcrops where such caves and rock shelters can be found are limited to certain areas, and often exist in very remote places. The most extensive research to date has been done in the Niah caves complex and several other sites in Sarawak (Gua Sireh, Lubang Angin, the Sarang Cave Complex and the Ulu Kakus Complex), and in southeastern Sabah (the Madai and Baturong caves and the rock shelter of Bukit Tengkorak, the latter of volcanic origin).

The Niah Caves are located in the Gunong Subis limestone massif, approximately 16 km from the South China Sea. The Great Cave at Niah has several openings, with the largest called the West Mouth. The other main mouths are Lobang Angus, Gan Kira, Lobang Tulang (Cave of Bones), Tahi Manimbun, and Lobang Bulan. The last two are of minor importance and not much has been published on them. Other caves around the Gunong Subis limestone massif that contain archaeological remains are Lobang Jeragan, Kain Hitam, Upiusing and Magala.

1 The megalithic remains from Long Pujungan were first reported by Schneeberger in the 1930s. He defined urn-dolmens as large stone urns supported by four river boulders or two stone slabs, and covered
The earlier excavations conducted in the Niah Caves by Tom and Barbara Harrisson\(^2\) between 1954 and 1967 caused a number of interpretative problems, in part because Tom Harrisson was not a trained archaeologist and published little of a precise archaeological nature about the Niah sites, although Barbara Harrisson (1967) did publish the burials in considerable detail. Zuraina Majid later integrated all the material found at West Mouth for her PhD thesis (1979; 1982). She analysed all the data collected from the Harrisson excavations as well as her own, as well as the Harrisons’ published and unpublished reports. Although Majid’s research provided valuable additional information on Niah, major uncertainties of the Harrisson excavations were left still unresolved (Barker et al. 2000:113).

In 2000, an inter-disciplinary programme of archaeology and environmental science termed “The Niah Caves Project” was established in the UK to “reinvestigate the cave stratigraphies to clarify their integrity and chronology; to establish the climatic and environmental contexts in which human activities took place; and to reanalyse the Harrisson finds within this new framework.” (Barker et al. 2000:113). The project, which is still continuing, also aims to elucidate three major areas of debate in the prehistory of Southeast Asia: “The timing of initial settlement by anatomically modern humans; the means by which they subsisted in the late Pleistocene and early Holocene; and the timing, nature, and causation of the transition from foraging to farming.” (Barker et al. 2002:147).

The Niah Caves, especially the West Mouth, revealed thick human habitation deposits. During the long span of human occupation in the late Pleistocene, the Gunong Subis limestone massif experienced several sea level changes which “resulted in marked environmental changes around the caves at these various times.” (Majid 1982:32). Majid (1982:31-2) suggested that from 40,000 to 11,000 years ago the massif must have been further inland than now. The sea level then rose about 11,000 years ago and by about 5000 years ago it was slightly higher than today, at which time the limestone massif may have been very close to the coastline. Since 5000 years ago the sea level has fallen and now the coast is about 25 km from the limestone massif. The fluctuations in glacial and post-glacial climate also resulted in quite significant changes in the flora and fauna of the region.

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\(^2\) Harrisson conducted the first excavation in the West Mouth in 1954 but no detailed report was ever published (Solheim 1983:41). Due to financial difficulties, further excavations could only be started in 1957 and continued until 1962 under Tom Harrisson’s direct supervision. Barbara Harrisson was later in charge until 1967, although Tom Harrisson still supervised the program indirectly (Solheim 1983:41).
The enormous amount of animal bone from Niah showed a local extinction of some of the animals, such as the giant pangolin (*Manis palaeojavanica*), which is now totally extinct, and the tapir (*Tapirus indicus*), which is locally extinct on Borneo (Medway 1964b:35). Evolutionary changes also occurred in the body sizes of species as shown by the reduction of dental size in some mammals, such as orang-utan, leaf monkey, long-tailed macaque, several species of bats, oarking deer, Muller’s rat and long-tailed giant rat (Medway 1964b:36). Changes in mean body size of species suggest progressive alteration towards warmer and wetter environmental conditions that occurred from the end of the Pleistocene into the early Holocene (Medway 1964b:36). Further, Medway pointed out that “the presence in Pleistocene levels of two other mammals, the Lesser Gymnure and the Ferret-badger, both today characteristically submontane in distribution, gives some indication of the nature of this alteration.” (Medway 1964b:36).

From her extensive analysis of the archaeological deposit of the West Mouth, Majid recognised five phases of human occupation (Majid 1982:134). The description of these phases below is abstracted from Majid (1982:134-40).³

Phase I ran from about 40,000 to 20,000 years ago. The environment around Niah Caves at this time consisted of a more open forest than today, which supported a large variety of fauna and flora, including the extinct and extirpated species *Manis palaeojavanica* and *Tapirus indicus*. The most common animals hunted in this phase were pigs, monkeys and porcupines. Phase I lithic artefacts consisted of flakes without clear-cut typological characteristics. A few were identified as semi-lunar in shape, a form more common in the following two phases.

Phase II started about 20,000 BP and contained thinner deposits than Phase I, as well as fewer material remains spread presumably over a much shorter duration. This phase was characterised by the introduction of the chopper and axe-adze types of pebble tools and the use of secondary retouch or trimming.

Phase III dates towards the end of the Pleistocene, around 15,000 years ago. This period has much more numerous archaeological remains than the earlier ones. The lithic

³ Tom Harrison also established a cultural sequence for the site, which he revised from time to time. His chronology was based on the assumption that depth-age correlations were uniform across the site, an assumption that now seems unwarranted (Majid 1982:38). It seems that Harrison’s cultural sequence came from general observation of the excavated remains, especially the stone artefacts. But Majid (1982:131) states that “analysis of the total lithic collection indicates that the diagnostic features Harrison selected to characterize each phase are not representative.” Therefore, only Majid’s cultural sequence will be discussed here.
assemblage is characterised by a large variety of pebble implements and several new flake artefact types, such as scrapers, notched scrapers and pointed flakes (Majid 1982:97), although the lithic artefact types from the previous phase continued to be used. The use of quartz increased, and the use of haematite for red pigment became common. Faunal remains showed that the first part of the phase was dominated by large animals, such as rhinoceros and bear. The later part produced a smaller range of species, and mostly ones small such as squirrel and ferret-badger. In addition, fewer species of shellfish were present in this phase.

Phase IV marked the beginning of the Holocene, with continuing rise of sea level and further increases in temperature and rainfall, resulting in dense rainforest like today (Majid 1982:138). Such an environment is not suitable for large mammals, which preferred more open forest. The faunal remains thus include mainly small species, although bearded pig, monkey and orang-utan were still hunted, together with fish and shellfish, mostly from freshwater and estuarine habitats. Rising sea level reduced the distance to the coastal area and made the estuarine fauna more accessible. Majid also suggested that the lowland forest would have held many plant resources.

According to Majid (1982:139), describing the Niah lithics, “the lithic artifacts here lack formal types and are multi-functional – they record a series of discrete processes which have acted on them.” (Majid 1982:139). The lithic assemblage of Phase IV shows an increase in occurrence of axe-adze pebble tools, pounders, hammerstones, and haematite, the latter used in burial rituals. The first mortars appeared and the earliest type of artefacts, the semi-lunar and pointed flakes disappeared. Edge-ground pebble axes also appeared (Bellwood 1997b:173).

Phase V saw the first pottery and a decrease in numbers of pebble and flake tools and implements, with no significant changes in technology. Pottery was found scattered all over the excavated area, but was mainly associated with burials. Decoration is mainly carved paddle impression with squares, rectangular or diamond patterns, and bound paddle impression with cord or basketry-marking. Double-spouted vessels are found in association with burials and presumably date between 3500 and 1000 years ago (T. Harrisson 1971:370-1). The most intricately decorated pottery is Niah Three Colour Ware, decorated by painting in red and black and by zonal incision (Solheim et al. 1961:229).

Majid differentiated pebble tools and pebble implements. She explained “A pebble tool or core tool is a pebble stone which has been modified through flaking and trimming prior to use into an intended form, while a pebble implement or core implement is an unmodified pebble stone not flaked into an intended shape prior to use but modified through use.” (1982:56).
Many of the West Mouth burials are not associated with ceramics but with stone and bone tools, often covered with red ochre (haematite) and regarded as Mesolithic (B. Harrisson 1967:133). They consist of flexed, seated, and mutilated (disturbed fragmentary remains. Those found with ceramics (Neolithic and later burials) are associated with a polished quadrangular adze, a chip from a pebble tool, “phallic pebbles”, a polished point, polished bone rings, a wooden armlet, a fragmented shell anklet, an oval shaped wooden disk, and a glass bead (B. Harrisson 1967:155-7). Burial with bronze object was rarely found (B. Harrisson 1967:159). Most corpses were individually wrapped into wooden mats or textile and remains of such materials often found (B. Harrisson 1967:151). The burials consist of extended, multiple, cremated and burnt burials, variously placed in coffins, jars or baskets (B. Harrisson 1967).

The extent of the archaeological remains in West Mouth has made the cave the best known archaeological site in Borneo, with the longest duration of human habitation in Southeast Asia (Majid 1982:1). The site gives a clear picture of climatic change during the Last Glacial Maximum and makes a great contribution to the archaeology and environmental history of Southeast Asia. The Deep Skull is securely dated to c. 43-44,000 year ago (Barker et al. 2002a: 153), and prior to that date only sporadic visits to the site can be documented. The date of first human presence is not yet known. The new research has given striking evidence of effective foraging strategies in a mosaic landscape (Barker et al. 2002a:160), and has indicated that the site was inhabited intensively in the late Pleistocene. During the Neolithic period the cave was used intensively for burials, as so clearly documented by the Harrissons, and a better recognition of their complexity and density has been obtained (Barker et al. 2002a:160).

However, the current Niah Cave Project has also demonstrated that any claim for a continuous sequence of occupation over the past 40,000 years at Niah would be rather exaggerated:

the site was clearly used at very different levels of intensity, and in very different ways, at different times in the past; in some periods, perhaps of long duration, it may have been more or less abandoned. However, the evidence for rather sophisticated tropical foraging systems from the first arrival of modern humans, and the complexity and highly variable nature of the archaeological record of the different phases of occupation at Niah from then to the present day, may also be more typical of cave use in tropical rainforest in south-east Asia and Oceania than the Harrisson model. (Barker et al. 2002a:161).

The archaeological remains of the other caves in the Niah complex are not as rich as in the West Mouth. Lobang Angus contained animal and human bones, food shells, bone tools, and stone tools. The animal remains are similar to those found in the West Mouth. Limestone tools seems to be the major feature in this cave (T. Harrisson
1966:216), but the lack here of the sophisticated ornamental artefacts of bone and animal teeth associated with Neolithic and later cultures elsewhere at Niah (Medway 1966:193-4) suggests that occupation in this mouth is mainly Palaeolithic (Medway 1966:194).

Lobang Tulang revealed earthenware and polished stone tools, together with imported ceramics, glass (beads and bangles), iron (parangs, knives, spearheads, rings and bangles, bird’s-nesting tools), bronze (fishhooks, bells, bangles, beads and lids), brass (bangles and earrings), gold fragments, Chinese copper and iron coins, worked bone and teeth, worked shells, and fragments of textiles (B. Harrisson 1958:601; 1959). Harrisson concluded that the site was mainly used for Neolithic and Metal Age burials of high-class people with mainland connections (B. Harrisson 1959:178). Gan Kira also produced burials and artifacts of relatively recent date (Yim 1963:177), with stone tools and animal bones in the lower levels.

Other cave sites in Sarawak, such as Lobang Jeragan, Kain Hitam, Upiusing, Magala, and the Sarang and Ulu Kakus cave complexes, were not as rich in finds as the Niah Caves. Perhaps the most important one is Gua Sireh (or Sirih) in the Serian District, more than 50 km inland from Kuching, a cave that was used for quite a long period. Ipoi Datans excavation revealed that the site had been visited occasionally by hunter-gatherers since 20,000 years ago (Datans 1993: 163).

Gua Sireh is most important for its mid-Holocene record of the introduction of rice and dogs, as well as pottery and polished adzes. Dog bones from Gua Sireh are estimated to be of late Neolithic date, while no clear date for the introduction of domesticated pig is available. Pottery initially appeared between 3500 and 4500 years ago and belonged indicated to a fairly uniform and continuous tradition dominated by paddle impression. Some of the potsherds contain rice grains and husks. Some of the geometrically stamped pottery is related stylistically to that found in other sites in Sarawak, such as the nearby sites of Tanjong Kubor and Gua Bunghoh, as well as the Niah caves and Kupang in Brunei (Datans 1993:164).

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5 Sarang Hill consists of two outcrops of limestone, located in the middle of an extensive swamp, about 80 km southwest of Niah (Harrisson & Reavis 1966:249). In 1966 a Sarawak Museum team recorded 14 caves. The most important ones, Liang Batu Puteh and Liang Ringen, were excavated. The archaeological remains indicated three different uses for these sites: long term habitation, burial and temporary camping (as practiced until very recently by the Punan of the area).

6 A Sarawak Museum team conducted a survey in Ulu Kakus in 1966 and recorded 45 caves, mostly unsuitable for human habitation (Reavis 1966:269-70). Seven caves were excavated, three of them burial sites, two habitation sites, and the rest archaeologically sterile.

7 The first excavation of this cave was conducted by Solheim and Harrisson in 1959, but no full report has ever been published. Zuraina Majid excavated further in the cave in 1977, Edmund Kurui in 1980 and Ipoo Datun in 1989.
About 2000 years ago Gua Sireh was also being used for human burials with monochrome glass and carnelian beads, cupreous and iron objects and later on, gold beads. The imported glass and carnelian beads perhaps came from South India or Thailand, while the metal objects could have been produced locally at e.g. Santuhong for iron and Bau for gold (Datan 1993:164). Around 1500 AD, Chinese ceramics were imported into Gua Sireh and it seems that the site was continually utilised until the last century (Datan 1993:164).

Gua Sireh also has charcoal drawings on the back wall of the cave. Most of them are simple stick or straight-line human figures, with a few imaginary beings, but they are so far undated.

In southeastern Sabah, several important cave sites have been excavated in the Madai and Baturong limestone complexes. The Harrissons recorded at least 25 caves at Madai, most being dark and damp bird’s-nest bearing caves, sometimes with ancient wooden coffins (Harrisson & Harrisson 1971). Agop Atas and Pusu Samang Tas were excavated in 1968. Later, a Sabah Museum team under the direction of Peter Bellwood and Peter Koon excavated three sites at Madai: MAD1 (Agop Atas), MAD2 (Agop Sarapad), and MAD3 (Agop Alag), in 1979 – 1980. These sites, together with Pusu Samang Tas (MAD4), provide an important occupation record for the early Holocene (11,000 to 7000 years ago) and for the last 3000 years, with a hiatus in occupation in-between (Bellwood 1988:97).

The Baturong limestone massif is now about 30 km from the coast, but during the Last Glacial Maximum it might have been as much as 100 km inland. During the lake-full period of Lake Tingkayu that apparently ended by 18,000 years ago this limestone massif was an island (Bellwood 1988:25). As in Madai, wooden coffins were found in some of the rock shelters. The Harrisson’s visited five shelters in 1966 and excavated in two - Lobang Tingalan and Pusu Serap Gaya (Harrisson & Harrisson 1971). The Sabah Museum team excavated the main shelter of Hagop Bilo (BAT1) and another subsidiary shelter termed BAT2 (Bellwood 1988).

Bellwood concluded that there were three main blocks of human occupation in these sites. The oldest is the Bilo-Sarapad Period (17,500 – 7000 BP), second is the

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8 Agop Atas was the first site to be excavated in Madai and the importance and antiquity of this shelter for further archaeological research was recognised immediately. The excavation at Pusu Samang Tas produced a wide range of earthenware pots, with iron knives, glass beads, animal bones, food shells, as well as human burials (Harrisson & Harrisson 1971:94-5).

9 Hagop Bilo is still used by the Idahan people for shelter. It was under the water of Lake Tingkayu when it was a true lake, but when the lake drained prior to 18,000 years ago the rock shelter became suitable for human occupation (Bellwood 1988:28).
Atas Period (3000 – 1000 BP) and the youngest is the Idahan Period (400 BP onwards). No data are available for the period between 7000 and 3000 BP. He summarised:

…the Bilu-Sarapad Period reveals fairly intensive exploitation of stone, animal and shellfish resources in all sites. The Atas Period shows a dramatic decrease in the use of stone for tools, but continuing strong reliance on shellfish and hunted animal foods. Pottery is in intensive use throughout the Atas Period, as are tools of copper-bronze and iron from MAD1 layer 10 (c. 2,200 BP) upwards. The Idahan Period, finally, lacks any major primary association with stone tools, and shellfish appear to have been consumed only rarely in the period of the birds’-nesters’ village. By this time the bulk of the meat consumed at Madai came from imported marine fish (Bellwood 1988:131).

It should be noted that some of the pottery, especially that from MAD1 layer 11a (c. 2,800 BP), has similarities with the earliest red-slipped pottery from Leang Tuwo Mane’e in the Talaud Islands, and Bellwood suggested that both sites may have had a common pottery tradition, although there was not necessarily any direct contact between them (Bellwood 1988:178). In more recent publication Bellwood added Bukit Tengkorak early phase and Uattamdi, on Kayoa Island, to the west of Halmahera as having similar red-slipped pottery as MAD1 (Bellwood 1997b:229). The incised and impressed pottery from the layers above layer 11a was very similar to that found at Buidane (Talaud Islands), dating from the Early Metal Period.10

Another important site in Sabah which contained artefacts originating from far away is Bukit Tengkorak, a volcanic rock shelter located on top of a volcanic crater overlooking the Sulawesi Sea and the end of the Sulu Island chain, approximately 5 km from Semporna.11 The 1987 excavation here revealed two distinct archaeological layers belonging to an Early and a Later Phase. The considerable differences in pottery style between these phases suggested that the site was occupied at different stages, but presumably by the same cultural group (Bellwood 1989:128). Based on the radiocarbon dates, Bellwood concluded that the total time span of occupation ran from the early first millennium BC to the early first millennium AD, with a change-over period dating to about 300 BC (Bellwood 1989:130).

An outstanding vessel-and-lid combination with sophisticated decoration was recovered from the Early Phase and presumably was imported. To some extent it resembles the contemporary Lapita assemblages of the western Pacific. In general the Early Phase pottery at Bukit Tengkorak is very similar to the Early Atas Phase red-

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10 Indicated by intricate incised decoration on pottery, notched or scalloped rims and carinations, pedestals and bottle-necked flasks (Bellwood 1988:187).
11 There are several rock shelters at Bukit Tengkorak. Shelter 1 was excavated by the Muzium Sabah team in 1987 under the direction of Peter Koon and Peter Bellwood. In 1994 and 1995 a joint research team from the Centre for Archaeological Research Malaysia and Muzium Sabah excavated further in Shelter 1, and in another shelter about 20 metres away.
slipped pottery at Agop Atas and that from Leang Tuwo Mane’e in Talaud and Uattamdi in the Moluccas (Bellwood 1989:136; 1997b:229)

Some of the incised Late Phase decoration shows similarities with the ‘three-colour ware’ assemblages from the Niah Caves and Lobang Angin (Mulu National Park) in Sarawak, Manunggul Chamber A on Palawan, Kalumpang in west-central Sulawesi, and the Nansay Resort site on Saipan in western Micronesia (Bellwood 1989:136).

Bukit Tengkorak stone tools include trapezoidal-sectioned stone adzes, agate microblade used as drill points for working shell, and tiny obsidian flakes and chips. The latter were only found in the Early Phase, while stone adze and agate microblades were found in both phases. The stone adzes belong to the common Sabah untanged and trapezoidal-sectioned type which was also found in Tapadong Cave, Hagop Bilo shelter, from sites on Mindanao and elsewhere in the Philippines (Bellwood 1989:142). The agate microblades have non-specific parallels in north-eastern Indonesia, the Philippines and the neighbouring regions of mainland Asia, but the parallels are not precise and the industry is quite unique in the Southeast Asian context (Bellwood 1989:148). Nevertheless, sites with similar industries date approximately between 5500 and 2000 years ago. The obsidian industry is perhaps the most surprising in terms of the western Melanesian location of two of its three sources. Group A matches the Kutau/Bao obsidian source in Talasea, New Britain; group B matches obsidian artefacts from the Talaud Islands (the geological source is unknown), and group C matches the obsidian sources in the Admiralty Islands to the north of New Guinea (Chia 1997:136-7).

The 1994 and 1995 excavations at Bukit Tengkorak revealed a similar archaeological record to that in 1987. Based on further radiocarbon dates, stratigraphy, and the spatial and temporal distributions of artefact types, Chia differentiated three occupational phases at Bukit Tengkorak quite different from those suggested by Bellwood: (1) Early Phase, 4340 – 1285 BC; (2) Middle Phase, 1200 – 900 BC; and (3) Late Phase 900 – 50 BC (Chia 1998:2). The existence of Chia’s Early Phase date is doubted by Bellwood, since the earliest date comes from a level at the base of the artifact distribution, and seems to relate to undocumented preceramic activity in the site (Bellwood, pers. comm.)

Since archaeological research in Kalimantan is still very limited, almost no record is available on cave sites from this region. In the upper Mahakam, Chazine recorded almost 20 caves, especially along the Cihan and Kasau Rivers. The most common items found in these caves are earthenware sherds, stone tools, animal bones
and freshwater shells (Chazine 1994). Only Gua Babi in South Kalimantan has been excavated. The excavations revealed three occupational layers, with the middle being richest in shells, lithics, sherds, bone tools and animal bones. The lithic artefacts are mostly flake debitage. Many flakes and blades with sharp edges were used directly without being retouched. Bone artefacts were not as prominent in quantity as lithic ones and were mainly made from animal long bones. They include unipoints, bipoints and spatulae. 23% of the sherds have paddle impression with corded and check-stamped motifs, and one sherd has lip incision. The animal bones include pig, deer, bear and monkey.

Borneo also contains a large amount of rock art, especially in caves. That from Sarawak and Sabah has been under documentation since the beginning of archaeological research in the region. Such sites include Kain Hitam, Gua Sireh, and Liang Batu Putih and Liang Ringen in the Sarang Caves complex. In Kalimantan, recent records of rock art come from Kaung Cave, located in the upper Kapuas catchment in the Muller Mountains of Central Kalimantan (Chazine 1993a; 1993b; 1994); from Batu Cap Cave (Ketapang) in West Kalimantan (Yondri 1996; Prasetyo 1997); from Tengkayu, Batu Bakil and Batu Kadok Caves at Sungai Sungkung Village (Sambas), near the Sarawak border, West Kalimantan (Prasetyo 1997:46); from Mardua III rock shelter in the limestone formation of Sangkulirang, Kutai, East Kalimantan (Prasetyo 1997); and from another 20 rock art sites in the Sangkulirang area (Chazine et al. 2001).

4.5 The Characteristics of Archaeological Sites in Borneo

Most of the early occupational sites in Borneo are found in caves, some occupied since the late Pleistocene. These include the West Mouth at Niah, Gua Sireh, and Baturong. Such sites were often occupied intermittently over very long periods and most were still being used until recently.

In the West Mouth, where human occupation layers commenced at least 40,000 years ago and continued to a few hundred years ago, not only can changes in cultural patterns be recognised, but also changes in environment. Climatic changes during the late Pleistocene can be documented by changes in animal body sizes and species distributions (Cranbrook 2000:89-91). By the beginning of the Holocene, the more open

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12 Balai Arkeologi Banjarmasin in collaboration with the National Research Centre of Archaeology (Jakarta), Balai Arkeologi Yogyakarta and Bidang Musikala Kanwil Depdikbud South Kalimantan, have conducted five excavations in this cave. A report on the first two excavations has been published (Widianto et al. 1997).
forest of the Niah surroundings had gradually changed into a dense rainforest, at the same time as sea level rose and temperatures and rainfall increased. Human occupation of humid rainforest may have been rather difficult for Palaeolithic hunter-gatherers. It has been argued that, while rainforest may be the most productive terrestrial ecosystem on earth in terms of pure biomass, it may still be a food-poor environment for hunter-gatherers (Headland & Bailey 1991). Therefore, it can be expected that only groups of limited size could have occupied such areas. However, it should be noted that even though the occupation of interior rainforests was sporadic at best during the pre-Neolithic, by the beginning of the Holocene there are some sites that were being occupied quite intensively, such as the Madai Caves (Bellwood 1988:131; 1997b:180).

The arrival of groups of Austronesian-speaking people in Borneo between approximately 4500 and 3500 years ago may have changed the situation. These agriculturalists were equipped with technologies of pottery and polished stone, and practiced cultivation that could support a larger population than the previous hunter-gatherers. Bellwood suggests:

The Austronesians who entered Borneo, perhaps via Sabah from the southern Philippines, brought with them a Neolithic material culture of polished stone adzes, pottery, raised-floor houses and clothing of beaten bark-cloth. They tattooed themselves, used the bow and arrow, and travelled in canoes, probably with outriggers and sails. They also had domestic dogs, pigs and chickens, and a range of crops including rice, millet, sugar cane, greater yam and taro. A number of other crops such as banana, breadfruit and coconut were probably brought under cultivation more locally within the equatorial zone, to which they are native (Bellwood 1985). As far as Borneo is concerned it seems likely that these cultivators expanded rapidly around the coasts and up the rivers with little resistance from the existing but sparse foraging populations, although the latter may have contributed much to subsequent cultures in terms of their environmental knowledge (Bellwood 1992a:10-11).

Neolithic assemblages (4500 – 2000 years ago) are reported from Niah, Lubang Angin, Gua Sireh, and Bukit Tengkorak. Pottery grave goods at Niah and Lubang Angin include the beautiful pottery commonly named “three-colour ware”, decorated by painting and incision, and double-spouted vessels. The Neolithic burials at Niah were placed in extended postures in wooden coffins or bamboo caskets, sometimes wrapped in textiles. Jar burials and cremations are also reported (B. Harrison 1967). The burials at Lubang Angin were simpler than the Niah ones. Only extended or flexed postures were found, with bark cloth wrappings (Datun 1993:103). Three-colour ware and double-spouted vessels also occurred here, together with paddle-impressed pottery, monochrome glass beads and marine bivalve shells.
At Gua Sireh, presumed Austronesian influence is marked by the appearance of pottery between 3500 and 4500 years ago (Datan 1993:163). The younger carved-paddle-impressed ribs, herringbones, diamond motifs and crossed patterns from Gua Sireh are similar to those found at Tanjong Kubor on the west coast of Sarawak and Gua Bungoh in the southwest. The older cord- and basked-marked decoration and incised and impressed circle motifs have close affinities with the Niah Neolithic pottery.

The presence of pottery with rice fragments at Gua Sireh is important for Borneo, since there is no other direct evidence of rice agriculture from this period, back to about 4300 years ago. The lowest such pottery found has a calibrated date of 4835-4096 BP (ANU 7049) (Datan 1993:116). From about 2000 years ago (Datan 1993:164), highly fragmented burials at Gua Sireh include monochrome glass and carnelian beads, cupreous and iron objects and gold beads (Datan 1993:164).

The introduction of iron and bronze metallurgy from the mainland of Southeast Asia to Borneo approximately 2000 years ago created additional changes (Bellwood 1992a:12). The Dong Son culture, which originated in Vietnam and was characterised by massive bronze drums, influenced almost all of the Southeast Asian Archipelago (Bellwood 1997b:269). Simple iron and bronze tools and weapons dating from about 2000 years ago have been found at Madai and Gua Sireh (Bellwood 1992a:12).

Approximately at the same time as the introduction of metal into Borneo, Indian influence started to appear in the archipelago. However, actual epigraphic evidence for an Indian presence in the island falls a little later, around AD 400. It is represented by seven Sanskrit inscriptions issued by King Mulawarman found at Muara Kanam, Kutei, East Kalimantan.\(^\text{13}\) Although these inscriptions are the oldest written records found in Indonesia, Indian influence in Borneo was never as strong as in Java and Bali. However, contact with other areas, such as China, become much more intense during the second millennium AD, as shown by the abundance of glazed ceramics mainly found in coastal or riverside sites such as Kota Batu (T. Harrisson 1970), Kupang (Omar 1981) and Sungai Lumut (Omar 1981) in Brunei, and Santubong in the Sarawak River delta (Harrisson & O’Connor 1970).

The coastal area was also shows Islamic influence, marked the presence of an Islamic sultanate in Brunei, with the first Sultan embracing the religion in the early 15th century AD (Omar 1981:2). However, a minor presence of Islam seems to have

\(^{13}\) Hindu artefacts have been found in various places in Kalimantan, but are not discussed further in this chapter.
occurred much earlier, as indicated by a Muslim Chinese tombstone dating from 1264 in Bandar Seri Begawan (Omar 1981:2).

4.6 Current Issues in Borneo Prehistory

There are several major issues concerning Bornean prehistory that need to be examined by future research. The first was put forward by Tom Harrisson in 1978, when he noted that no fossil hominids or early Palaeolithic sites had been found in the island. This remains true today. Since Charles Darwin published his *Origin of Species* in 1859, the concept of human evolution inspired other scientists to look for the ancestors of modern humans in the tropical regions. In 1869, Alfred Russel Wallace wrote that the remains of the first anthropoids could be expected to appear in Sumatra and Borneo, where the orang utan still lives today (Sémah et al. 1990:7). For the very same reason, Eugene Dubois went to Sumatra to find this missing link. Although he found the ancestor of modern man, which he called *Pithecanthropus erectus*, not in Sumatra but in Java, there has always been an expectation that similar fossils should one day be found in Borneo. But they have not, and Harrisson once concluded:

... it is possible that a significant segment of the larger, terrestrial, herbivorous mammal fauna failed especially to populate effectively heavily humid, forested terrain, including much of Borneo and Sumatra. Perhaps *H. erectus* was primarily dependent on these and had ecologically similar habits, ill-adapted to the equatorial jungle which *H. sapiens* slowly mastered with new techniques of craft and wit (T. Harrisson 1978:51).

Therefore, hominid fossils can be expected to be found in more open forest and savannah, similar to the environments in which *Homo erectus* lived in Java. Harrisson suggested that to find such sites, pollen analysis should be applied to detect possible past savannah landscapes. He proposed south-eastern Kalimantan as a likely place to start because of its relatively dry climate (T. Harrisson 1978:52).

The lack of hominid fossils and Early Palaeolithic tools in Borneo brings us to the second issue, concerning the debate over the origins of the nomadic hunter-gatherers in the tropical rain forests of Borneo and other parts of Southeast Asia. Bailey and Headland (1991) postulated that hunter-gatherers never lived in interior tropical rainforest without direct or indirect access to cultivated foods. They stressed that hunter-gatherers could only have occupied interior tropicals forest with the advent of agriculture. However, Baturong and Gua Sireh were both inland caves during the late Pleistocene, Baturong about 100 km from the sea (Bellwood & Hughes 1988:7). The site was frequented by hunter-gatherers who mainly consumed pigs as well as deer, and
freshwater and terrestrial chelonians (Cranbrook 1988b:153). Gua Sireh was located 500 km inland about 20,000 years ago, and was visited occasionally by hunter-gatherers (Datun 1993:163).

In the northern and central regions of Peninsular Malaysia, similar evidence is also present, especially for the early Holocene. About nine interior limestone caves and shelters were occupied by Hoabinhian hunter-gatherers, commencing perhaps 10,000 years ago (Endicott & Bellwood 1991:174-6).

Thus, there is no doubt that the rainforest of Borneo was exploited to some degree by pre-agricultural communities during the Late Pleistocene. However, there are indications that some of this rainforest might have been drier than today, and more open during the Late Pleistocene. The apparent absence of human habitation in the heart of the island during the Late Pleistocene probably indicates that this deep interior region was always covered by dense rainforest unsuitable for hunter-gatherers.

\[14\] For a detailed description of this debate see Chapter 1.
V. THE EXCAVATIONS

5.1 Kimanis Cave

Kimanis is a large cave, with a big rock shelter in front of it, located at 2º 27' 4" North and 117º 24' 38" East.¹ It lies about 160 m west of Lubang Payau (Map 1.2). At the time of excavation the Basap people had long since ceased to use the rock shelter. This was probably because people from Tanjung Redeb had been exploiting the bird’s-nests of this cave heavily for more than two decades. The Basap claimed that they used the rock shelter a long time ago.

Inside the cave, not far from the entrance, a decayed ulin plank (ironwood, *Eusideroxylon zwageri*) was found on the floor. According to the bird’s-nest collectors this plank had fallen from a cavity in the ceiling. Probably it was part of a lungun (wooden burial construction²). It was impossible at the time of my visit to reach the cavity since it was too high above the cave floor, but there should be another entrance to the chamber where the ulin fell from. However, the bird’s-nest collectors have not found it yet. If the ulin pole was part of a lungun, the burial must have belonged to non-Basap people since the Basap are not reported to have buried their dead in this fashion. The timber is unlikely to have been part of an ancient climbing structure for collecting bird’s-nest since it was found in an area of the cave without nests. Besides, ulin are not used for scaffolding since the wood is too heavy; bamboo is more preferable.

The exploitation of the bird’s-nests in this cave started a long time ago. At the beginning of last century, Spaan explained that the region was under the sovereignty of the Berau Sultan and his family (Spaan 1902a, 1903b). Therefore, they had the right to exploit the forest products of the region, including the bird’s-nests. By that time, bird’s-nests had become a valuable commodity and had to be protected from thieves. The Sultan of Gunung Tabur appointed a group of Basap people who lived along the

¹ The location was plotted by using a hand-held GPS. Only Kimanis could be located by this instrument, as Lubang Payau and Liang Gobel were covered by quite dense forest and no signal could be detected from satellites.

² Lungun are commonly used for burial by various tribes in Kalimantan. However, they are normally used by settled people, not by nomadic people such as Puran or Basap.
Totoong River, the most upstream Basap group in the Birang River area, to guard the caves from thieves coming from Bulungan, an area further north over the mountains (Spaan 1903b:667). Today, Kimanis produces the largest quantity of black bird’s-nests in the region, more than one ton per year.

The bird’s-nest collectors previously occupied the rock shelter at the entrance to the cave during harvest times. They built their huts from wooden poles, elevated above the ground. Recently they moved their huts into the cave for better protection of the bird’s-nests from thieves.

The rock shelter forms a spacious dry area, with its surface sloping slightly to the west, towards the entrance of the cave (Figure 5.1). This habitable area is about 22 x 8 metres and is located 230 metres above sea level. Tillema, who visited Kimanis Cave in 1927, mentioned that the Basap used to spend the night in this big rock shelter and he saw their fresh hearth remains (1937:258).

The area surrounding the rock shelter is covered by collapsed rock from the ceiling. The entrance to the cave is reached by climbing over a five-metre-high pile of rock at the west end of the habitable area, and then steeply descending about 20 metres to a flat area, before the final climb into the darkness of the cave. This flat area is very humid and with little sunlight. It is likely that this area was never occupied in the past, so the excavation was conducted in the dry rock shelter area.

The cave proper consists of a long and complex tunnel system with a river flowing in it, emerging as the Birang River about 240 metres south-east of the rock shelter. The cave mouth where the river flows out is called Liang Aput. When it rains heavily the surface of the water in the cave rises and becomes muddy, as does the Birang River. However, the rock shelter in front of the cave is always dry, no matter how heavy the rain.

Three squares were excavated in this site. The test pit (KMS/TP) was excavated during the first period of fieldwork to assess the reliability of the site for further research.

Only earthenware sherds, lithics and human bones were analysed from this test pit. The animal bones were only sampled, and not included in the statistical analyses.

The other two squares were excavated during the main excavation period. On this second fieldwork visit the rock shelter was laid out with a two-metre grid and two squares, C4 and C8, were excavated. However, due to time limitations, only half of each 2 x 2 metre square was excavated.
Figure 5.1 Plan and section of Kimanis Cave

LEGEND
- Excavation pit
- Cave wall and ceiling
- Roof fall
- Soil surface
- Soil surface
- Vertical projection of the cave ceiling
- Drip line
Figure 5.2 Sections through the KMS/TP deposits

LEGEND
A Brown ashy soil
B Dark yellowish brown ashy soil
C Brown ashy soil
D Dark brown ashy soil
E Brown ashy silty soil
FB Flexed burial
WF Fossilized wooden fragment
Ash lenses from human activities
Roof fall
RF Roof fall with flaking marks

UNIT I
UNIT II
5.1.1 The Kimanis Test Pit

A single preliminary test pit one metre square was located near the eastern end, at the highest point of the shelter (Figure 5.1). The excavation was done in spits, each 5 cm thick. The soil was very fine and loose and it was rather difficult to separate different layers. At the completion of the excavation five layers could be differentiated based on colour and soil texture (Figure 5.2). Identification of soil particles and colours was conducted by M. Fadhlan from the Centre for National Archaeological Research in Jakarta.

The deposits excavated were divided into two cultural units (Figure 5.2). Unit I (spits 1 – 10) comprised several layers with earthenware sherds. Unit II (spits 11 – 27) did not have earthenware sherds and contained lithic items, vertebrate and invertebrate remains.

From Layers A to D the soil texture was the same, being ashy soil, but colours were different. Layer A was brown (5YR 4/4), Layer B dark yellowish-brown (10YR 4/4), Layer C brown (10YR 3/3), and Layer D dark brown (7.5YR 3/2). Layer E had a different texture, being a brown (7.5YR 4/3) ashy silty soil.

Layer A, the topsoil, was an even layer about 2 cm thick. It was very compact and hard. It contained chipped wood, plastic wrappers, a metal beer bottle top, charcoal particles, and some shell and bone fragments. A wooden pole, remains of a bird’s-nester’s sleeping platform, was found near the north-west corner.

Layer B was also a thin layer, but with variable thickness, between 3 and 20 cm. This fine and loose soil was mixed with chipped wood, charcoal particles and many fine long bones of bats, as well as shells, lithic material, earthenware sherds, and damar (tree resin) particles.

Layer C was 10 to 35 cm thick. The thickest part could be seen in the east wall and probably represents a small pit. The soil was fine and loose and mixed with vertebrate bone fragments, mainly of bats, some of which were burnt. Ash lenses could be seen in the west wall. Shells, lithic artefacts, earthenware sherds, damar particles, and some small pieces of limestone shatter were also found in this layer.

Layer D had very uneven thickness, from 20 to 50 cm, of loose soil, which becomes compressed when stood upon. In this layer bat bone fragments were rarer. Some of the vertebrate bones were burnt and charcoal particles were found scattered randomly. Ash lenses, as in layer C, could be seen in the west wall. Lithic material, earthenware sherds, shell, charcoal and damar particles were also mixed in this layer,
together with calcareous sandstone shatter from the roof fall. Some of the pieces were quite large, about 15 x 15 x 10 cm.

Layer E had an uneven thickness, from 40 to 75 cm. It may have been thicker, since when the excavation stopped in spit 21 this layer still continued downward. Layer E was rather damp, but very loose and became compressed when stood upon. In this layer the calcareous sandstone shatter and boulders became more abundant, some of them quite large, and clearly represented rock fall from the shelter roof. Bat bone fragments were much less than in the layer above, but bone fragments from bigger vertebrates increased in number. Many of the shells were fragmentary. Earthenware sherds and damar particles were no longer present in this layer. The test pit excavation stopped when it hit a flexed burial at about 130 cm from the surface (Figure 5.3).

In the upper layers, bats dominated the vertebrate bone assemblage. Gradually downwards they reduced in number and bigger vertebrate bone fragments became more abundant in lower layers. However, since the test pit was dug to assess the possibility for further excavation of the site, the bones were only sampled selectively. Therefore, no statistical analysis can be conducted for the vertebrate bones found in this test pit. Apart from bats, taxa represented include bovids, deer, suids, rhinoceros, sun bear, civet, mongoose, weasel, badger or otter, rats/mice, squirrels, monkeys, shrews, snakes, turtles and monitor lizards, as discussed in Chapter VI.

The invertebrate fauna was dominated by various molluscan taxa, including freshwater and marine taxa, and only one Crustacean, the true fresh water crab. Many of the molluscs found in this test pit were crushed or very fragmentary. The most common mollusc was the freshwater gastropod, Brodia sp. (Chapter VI).

Lithic artefacts consisted of 310 specimens, made from 11 different stone materials, most of small size. (Chapter IX). Bone points made from mammalian long bones were discovered in Unit II. Shell artefacts consisted of four marine bivalve scraper fragments, two from Unit I and the other two from Unit II. Ornaments made from cowrie shells were found in Units I and II, each one specimen. (Chapter X).

Earthenware sherds occurred only in the upper layers, from spits 2 to 5. There were 44 sherds and most were plain body fragments, with only five rim fragments. The pottery was made by a paddle and anvil technique. (Chapter XI).
Figure 5.4 Flexed burial from KMS/C4

LEGEND

HR  Human remains

Roof fall

SECTION A - A'

PLAN

N

0 (230.00 m asl)

0 50 cm

HR

A

A'

0 (230.00 m asl)

- 0.25 m

- 0.50 m

- 0.75 m

- 1.00 m

- 1.25 m

- 1.50 m

- 1.75 m

- 2.00 m

- 2.25 m

- 2.50 m

- 2.70 m
5.1.2 KMS/C4

As mentioned earlier, only the eastern half of square C4 was excavated, covering an area 1 x 2 m². KMS/C4 was located six metres east of KMS/C8 and 1.5 m west of the Test Pit (Figure 5.1). The surface here sloped down to the north, with the north-east corner lowest and south-west corner as the highest point. The height difference across the surface was about 35 cm. The excavation reached a depth of 300 cm below the surface at the north-west corner, at spit 62. However, from spit 32 downwards only half of the square, an area of one by one metre, was excavated.

In spit 30 a flexed burial was found (Figure 5.4). Since the process of exposing the skeleton would have taken a long time and might have stirred the curiosity of the bird’s-nest collectors, and since the time left was very limited, the skeleton was covered by a plastic sheet and thin soil. It was later exposed at the end of the excavation and reburied. Meanwhile, excavation continued only in the southern part of the square, in an area of 1 x 1 m². The decrease in the size of the excavation meant that work could be done much faster. The target of the excavation was to reach the basal rock, in order to determine a complete chronology of human occupation for the site.

After completion of the excavation, five units were distinguished (Figure 5.5). Unit I (spits 1-10; 0<x≤50 cm) contained the pottery layers. Unit II (spits 11-23; 50<x≤105 cm) contained relatively few animal remains compared to the spits below. This unit also contained large amounts of roof fall. Unit III (spits 24-34; 105<x≤160 cm) contained the most abundant lithics and animal remains (vertebrates and invertebrates), indicating the most intensive occupation of the site. Unit IV (spits 35-42; 160<x≤200 cm) had fewer lithics and animal remains, but still plenty of shells, especially Brotia sp. The soil in this unit contained some ash lenses, not common in the upper units. Unit V (spits 43-61; 200<x≤295 cm) contained fewer lithics and animal remains, but ash lenses are more prominent than in Unit IV above. This unit also contained large rocks which finally stopped the excavation.

Eleven layers of different colour and soil texture could be distinguished (Figure 5.5). Layer A was thin topsoil of a dark brown (10YR 3/3) ashy silt. It was dry, hard and compact, 3 to 10 cm thick, mainly containing modern materials such as wooden chips.

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3 The discovery surprised the bird’s-nest collectors who thought this could disturb the spirit of the cave and bring bad luck to their work. The spirits were appeased by sacrificing a white chicken at the cave entrance at the end of the excavation. However, the occasion created uneasiness among the collectors and delayed excavation at Kimanis on the second visit. To prevent such awkwardness it was decided not to let the collectors know about the discovery of the other human skeletons in the site.

2 The roof fall in Kimanis has been tested in the Department of Geology at ANU. It consists mostly of calcareous sandstone.
Figure 5.5 Sections through the KMS/C4 deposits

LEGEND

A  Dark brown ashy silt
B  Dark yellowish brown sandy silt
C  Brown ashy silt
D  Dark brown silt
E  Dark brown ashy silt
F  Very dark greyish-brown silty sand
G  Dark greyish-brown silty ash
H  Brown ashy silt
I  Dark greyish-brown silt
J  Dark brown ash
J1 Reddish yellow ashy silt
\[\text{Secondary burial}\]
[\text{Ash lenses from human activities}\]
[\text{Roof fall}\]
DP Datum point (altitude above sea level)
* Charcoal sample
\# Fresh water shell sample
corroded tin, plastic rope and charcoal, but also including lithic material, earthenware sherds, vertebrate and invertebrate faunal fragments.

Layer B was a dark yellowish-brown (10YR 3/4) sandy silt. It was also thin, 3 to 10 cm thick, similar to Layer A. Cultural materials in this layer consisted of earthenware sherds, lithic material, vertebrate and invertebrate fauna, charcoal and damar particles.

Layer C was a loose, brown (7.5YR 4/3) ashy silt of uneven thickness, 10 to 55 cm, with the eastern side being thicker. This layer contained earthenware sherds, lithic material, vertebrate faunal fragments (especially long bone fragments of bats), small quantities of invertebrate fragments (molluscs and fresh water crabs), and some scattered charcoal and damar particles. A charcoal sample collected from this layer (spit 11) was submitted to the ANU Radiocarbon Dating Laboratory (see Radiocarbon Dating section).

Layer D consisted of a very loose dark brown (7.5YR 3/2) silt, which tended to become compressed if stood upon. Its thickness varied from 40 to 80 cm and it contained many roof fall blocks of varying size. Some of these showed signs of deliberate flaking. Layer D also contained a secondary burial (only the skull and some other bones) located in the northern part of the west wall. Earthenware sherds and damar particles were absent, vertebrate bone fragments increased in the lower part of this layer and molluscs were relatively scarce. Lithic materials reached their peak density. Two charcoal samples, from spits 20 and 24, were radiocarbon dated (see Radiocarbon Dating section).

Layer E consisted of a loose, dark brown (10YR 3/3) ashy silt. This layer was much thinner than Layer D, between 6 and 35 cm. Lithic materials were fewer than in Layer D, but vertebrate bone fragments were more abundant and the mollusc remains, especially the fresh water snail, Brotia, increased significantly in the lower part of the level. A flexed human burial was found in this layer.

Layer F consists of a loose, very dark greyish-brown (10YR 3/2) silty sand, from 18 to 40 cm thick. Lithic materials and vertebrate bone fragments reduced in quantity, but Brotia increased significantly. A charcoal sample from this layer (spit 34) was radiocarbon dated (see Radiocarbon Dating section).

Layer G consisted of dark greyish-brown (10YR 4/2) ashy silt, 8 to 20 cm thick. Lithic material and vertebrate bone fragments were reduced in number, but again Brotia were abundant. This layer was covered by whitish-grey ash lenses mixed with small charcoal particles that covered the whole excavation unit, scattered like islands within the dark soil. In some places the ash was cemented.
Layer H was a brown (10YR 4/3) ashy silt, 8 to 22 cm thick. In this layer, the ash lenses were mixed with tiny charcoal particles. Lithic material and vertebrate bone fragments were only found in small numbers and *Brotilia* were also rarer.

Layer I consisted of a dark greyish-brown (10YR 4/2) silt with a thickness of 20 to 40 cm. The soil was rather wet, sticky and difficult to sieve. Ash lenses mixed with tiny charcoal particles occurred scattered all through the excavation unit. Several small accumulations of shattered calcareous sandstone, mostly from the roof fall, some of gravel size, occurred especially in the lowest part of the layer. Cultural remains are rare.

Layer J was a dark brown (7.5YR 3/3) ashy soil, with a thickness of 20 cm. Calcareous sandstone gravel and ash lenses mixed with tiny pieces of charcoal and charred vertebrate bones (especially bat long bones) occurred throughout this layer. The ash was especially concentrated in the south-east corner. One of the calcareous sandstone pieces showed some flaking scars. At the bottom of this layer there were large calcareous sandstone boulders fallen from the shelter roof, which caused the excavation to stop. Excavation of the last three spits (60-62) could be done only in a small boulder-free area in the south-east corner of the pit.

Layer J₁ consists of a reddish yellow (7.5YR 6/6) ashy silt about 5 cm thick, beneath the large calcareous sandstone boulders. No archaeological remains were found in this layer.

Animal bones found in this square were very fragmentary and difficult to identify to species level. More than half of the assemblage could not be identified and those that could were dominated by mammals (302 individuals/91%), followed in importance by reptiles (24 individuals/7%), birds and fish (each had two individuals/0.6%), and amphibian (one individual/0.3%). (Chapter VI). The invertebrate fauna was dominated by various molluscan taxa, including freshwater and marine taxa, and only one Crustacean, the true fresh water crab. The molluscs were dominated by *Brotilia* (95%). (Chapter VI).

The lithic material consisted of 347 specimens, made from 12 different raw materials, mainly of small size (Chapter IX). Bone and shell artefacts were scarce and scattered mainly in the upper layers. The bone artefacts consist of two points and two spatulae, and the shell artefacts comprised six ornaments made from cowrie shells and 12 scrapers from marine bivalves (Chapter X).

Earthenware sherds were found from spits 3 to spit 10, a total of 58 fragments. Forty-nine are plain body fragments, only seven were rims, and there are two bases.
Most of the sherds are small and eroded. They were made by a paddle and anvil technique (Chapter XI).

5.1.3 KMS/C8

KMS/C8 was situated six metres west of KMS/C4 (Figure 5.1). Only the eastern half of square C8 was excavated, covering an area of 1 x 2 m². The excavation had to stop at a depth of 130 cm below the surface because of time limitations.

At completion of excavation, two units were distinguished (Figure 5.6). They were quite similar to the first two units in KMS/C4. Unit I (spits 1 – 10) contains the pottery layers with vertebrate and invertebrate remains and some lithic items, and Unit II (spits 11 – 27) contains more vertebrate and invertebrate remains than Unit I. It also contained much roof fall.

Four layers could be distinguished (Figure 5.6). These layers showed different soil colours, but the same texture. They were all ashy soil with slightly different colours: Layer A brown (7.5YR 4/4); Layer B dark yellowish-brown (10YR 3/4); Layer C dark brown (7.5YR 3/3); Layer D very dark brown (10YR 2/2).

Layer A was the topsoil, about 5 cm thick and very compact and hard. Most of the archaeological remains from this layer belonged to recent bird’s-nest collecting activities.

Layer B was a loose soil of uneven thickness, 5 to 35 cm, which tended to be thinner in the west wall but thicker in the east wall. This layer contained lithic material, earthenware sherds, small numbers of vertebrate (mostly bat) and invertebrate (mostly mollusc) faunal remains, charcoal and damar particles.

Layer C was also loose but darker than the layer above it. This layer had an uneven thickness, thicker than layer B, between 10 and 50 cm. Lithic material, earthenware sherds, vertebrate and invertebrate remains were excavated from this layer. They increased in number in the lower part of the layer, except for the damar and the earthenware sherds. The latter completely disappeared below spit 10, the bottom of this layer.

Layer D contained very loose soil, which tended to become compressed if stood upon. Its thickness varied from 40 to 80 cm. This layer was similar to Layer D in KMS/C4 and had a thickness between 65 and 85 cm. It may have been thicker, since when the excavation stopped in spit 27, this layer still continued downward. It contains many boulders of various sizes from roof fall, some of them bearing clear marks
Figure 5.6 Sections through the KMS/C8 deposits

LEGEND
A Brown ashy soil
B Dark yellowish-brown ashy soil
C Dark brown ashy soil
D Very dark brown ashy soil
RF Roof fall with flaking marks
* Cave wall and roof fall
asl above sea level
of deliberate flaking by humans, and the lithic, vertebrate and invertebrate remains were more numerous than in the upper layers.

KMS/C8 produced pottery and lithic artefacts, bone and shell artefacts, sherd, faunal and human bone remains, shells, charcoal, and damar particles. The lithics consisted of 294 specimens (Chapter IX). Only one bone point was found in KMS/C8. Shell artefacts were also rare and consisted of seven ornaments made from cowrie shells and five scraper fragments from marine bivalves. (Chapter X). Earthenware sherd were only found in the upper layers, between spits 2 and 10, and consisted of 56 sherd fragments, six decorated with paddle impressed patterns. (Chapter XI).

Vertebrate bones were dominated by non-identifiable fragments (54%). Identified remains were dominated by mammals (121 individuals/88%) followed by reptiles (11 individuals/8%), birds (two individuals/1%), and fish (three individuals/2%). (Chapter VI).

The invertebrate fauna consisted of molluscs (gastropods, bivalves and Cephalopoda) and Crustacea. The molluscs were dominated by Brotia sp., which was present in all spits except spit 2, and tended to gradually increase into the lower layers. Other molluscs were scarce and usually found individually in different spits. They included the fresh water snail, Paludomus broti and fresh water bivalve, Pseudodon vondenbuschianus, and five land snail species including Cyclophorus borneense, Pterocyclis termilabiatus, Leiptopoma geotrichiforme, Amphidromus sp. and an unidentified species. Marine molluscs were represented by one bivalve, Polymesoda erosa, and a Cephalopod, Nautilus sp. Crustacea were represented by the fresh water crab (Brachyura) (Chapter VI).

5.2 Lubang Payau Site

The location of Lubang Payau could not be plotted by the GPS since it was covered by quite dense forest and no satellite signal could be detected. The cave was located between Kimanis and Liang Gobel, Kimanis being 160 m to the west and Liang Gobel 60 m to the southeast (Map 1.2).

Lubang Payau was a commercial bird’s-nesting cave, but much smaller than Kimanis Cave (Figure 5.7). The entrance chamber covered approximately 10 x 20 metres with a flat platform at the entrance, gradually sloping down inside. The cave has two tunnels, both of them leading to the same underground river. The left one was a much shorter tunnel than the right. The cave was always very wet, especially at the back
Figure 5.7 Plan and section of Lubang Payau Cave

LEGEND
- Excavation pit
- Cave wall
- Roof fall
- Soil surface
- Vertical projection of the ceiling
- Drip line
- Line section
of the entrance chamber. Water was always dripping from the ceiling. At the entrance to the right tunnel there was a small pool.

The front of the cave was quite open, therefore in the morning it was bathed with sunlight. However, the sunlight does not penetrate deeply into the cave, and since the cave was humid the soil surface near the entrance is covered by green moss.

The excavation in this cave was based on a grid system. Two squares were excavated: C3 (2 x 1 m) at the entrance of the cave and D5 (2 x 2 m) further inside (Figure 5.7). The thickness of each spit in C3 was 5 cm, while in D5 it was 10 cm. The reason D5 was excavated with the thickness of 10 cm per spit was because the soil was very hard from calcification. Use of a 5 cm spit unit was considered too time consuming and not practical, since flattening the surface to an even elevation at the bottom of the spit required more time in such hard and lumpy soil.

5.2.1 LPY/C3

LPY/C3 was located at the highest point of the cave (Figure 5.7). The surface here was relatively flat with the lowest part at the north-east corner and the highest part at the south-west corner; the vertical difference between the two points was about 26 cm. No archaeological remains were observed on the green moss-covered surface before excavation.

LPY/C3 has three units: Unit I (spits 1 – 8), Unit II (spits 9 – 18) and Unit III (spits 19 – 32) (Figure 5.8). The first unit consists of several thin stratigraphic layers, which contain pottery. Potsherds were actually found down to spit 21, however those found below spit 8 appear to have trickled down from the upper layers. The north wall stratigraphy showed a post-hole extending down to spit 22, and most probably the potsherds were from this. Unit II consisted of two stratigraphic layers. The upper one contains the densest archaeological deposit of this square, and the lower has less. Unit III also consisted of two stratigraphic layers, with the upper layer being a continuation from Unit II above. Very little archaeological deposit it was present.

The excavation revealed seven layers of different soil texture and colour, labelled Layer A (top), B, C, D, E, E1, and F (bottom) (Figure 5.8). Layer A was a thin topsoil, approximately 5 cm thick, consisting of a dark brown (7.5YR 3/2) sandy silt which was compact and wet. In this layer recent artefacts from bird’s-nest collecting were found, such as a torch bulb, a battery, plastic bags, earthenware sherds, shells, and animal bone fragments.
Figure 5.8 Section through the LPY/C3

LEGEND
A  Dark brown sandy silt
B  Very dark greyish-brown sandy silt
C  Brown ashy silty clay
D  Dark brown ashy silt
E  Dark greyish brown ashy silt
E.1 Brown ashy silt
F  Yellow ashy silt

- Bed rock and roof fall
- asl above sea level
Layer B consisted of a very dark greyish brown (10YR 3/2) sandy silt. It was less compact than Layer A. This was also a thin layer, a little thicker than Layer A, with an uneven thickness of 5 to 15 cm. Lithic material, earthenware sherds, shells, animal bones and charcoal particles were found in this layer.

Layer C, a brown (7.5YR 4/3) ashy silty clay, was not visible everywhere in the square, being absent in the east wall. In the north wall only a thin long lens, approximately 5 cm thick, was present. In the south wall this layer was about 5 to 10 cm thick and 60 cm long. This damp, loose soil layer contained lithic material, earthenware sherds, shells, animal bones and charcoal particles. Layer D was a loose, damp, dark brown (7.5YR 3/2) ashy silt with an uneven thickness of approximately 10 to 20 cm. It contained similar archaeological deposits to the layer above.

Layer E had an uneven thickness (approximately 20 to 50 cm), tending to be thicker in the north wall area. It was a dark greyish brown (10YR 4/2) ashy silt, very loose, and with similar archaeological materials to Layer D, although with much denser shell remains, especially *Brotia*.

Layer E₁ was similar to Layer E, but of slightly different colour. This brown (10YR 5/3) ashy silt was also damp and very loose. It had an uneven thickness (approximately 10 to 50 cm). At approximately 80 cm from the surface (measured from the north-west corner of the square) the excavation hit a large limestone boulder, which covered the west and south sides of the square, therefore only the north and east parts could be excavated further. The area to be excavated became very small, so a part of the boulder in the south-west corner had to be broken and removed. This was done in spit 18, about 80 cm (90 CM IF 5x18) below the surface. At this level the soil still belonged to Layer E₁, which continued further down in the middle of the north side of the square, creating a shallow, roughly round pit up to 60 cm deep. The quantity of archaeological material decreased significantly from the upper to the lower part of Layer E₁.

Layer F was very different in colour compared to the layers above. It was a damp, rather sticky, yellow (10YR 7/6) ashy silt, about 30 to 40 cm thick. The archaeological materials found in this layer were dramatically fewer compared to Layer E₁, and finally disappeared altogether. The last spit (spit 33) was therefore sterile when it reached solid rock at 165 cm from the surface. The archaeological remains found in LPY/C3 included lithic material, earthenware sherds, bone and shell tools, animal bones and shells, as well as charcoal particles, ochre and *damar*. 

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The earthenware sherds were mainly small fragments, mostly eroded, and were only found in the upper layers of the square, from spit 1 to 13, although they were absent from spits 9 and 12. One isolated earthenware sherd was found in spit 21. There were 367 earthenware sherds altogether.

There were 240 lithic artefacts made of various rock materials, mainly chert, but also sedimentary rock, volcanic rock, microgranodiorite, calcareous sandstone, quartz, limestone and sandstone. Most were flakes without modification, followed in abundance by debitage, flake fragments, heat shattered pieces, flake shatter, multidirectional cores, and a bipolar core. These lithic materials occurred from spits 2 to spit 30, with greatest concentration between spits 6 and 17 (Chapter IX).

Bone and shell artefacts were very rare. There were three bone artefacts, found in spits 2, 5, and 15. The first two were points made from mammalian long bone fragments and the last one was an unknown object made from a mammal skull fragment. Shell artefacts were found in spits 3, 6 and 10, one from each spit. They were broken scrapers made from fragments of marine bivalves (Polymesoda erosa) (Chapter X).

Earthenware sherd decoration was mainly by carved paddle-impression (checked pattern) or cord-marking (84 potsherds in total were decorated). In addition there are two potsherds which have incised marks. In most cases the checked pattern was eroded, unlike the cord-marks which could still be seen clearly. The earthenware sherds were made by a paddle and anvil technique and some of the potsherds contain impressions of rice husks (identified by Jill Thompson) (Chapter XI).

Vertebrate and invertebrate faunal remains were found in all spits except the bottom one (33). More than 80% of the vertebrate faunal bones could not be identified anatomically. Those that could be identified comprised 39 individuals, mostly (87%) mammal, with a few reptiles (13%) and birds. Most of the faunal remains were found between spits 5 and 9. Below spit 9 vertebrate bones were scarce, especially below spit 19 (Chapter VI).

The bones were very fragmented, therefore identification to species was difficult. Only six species were identified: bearded pig (Sus barbatus), bear cat (Arctictis binturong), sun bear (Helarctos malayanus), orang utan (Pongo pygmaeus), Bornean gibbon (Hylobates muelleri), and lutung (Trachypithecus cristatus). Most of the vertebrate faunal assemblage was only identified to family, including bovids, deer, mouse-deer, pig, rhinoceros, Mustelidae, Viverridae, Muridae, monkeys, bats, snakes,
monitor lizards, turtles, and birds. A few fragments of human bone were found, scattered in different spits.

The invertebrate fauna consisted of molluscs and crustacea. The molluscs were dominated by *Brotia* (80%). The apex of this shell had almost always been broken to allow the whole animal to be sucked out. *Brotia* were concentrated in the upper layers, between spits 4 and 18, with a peak in spit 10. Other molluscs were rarer than *Brotia* and consisted of freshwater snails and bivalves, terrestrial snails, and one species of marine gastropod and three bivalves. The only crustacean present was the freshwater crab, *Brachyura* (Chapter VI).

Ochre or haematite particles were scattered in small fragments in almost every spit between 1 and 25.

5.2.2 LPY/D5

LPY/D5 was located on a slope, two metres inside from and almost one metre lower than LPY/C3 (Figure 5.7). The light here is dimmer than in LPY/C3 and the surface is always wet from dripping water. Therefore, the soil was calcified and hard to dig. Shells were scattered on the surface, many of which may have originally been deposited further up the slope inside the cave. Several limestone boulders also lay on the surface.

LPY/D5 consisted of 10 spits, but only the first six that contained archaeological deposits. Spits 7 to 10 are sterile. Only spit 6 lacked pottery, but lithics, bones and shells were still present, although in lesser quantity. Since spit 1 to 6 lie within one stratigraphic layer, they all regarded as one unit.

At the end of the excavation, 9 layers of different soil colours could be identified (Figure 5.9). They were labelled Layers A, A₁, A₂, A₃, B, B₁, C, C₁, and D, from top to bottom.

Layer A, the topsoil, consisted of compact, wet, brown (10YR 5/3) sandy silty clay. It was a thin layer of relatively even thickness, between 4 to 8 cm, thickest in the south-east corner of the square. It contained lithic materials, earthenware sherds, animal bones and shells.

Layers A₁, A₂, and A₃ were thin lenses only visible in the north-west corner of the square. Layer A₁ was a brown (10YR 5/3) sandy silt, very thin (approximately 2 cm). Layer A₂, which consisted of yellowish brown (10YR 5/8) silty sandy soil was of uneven thickness (approximately 2 to 10 cm). Layer A₃ had a similar soil texture to
Figure 5.9 Sections through the LPY/D5

LEGEND
A  Brown sandy silty clay
A.1 Brown sandy silt
A.2 Yellowish brown silty sand
A.3 Brown silty sand
B  Dark reddish-brown sandy silt
B.1 Dark reddish-grey sandy silt
C  Brownish-yellow sandy silt
C.1 Brownish-yellow silty sand
D  Brownish-yellow sandy silty clay
asl Bed rock and roof fall

Above sea level
layer A₂, but was of different colour (7.5YR 4/3) and only visible in the north wall of
the square. It had a thickness of 1 to 4 cm.

Layer B consisted of dark reddish-brown (5YR 3/4) sandy silt of uneven
thickness (1 to 24 cm). It was a wet and sticky soil, with some parts calcified and hard
to dig. It contained lithic materials, earthenware sherds, bones and shells. Layer B₁
contained thin small lenses, about 2 cm thick and 8 to 38 cm long, scattered horizontally
between Layers B and C. It had the same soil texture as Layer B (sandy silt) but was of
a different colour, being dark reddish-grey (5YR 4/2).

Layer C consisted of a brownish-yellow (10YR 6/8) sandy silt with an uneven
thickness of approximately 7 to 30 cm. Much of this layer was also calcified and
difficult to dig. Lithic materials, earthenware sherds, bones and shells were found in this
layer. Layer C₁ consisted of a brownish-yellow (10YR 6/8) silty sand with an uneven
thickness of approximately 5 to 40 cm. Almost no artefacts were found in this layer.

Layer D consisted of a brownish-yellow (10YR 6/8) sandy silty clay, with a
thickness approximately between 5 and 35 cm. No archaeological remains were found
in this layer.

The excavation of LPY/D5 hit basal rock at 45 cm depth on the north side and
about one metre on the south side. Depth measurements were taken from the surface at
the south-west corner of the square.

The archaeological remains from LPY/D5 consisted of lithic materials, bone and
shell artefacts, earthenware sherds, vertebrate and invertebrate faunal remains, human
bone fragments, ochre, charcoal and damar, similar to LPY/C3. They were concentrated
within the top 6 spits, while the four lower spits were archaeologically sterile. Spit 6 had
the fewest archaeological remains and spit 4 the most.

The lithic materials consisted of 109 specimens, dominated by flakes, followed
in abundance by flake fragments, flake shatter, heat shatter, utilised and retouch flakes,
core fragments, a utilised flake, a multidirectional core, and a manuport. They were
made from various rocks, including chert, sedimentary rock, microgranodiorite,
volcanic rock, milky quartz, limestone and calcareous sandstone (Chapter IX). There
were two bone unipoints made from long bones, but no shell artefacts (Chapter X).
Earthenware sherds were only found in the first 5 spits. The 258 sherds recovered weare
mainly small fragments. Most were plain, but decorated potsherds were also present (30
sherds), mostly very eroded. The decoration was made by carved paddle-impression
giving a check pattern, and also by incision. The earthenware sherds were made by a
paddle and anvil technique. Rice-husk impressions were found in several sherds,
although the density of impressions was insufficient to imply the use of husks as a
deliberate temper (Chapter XI).

Vertebrate bone fragments were dominated by non-identifiable specimens
(62%). The others consisted of 208 specimens from 19 individuals, mostly mammals
followed by reptiles, amphibians and fish (Chapter VI). The vertebrate fauna was very
fragmentary and difficult to identify to species level. Only two species were identified,
Malayan tapir (Tapirus indicus), and sun bear (Helarctos malayanus). Non-specific
elements included members of the following taxa: bovids, deer, pigs, Viverridae,
porcupines, squirrels, Cercopithecidae, Macaca sp., snakes, turtles, and monitor lizards,
frog and fish. Fragments of human bone were also found but were very rare and
distributed randomly in different spits.

The invertebrate faunas were overwhelmingly represented by molluscs, with few
crustacea. The most common molluscs were the fresh water snails, Brotia (76%), most
with their apices broken off. Other molluscs included freshwater snail Paludomus broti,
freshwater bivalves Pseudodon vondenbuschianus, four terrestrial snail species, two
marine bivalves and three marine gastropods. Crustacea were represented by fresh water
crab (Brachyura) (Chapter VI).

5.3 Liang Gobel

This small rock shelter (8 x 5 m) was located 60 m southeast of Lubang Payau
(Map 1.2). It was situated within a steep limestone cliff wall about 5 m high, a few
metres from the path that led to Lubang Payau (Figure 5.10). Since earthenware sherds
and shells were found on the dry surface of this rock shelter, a test pit, LGB/TP (1 x 2
m) was opened to recover archaeological remains for comparison with those found in
Kimanis and Lubang Payau.

The area around this rock shelter covered by trees, which formed an interlocking
canopy. However, some open patches allowed sunlight all through the day since this
rock shelter faced south.

LGB/TP has a shallow archaeological deposit, which lie on an uneven basal
rock. The excavation revealed 11 spits, which in this analysis treated as one unit.

The depth of the single test pit was only about 20 cm, down to an uneven basal
rock floor (spit 11). Three stratigraphical layers can be differentiated: A, B, and C
(Figure 5.11). Layer A, the top soil, consisted of greyish brown (10YR 5/2) ashy soil,
about one to two cm thick. Layer B consisted of dry and loose brown (7.5YR 5/3) ashy
silt. Most of the archaeological remains were found in this layer. Layer C was only
Figure 5.10 Plan and section of Liang Gobel rock shelter

**LEGEND**
- TP Test pit
- DP Datum point (above sea level)
- Rock shelter wall and ceiling
- Soil surface
- Vertical projection of the ceiling
- Drip line
Figure 5.11 Sections through the LGBTP deposits

LEGEND
A  Greyish brown ashy soil
B  Brown ashy silt
C  Yellowish brown ashy silt
   Bed rock
found in the middle area of the bottom of the pit. It was yellowish brown (10YR 5/4) ashy silt soil, about 3 cm thick. No artefacts found in this layer. Only two bone fragments from Suidae and Testudinidae were present in this layer.

The test pit yielded scarce lithic material, earthenware sherds, vertebrate and invertebrate faunal remains. Lithic materials were not abundant, with only seven small flakes from spits 3 to 7 but none from spit 5. They consisted of flakes, flake fragments,flake shatter, utilised flakes, a bipolar flake, and heat shattered material (for descriptions of lithic types see Appendix 9.3). They are described in Chapter IX. No bone or shell artefacts were discovered in this site.

Earthenware sherds occurred in every spit except spits 1, 9 and 11. Twenty nine potsherds were recovered (16 decorated), some quite large compared to the small potsherds found in Kimanis and Lubang Payau. They were also not as eroded as those from Lubang Payau and Kimanis. The only decoration was carved paddle-impression (checked pattern) and the vessels were made by the paddle and anvil technique.

Vertebrate bones were found from the top to the bottom of the test pit, but were absent from spits 3 to 5. They were dominated by bone fragments of bearded pig (*Sus barbatus*), although only one individual was present in the MNI calculation. Other vertebrate faunal fragments, all representing one individual for each taxon, included bovid, deer, carnivore, sun bear (*Helarctos malayanus*), rodent, rats/mice, monkey, bat, snake, turtle and frog (Chapter VI).

Invertebrate faunal remains were dominated by molluscs, especially *Brotia*, but crustacea were also present (*Brachyura*). The other molluscs consisted of a freshwater snails, three terrestrial snails, and the marine *Polymesoda erosa* (Chapter VI).

### 5.4 Radiocarbon Dating

Seven radiocarbon samples from KMS/C4 and three from LPY/C3 were submitted to the ANU Radiocarbon Laboratory (see table 5.1). Six were on charcoal pieces and the dates were calibrated with the University of Washington Quaternary Isotope Lab Radiocarbon Calibration Program Rev. 3.0. 1993. The other four samples were freshwater shells for which the dates cannot be calibrated, except by comparison with the charcoal dates from the same horizon.

Charcoal was not abundant and occurred mainly as small particles concentrated in the upper layers of KMS/C4 and LPY/C3. Since no charcoal samples were enough for dating from the lower layers of the sites, fresh water shells (*Brotia* sp.) were used. However, fresh water shell is known to produce much older dates owing to
contamination from ancient calcium carbonate dissolved in rivers and groundwater in limestone environments. Therefore, two shells from each trench were dated, one from the same horizon that produced the charcoal radiocarbon date as a comparison and the other one from a much lower layer. From KMS/C4, a sample of freshwater shell dated to 13,100±140 BP (ANU 11260) was derived from the same layer (Spit 24, 105 – 110 cm below the surface) as a charcoal sample dated to 10,030±260 BP (ANU-11150). As suspected, the freshwater shell date was much older than the charcoal one, with the difference between them being more than 3000 years. The dates from LPY/C3 showed a greater difference between the charcoal and freshwater shell. Spit 6 (25 – 30 cm below surface) produced a charcoal radiocarbon date of 4610±110 BP (ANU-11152) but a freshwater shell date of 13,100±140 BP (ANU-11260), a difference of almost 8,500 years.

With such variation, it is difficult to rely on the freshwater shell radiocarbon dates, especially if the freshwater radiocarbon dates from the lower layers are used to date the oldest human occupation of the sites. Elsewhere, freshwater shell radiocarbon dates have always revealed much older dates than stratigraphically equivalent samples from charcoal. Bellwood suggested approximately 500 years too old for freshwater shell dates from Madai (1988:120), while Spriggs showed that freshwater shell could be 1500 years to old (1989:598). From Gua Sireh, Ipoi Datan suggested a 500 year increase in real age from freshwater shell (1993:17).

In the case of the upper Birang the difference is much greater than the dates mentioned above. Such a great difference also occurred for radiocarbon dates obtained by Adi Taha from Ulu Kelantan in Peninsular Malaysia (Adi 2000:121). Adi used three parallel dates from charcoal and freshwater shell from Trenches 1 and 2 in Gua Chawas and from Trench 1 in Gua Peraling. He mentioned that:

The parallel dates indicate that the shell dates are much older than the charcoal dates. However, the difference in dates between the charcoal and shell dates varies among the three trenches. At Trench 1, the difference between charcoal and shell dates are substantial amounting to 4,880 years, at Gua Peraling a difference of 3,350 years while in Gua Chawas Trench 2 the difference is reasonable with a difference of 1420 years (Adi 2000:121).

The Upper Birang freshwater shell radiocarbon dates showed the same trend as those from Ulu Kelantan. The difference is even greater at Lubang Payau, almost 8,500 years. However, the stratigraphy here does not show any disturbance and the dates are all in sequence if charcoal and shell are considered separately. But since the freshwater
shell radiocarbon dates are clearly questionable, in the following analyses only the charcoal radiocarbon dates will be used.

**Table 5.1: Radiocarbon dates from the Upper Birang sites**

<table>
<thead>
<tr>
<th>SQUARE/SPIIT</th>
<th>SAMPLE DEPTH (CM)</th>
<th>MATERIAL</th>
<th>LAB. NO.</th>
<th>CONVENTIONAL AGE (BP)</th>
<th>CALIBRATED DATE (BP), ONE SIGMA RANGE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMS/C4/Spit 8</td>
<td>35 -40</td>
<td>Charcoal</td>
<td>ANU-11311</td>
<td>1270 ±240</td>
<td>1220, 1180</td>
</tr>
<tr>
<td>KMS/C4/Spit 11</td>
<td>50 – 55</td>
<td>Charcoal</td>
<td>ANU-11148</td>
<td>4650 ± 90</td>
<td>6440, 6430, 5320</td>
</tr>
<tr>
<td>KMS/C4/Spit 20</td>
<td>98</td>
<td>Charcoal</td>
<td>ANU-11149</td>
<td>8840 ± 250</td>
<td>9880</td>
</tr>
<tr>
<td>KMS/C4/Spit 24</td>
<td>105-110</td>
<td>Charcoal</td>
<td>ANU-11150</td>
<td>10030 ± 260</td>
<td>11330, 11300, 11260, 11220, 11170, 11140</td>
</tr>
<tr>
<td>KMS/C4/Spit 24</td>
<td>105-110</td>
<td>Freshwater shell</td>
<td>ANU-11258</td>
<td>13860 ± 180</td>
<td></td>
</tr>
<tr>
<td>KMS/C4/Spit 34</td>
<td>155 - 160</td>
<td>Charcoal</td>
<td>ANU-11151</td>
<td>11270 ± 220</td>
<td>13180</td>
</tr>
<tr>
<td>KMS/C4/Spit 59</td>
<td>280-285</td>
<td>Freshwater shell</td>
<td>ANU-11259</td>
<td>23630 ± 480</td>
<td></td>
</tr>
<tr>
<td>LPY/C3/Spit 6</td>
<td>25 - 30</td>
<td>Charcoal</td>
<td>ANU-11152</td>
<td>4810 ± 110</td>
<td>5310</td>
</tr>
<tr>
<td>LPY/C3/Spit 6</td>
<td>25 - 30</td>
<td>Freshwater shell</td>
<td>ANU-11260</td>
<td>13100 ± 140</td>
<td></td>
</tr>
<tr>
<td>LPY/C3/Spit 23</td>
<td>110 - 115</td>
<td>Freshwater shell</td>
<td>ANU-11261</td>
<td>17730 ± 250</td>
<td></td>
</tr>
</tbody>
</table>

*University of Washington Quaternary Isotope Lab. Radiocarbon Calibration Program 1993 Rev.3.

One possibility is that ancient shells have been mixed upwards into higher layers that contain pottery. This can happen very easily in caves and would not necessarily require visible disturbance of the deposits. Excavation of small postholes for sleeping platforms would be sufficient, or even crab burrows. If this happened, then the shell dates could be almost "right" for the shells themselves, but not for the layers in which they were found.
VI THE ANALYSIS OF THE FAUNAL REMAINS

6.1 Faunal Remains in the Archaeological Deposits

The faunal remains from the upper Birang River sites consist of vertebrates (mammals, reptiles, amphibians, fish and birds), and invertebrates (arthropods, gastropods, pelecypods and cephalopods). In this chapter the vertebrate and invertebrate remains are analysed separately.

Faunal remains are an important finding in an excavation, since they can provide information on ancient environments and human behavioural activities. However, the interpretation of faunal remains is not simple and many problems can occur. An ancient animal bone assemblage has passed through several stages before being analysed by an archaeologist. Klein and Cruz-Uribe (1984:3) point to five basic stages: 1) the life assemblage (the community of live animals in their “natural” proportions); 2) the death assemblage (the carcasses that are available for collection by people, carnivores, or any other agent of bone accumulation); 3) the deposited assemblage (the carcasses or portions of carcasses that come to rest at a site); 4) the fossil assemblage (the animal parts that survive in a site until excavation or collection); 5) the sample assemblage (the part of the fossil assemblage that is excavated or collected).

The taphonomic history of a faunal assemblage plays an important role in determining the condition and nature of an ancient fauna excavated by an archaeologist. Taphonomic processes affect a faunal assemblage from the time the animals were killed, and then before and after they were buried. Relevant human activities can involve selection of certain parts of an animal for bringing back to a site, discard behaviour, and subsequent site use in terms of trampling and scattering. Any excavated fauna need not contain only remains of animals eaten by humans, but might also contain animals that died naturally on the site or were brought in by carnivores. Therefore, it is important to understand not only human behaviour and taphonomic processes, but also the behaviour of other animals which occupy the site.

In order to get a good interpretation from an archaeological assemblage the excavation has to be done carefully, so that all the bone remains can be retrieved. The
larger the sample the better the result will be. Therefore, total excavation of a site is an ideal, but this cannot always be done. Most interpretations have to be derived from limited samples. The problem is how to extract as much information as possible from a small sample in order to understand aspects of human behaviour, diet and the ancient environment. Therefore, various methods are developed in this thesis to quantify the taxa available in a site.

6.2 The Analysis of Vertebrate Remains

Quantification is necessary to define characteristics that can clearly differentiate between groups (Reitz & Wing 1999:145). There are three approaches for the quantification of faunal bones found in an archaeological site: (1) the number of identified elements per taxon, consisting of complete or fragmentary bones or teeth, (2) the minimum number of individuals per taxon depicted by those identified elements, and (3) the weight of bones per taxonomic unit (Grayson 1978:53). The third approach is not commonly used, while the first is normally used in combination with the second.

To be able to measure taxonomic abundance is very important, especially for comparing two or more samples. Klein and Cruz-Uribe (1984:24) state that without this ability:

...there is no way to argue that the differences or similarities between samples did not arise by chance—that is, that they reflect real differences or similarities in past environments or in the behavior of bone-collecting agents. Comparisons based simply on the presence or absence of taxa are inadequate because without abundance estimates there is no way to show that a species’ presence in one sample and its absence in another reflects a “real” (vs. chance) difference.

There are various indices of taxonomic abundance that each have strengths and weaknesses (for more detailed description see Klein and Cruz-Uribe 1984:24-37; Ringrose 1993: 125-32; Reitz & Wing 1999). Klein and Cruz-Uribe (1984) suggest that the best approach is to combine the calculations for Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI). In this analysis their approach will be applied, although like other approaches it has its weaknesses and strengths, as described later. The following description is summarised from Klein and Cruz-Uribe (1984:25-28).

NISP is simply the number of bones or bone fragments counted for each taxon. However, NISP cannot be used as the sole index of taxon abundance since it has several disadvantages. First, it does not count the fact that some animals have more skeletal parts than others, therefore the NISP may exaggerate the abundance of certain species.
Second, it may give a wrong impression of the importance of certain species because some species might be brought to a site intact, whereas others could have been butchered elsewhere with only some body parts being brought back to the site. Third, bone fragmentation can affect NISP calculations significantly since highly fragmented bone produces higher NISPs, even though species abundances remain unchanged. Similar criticisms have also been put forward by other writers (Grayson 1984:20-24; Ringrose 1993: 125-6, and Reitz & Wing 1999:191-3).

Despite the disadvantages, NISP calculations are of value if they are combined with the calculations of minimum numbers of individuals from which the identified bones must have come (Klein and Cruz-Uribe 1984:25). Minimum number of individuals (MNI) is always smaller than, or in rare situations the same as, NISP. Unlike NISP, MNI does not vary depending on the number of bones in an animal’s skeleton. Also unlike NISP, the MNI counted for a particular animal is the same regardless of whether there is a full skeleton or just one bone. Lastly, unlike NISP, the MNI is not affected by bone fragmentation. Species that have high fragmented bones will have a high NISP, but the MNI in theory should remain the same regardless of degree of fragmentation. Therefore, compared to the NISP, the MNI is a stronger and more reliable index for taxonomic abundance, although it also has its disadvantages.

The main problem with the MNI is that it can be exhausting to calculate, and with a small sample the risk of making an estimation error is quite obvious. Taxa containing smaller numbers of bone specimens tend to contribute proportionately greater MNI than taxa with larger numbers (Grayson 1978:54).¹ The problem is complicated by the fact that there are various ways to calculate the MNI, thus making it sometimes difficult or even impossible to compare results for one sample with those for another (See also Ringrose 1993: 126-8).

One way to calculate the MNI is to sort out matching specimens into left or right parts (i.e. left or right femur, left or right tibia, etc.). The MNI is then counted as the maximum number of bones attributed to either the left or right sides. But specimens often cannot be differentiated into right and left sides because of lack of the distal or proximal end, or if such ends are weathered or damaged. In such cases the MNI is calculated simply by dividing the number of matching specimens by two. For example, a hypothetical sample of twelve proximal ends, eight distal ends and five tibia shafts

¹ Such a phenomenon is represented in the Upper Birang assemblage. The Hystricidae from KMS/C4 are represented by three specimens from three individuals, whereas the Suinae are represented by 574 specimens from only 7 individuals.
without epiphyses of *Macaca* sp. gives an MNI of nine individuals (12 + 5 = 17. 17/2 = 8.5).

These two techniques of calculating MNIs (dividing the total number by two or sorting into separate left and right) can produce different MNIs for one sample, especially for small ones.

MNIs can also be calculated by matching specimens to determine whether they belong to the same individuals or not. In order to do this, size, sex and age criteria have to be considered. In principle, different bones can sometimes be matched by this method (e.g. the femur and tibia). However, usually people attempt to match specimens of the same anatomical element. For example, ten left and seven right humeri can be automatically assigned to 10 individuals. However, if by matching the size of the left and the right humeri it becomes obvious that two of the right humeri do not match any of the left humeri, then the MNI must be calculated as 10 left + 2 right = 12 individuals.

Matching to calculate MNI can also be affected if the sample is small. Another complication can arise from the way fragmentary bones are treated during analysis. These can be totally ignored, or treated as complete bones, or recorded separately as fragments of complete bones (Klein & Cruz-Uribe 1984:27). Klein & Cruz-Uribe (1984:27-8) explain that:

...the fractions for a skeletal part are summed and added to the number of complete bones. The MNI for the part is the resulting figure, rounded upward to the next whole number. Thus, for a particular species, the left distal humerus category might include three complete specimens and three fragmentary ones, consisting of one-half, one-third, and one-third of a complete distal humerus respectively. The sum for left distal humeri would then be 4.16 (3 + .50 + .33 + .33). The MNI for left distal humeri would be 5.

If fragmentary bones are ignored, MNIs will be artificially depressed. If fragments are treated as whole bones, MNI will be artificially inflated. In either case, MNI values will become dependent on the degree of fragmentation, which may vary between assemblages or between species within an assemblage. The result will be MNIs that may not be comparable between assemblages or between species.

The estimation of fractions is therefore the preferred alternative. The major objection to it is that it must be subjective to some extent. However it is probable that the fractions estimated by experienced analysts will be very similar.

It is obvious that each of these alternatives can give a different MNI. However, as long as it is stated clearly how the analysis was conducted, there should be no confusion.

Another weakness of MNIs is that they are not additive in the way that NISPs are (Klein & Cruz-Uribe 1984:28). This is significant when a site has been excavated more than once and the bones from the different excavations are lumped together. For
example, if the first excavation produced a bovid sample of two humeri, three femora, two radii and one ulna, then the MNI would be 2 (NISP = 8). If a second excavation revealed a bovid sample of one humerus, one femur and five ulnae, then the MNI would be 3 (NISP = 7). However, if both samples are lumped together the MNI will be 3, not 5 (NISP = 8 + 7 = 15). It is obvious that lumping samples tends to reduce MNIs, especially if the samples are small.

Different aggregation techniques applied to a single faunal assemblage (i.e. taking the whole site as one location or taking all stratigraphical layers or spits individually) may also result in different minimum numbers. As Grayson (1984:29) described:

The smallest possible minimum number values will result when the entire faunal collection is treated as a single large faunal aggregate. Here, most abundant elements are defined only once for each taxon. The largest possible minimum number values will result when the spatial boundaries of each aggregate are so small as to contain only a single specimen. Here, each specimen becomes a “most abundant element,” because it is the only specimen in the faunal aggregate, and the minimum number of individuals will equal the number of identified specimens per taxon, the highest value it can attain.

6.3 The Analysis of Vertebrate Remains from the Upper Birang Sites

Klein and Cruz-Uribe (1984: 29) warned that:

MNI comparisons should especially be avoided among adjacent provenience units that have been arbitrarily defined, such as squares or spits within a layer. The reason is that the bones in one square or spit may come from the same individuals represented in an adjacent square or spit.

However, in the analysis of the Upper Birang vertebrates the assemblage from each excavation pit has been divided into units in order to record changes throughout the occupational layers. As stated in Chapter I, each unit was identified through variations in artifact content and density, as well as stratigraphy. Different units may contain bone fragments of the same animal, and this will inflate the overall number of MNIs counted. Such a possibility cannot be avoided, but the way the analysis has been conducted is regarded as quite reasonable in the circumstances.

Once the analytical units were determined, the bones from each unit were sorted and identified (see Chapter I: 1.2.2.). The bones were first identified by Rokhus Duwe Awe from National Archaeological Research Centre in Jakarta. Some were further identified, especially the primates and pigs by Colin Groves, the small mammals by Ken Aplin, and the bears by Erik Meijaard.

The non-identifiable fragments from each spit were weighed in bulk, while the identifiable fragments were weighed individually, with the exception of the mandibular
fragment of bats from KMS/C4, which were weighed together per unit and then sorted into left and right sides. Therefore, in the weight column of Microchiroptera in Appendix 6.3 only one row is filled for bat mandibular fragments.

The bones from all sites are very fragmentary, with more than 50% from each site being unidentifiable anatomically and taxonomically. A large proportion of these unidentifiable specimens consist of fragmentary long bones of large mammals. Those that can be identified are mainly relatively robust post-cranial bones such as humeri, ulnae, femora and radii. However, even these are most often incomplete, just proximal or distal ends, or shaft parts. The only bones commonly found in whole condition are metapodials, carpals, tarsals and phalanges. Cranial-dental elements are not as common as post-cranial elements. Bats are an exception here, because mandibles and maxillae (as well as long bone fragments) are more common than post-cranial elements.

Often the anatomical part itself can be identified but the bone can only be assigned to genus, family, order or class level rather than species. This is especially true for post-cranial elements. Therefore, some specimens can only be identified as indeterminate mammals, indeterminate carnivora or indeterminate Cercopithecidae. Such ambiguous identifications are classified separately to reduce confusion or miscalculation.

When all identifiable specimens had been assigned to taxa, the anatomical elements of each were counted in order to calculate MNIs. For some taxa, such as Chiroptera and Cercopithecidae, left and right mandibles can be differentiated easily, but this is not true for all. Matching between left and right elements could not be undertaken for every taxon. Therefore, MNIs are not generally counted from separated left or right elements, but more often by simply dividing the total number of elements (for example, the femora) by two.

In this analysis, for taxa such as Rodentia, Muridae, Viverridae, Mustelidae, Sciuridae, and Varanidae, which all have small NISPs, the counting of MNIs was not only done by sorting out the paired elements into left or right, but also by matching the size of the left and right elements as well as taking into consideration the colour of the bone. Since the number of bones of certain taxa is very limited, the accuracy of such procedures is very reliable.

When the MNI for each element of one taxon, for example the Rodentia (Table 6.1), has been counted, then the total MNI of that taxon is determined by the most abundant MNI for any one of the elements. In the case of Rodentia, the most abundant elements are pelvic fragments, indicating an MNI of two individuals.
Table 6.1 Anatomical elements of Rodentia from Unit II of KMS/C8.

<table>
<thead>
<tr>
<th>ANATOMICAL ELEMENTS</th>
<th>NISP</th>
<th>WEIGHT</th>
<th>MNI</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forelimb</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ulna proximal</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Ulna fragment</td>
<td>1</td>
<td>0.7</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Radius fragment</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hindlimb</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pelvic fragment</td>
<td>3</td>
<td>4.1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Tibial fragment</td>
<td>1</td>
<td>0.3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Calcaneum</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>8</td>
<td>6.6</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

The MNIs of some elements, such as long bone fragments, ribs, cranial bones, turtle plastrons and carapace fragments, could not be counted, unless they were only found singly, indicating the presence of one individual. In such cases a question mark (?) will be added behind the number, indicating that at least one individual of a certain taxon is present. For example, the MNIs of the cranial, short and long mandibulars and long bone fragments of Microchiroptera from Unit I of KMS/C4 (Appendix 6.3) could not be counted, but in the MNI column they are recorded as 1?.

The other reason to mark the uncounted MNIs with 1? instead of just a question mark (?) or blank in the MNI column is to ease the counting of the total number of individuals of different taxa in an excavation pit. For example, the MNI of Testudinidae and Rana from LPY/D5 could not be counted, but they were listed as at least have one individual (1?) each (Appendix 6.8). Therefore, when the total number of different taxa from LPY/D5 have to be counted, it can easily be counted as 19?. If Testudinidae and Rana were recorded as blank marks or question marks, only 17 individuals will be recorded and it will give the impression that no Testudinidae and Rana were present at all.

Table 6.2 Testudinidae from KMS/C4 (the unknown MNIs are marked with a question mark).

<table>
<thead>
<tr>
<th>TAXON</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>UNIT III</th>
<th>UNIT IV</th>
<th>UNIT V</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NISP</td>
<td>NISP</td>
<td>NISP</td>
<td>NISP</td>
<td>NISP</td>
<td>NISP</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>73</td>
<td>224</td>
<td>1</td>
<td>641</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

Counting the total number of one taxon in an excavation pit can also be misleading if the uncounted MNIs are labelled just with a question mark, as in the example of Testudinidae from KMS/C4 (Table 6.2). The Testudinidae specimens from Unit I and V consisted of carapace and plastron fragments only, therefore the MNIs could not be counted. If the columns for MNI were filled with question marks to indicate that MNIs were not known, then the total number of Testudinidae found in KMS/C4 would be counted only from Units II, III and IV, giving a total of 10. This gives the impression that Units I and V have no Testudinidae. Therefore, to mark the
existence of Testudinidae from Unit I and V, the uncounted MNIs were recorded as 1?, which indicates that at least one individual was present in both, so the total MNIs of Testudinidae from KMS/C4 can be recorded as 12? (Table 6.3). The question mark after the number 12 is to indicate that there may be more than 12 Testudinidae represented in KMS/C4, but the exact number is not known.

<table>
<thead>
<tr>
<th>TAXON</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>UNIT III</th>
<th>UNIT IV</th>
<th>UNIT V</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NISP</td>
<td>MNI</td>
<td>NISP</td>
<td>MNI</td>
<td>NISP</td>
<td>MNI</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>73</td>
<td>17</td>
<td>224</td>
<td>1</td>
<td>641</td>
<td>8</td>
</tr>
</tbody>
</table>

Marking the uncounted MNIs with 1? also eases the counting of the total number of individuals of all taxa from KMS/C4. For example, Rana (frog), an amphibian, is represented in LPY/D5 by two long bone fragments. Therefore, the frog MNI could not be counted precisely. But if counted as 1?, then the total number of amphibian can be counted. This is also applies for the reptiles. The reptiles from this square are represented by Python, Varanidae and Testudinidae. Python and Varanidae, each was represented by one individual. However, the MNIs of Testudinidae which consisted of carapace and plastron fragments could not be counted. But if it is mark with 1?, the total number of reptiles from this square can be counted: 3? Individuals (1 Python + 1 Varanide + 1? Testudinidae). This allows a percentage to be calculated (Table 6.4).

<table>
<thead>
<tr>
<th>CLASS</th>
<th>MNI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMMALIA</td>
<td>14</td>
<td>73.69</td>
</tr>
<tr>
<td>REPTILIA</td>
<td>37</td>
<td>15.79</td>
</tr>
<tr>
<td>AMPHIBIA</td>
<td>17</td>
<td>5.26</td>
</tr>
<tr>
<td>PISCES</td>
<td>1</td>
<td>5.26</td>
</tr>
<tr>
<td>TOTAL</td>
<td>197</td>
<td>100</td>
</tr>
</tbody>
</table>

Burnt specimens are also recorded, except for unidentifiable specimens.

6.3.1 Problems with the Identification of the Specimens

The inability to identify most specimens to species level was the major disadvantage of this analysis. Identification to family, order or class levels cannot give a clear picture of the kinds and numbers of animals actually occurring. It also inflates the MNIs. For example, 9 individuals were classified as indeterminate carnivores from all sites. Beside indeterminate carnivores, three families of carnivores were identified in the Upper Birang sites (Ursidae, Mustelidae, and Viveridae). Therefore, the nine individuals
of indeterminate carnivores actually should belonged to one of the three families and if they could be identified as such, the indeterminate carnivores will be omitted. Consequently the MNIs of Ursidae, Mustelidae or Viveridae would be added or remain the same. It depends on the bone fragments, whether they consisted of diagnostic elements that added the MNIs or not.

In KMS/C8 there are two individuals of Mustelidae and one Lutrinae?. Since the subfamily Lutrinae (otters) belongs to the family Mustelidae, there is a possibility that the two individuals of Mustelidae found in KMS/C8 were actually represented Lutrinae.

In KMS/C4 the family Viveridae consisted of three individuals. In addition there are two individuals of *V. tangalunga*, a species that belongs to the family Viveridae. It is possible that the three individuals of Viveridae were actually representing *V. tangalunga* and if the were as such, the MNIs for *V. tangalunga* will be added and the MNIs for Viveridae will be omitted.

It is clear that the assignment of practically the same taxa into different ones has certainly inflated the MNIs and makes it difficult to estimate the exact proportions of the species, in this case the carnivore, present in any site.

However, such situations could not be avoided, since the nature of the data did not permit more precise identifications. With these limitations, the interpretation of the vertebrate remains was aiming mainly to provide general information on the animals found in the sites. Even if the MNIs calculated are not entirely convincing, at least the proportions of different animals can be used for interpretative purposes. As Reitz & Wing (1999:195) mention: “MNI estimates should not be interpreted as actual individuals; more actual individuals may have been used at the site, or only portions may have been used.” Therefore, with all the weaknesses of this analysis, something important can still be expected to come from it.

### 6.3.2 Body Size Classes

To assess the role of vertebrate fauna in the prehistoric diet of the Upper Birang sites, the taxa first have to be grouped into body weight classes (Table 6.6) based on adult weights. However, the large weight range within one family, or even between males and females of a single species, makes it difficult to determine boundaries. Compromises have to be made, and five body weight classes are recognised (Table 6.5).
Table 6.5 Vertebrate size classes.

<table>
<thead>
<tr>
<th>SIZE</th>
<th>WEIGHT (KG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>&gt;200</td>
</tr>
<tr>
<td>Medium</td>
<td>&gt;1 – 10</td>
</tr>
<tr>
<td>Small</td>
<td>0.03 – 1</td>
</tr>
<tr>
<td>Very Small</td>
<td></td>
</tr>
</tbody>
</table>

Many taxa that can only be identified to family or order level contain several species with wide weight ranges.

Table 6.6 Body weight classes of vertebrates from the Upper Birang sites.

<table>
<thead>
<tr>
<th>WEIGHT CLASS</th>
<th>TAXON</th>
<th>SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARGE</td>
<td>Bovidae</td>
<td>400 - 800</td>
</tr>
<tr>
<td></td>
<td>Rhinocerotidae</td>
<td>&gt; 500</td>
</tr>
<tr>
<td>MEDIUM LARGE</td>
<td>C. unicolor? (Sambar deer)</td>
<td>85 - 100</td>
</tr>
<tr>
<td></td>
<td>Suidae (pig)</td>
<td>57 - 83</td>
</tr>
<tr>
<td></td>
<td>T. barbatus (bearded pig)</td>
<td>A:57-83/M:200</td>
</tr>
<tr>
<td></td>
<td>Tapirus indicus (Malay tapir)</td>
<td>&gt; 100</td>
</tr>
<tr>
<td></td>
<td>P. pygmaeus (orang utan)</td>
<td>AM:50-100/AF:35-50</td>
</tr>
<tr>
<td></td>
<td>H. malayanus (sun bear)</td>
<td>48 - 63</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Cervidae</td>
<td>20 - 28</td>
</tr>
<tr>
<td></td>
<td>M. muntjak (common barking deer)</td>
<td>20 - 28</td>
</tr>
<tr>
<td>SMALL</td>
<td>Tragulidae (mouse-deer)</td>
<td>0.7 - 4.6</td>
</tr>
<tr>
<td></td>
<td>Cercopithecidae indeterminate</td>
<td>3 - 9</td>
</tr>
<tr>
<td></td>
<td>Macaca sp. (macaques)</td>
<td>3 - 7</td>
</tr>
<tr>
<td></td>
<td>M. fascicularis (long-tailed macaque)</td>
<td>AM:5-7/AF:3-4</td>
</tr>
<tr>
<td></td>
<td>Presbytis sp. (leaf monkey)</td>
<td>3 - 7</td>
</tr>
<tr>
<td></td>
<td>T. cristatus (autung)</td>
<td>4 - 6.5</td>
</tr>
<tr>
<td></td>
<td>N. larvatus? (proboscis monkey)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>H. muelleri (Bornean gibbon)</td>
<td>5 - 6.4</td>
</tr>
<tr>
<td></td>
<td>Indeterminate Carnivora</td>
<td>1 - 10</td>
</tr>
<tr>
<td></td>
<td>Mustelidae (martens, weasels, badgers &amp; otters)</td>
<td>1 - 3</td>
</tr>
<tr>
<td></td>
<td>Lutrinae? (otters)</td>
<td>3 - 5</td>
</tr>
<tr>
<td></td>
<td>Viverridae (civets &amp; mongoosees)</td>
<td>2 - 10</td>
</tr>
<tr>
<td></td>
<td>V. Tangelung (Malay civet/tangalung)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>A. binturong (binturong)</td>
<td>6 - 10</td>
</tr>
<tr>
<td></td>
<td>Hystrixidae (Porcupines)</td>
<td>1 - 9.8</td>
</tr>
<tr>
<td></td>
<td>Indeterminate Reptilia</td>
<td>&gt; 1</td>
</tr>
<tr>
<td></td>
<td>Ophidia (snakes)</td>
<td>&gt; 1</td>
</tr>
<tr>
<td></td>
<td>Python (snakes)</td>
<td>&gt; 1</td>
</tr>
<tr>
<td></td>
<td>Varanidae (monitor lizards)</td>
<td>1 - 3</td>
</tr>
<tr>
<td></td>
<td>Agamidae</td>
<td>1 - 10</td>
</tr>
<tr>
<td></td>
<td>Testudinidae (turtles)</td>
<td>&gt; 1</td>
</tr>
<tr>
<td></td>
<td>Tryonichidae (soft-shelled turtle)</td>
<td>&gt; 1</td>
</tr>
<tr>
<td>VERY SMALL</td>
<td>Cynocephalus variusgatus</td>
<td>0.01 - 1</td>
</tr>
<tr>
<td></td>
<td>Megachirotropsa (fruit bats &amp; flying fox)</td>
<td>0.01 - 1.1</td>
</tr>
<tr>
<td></td>
<td>Microchirotropsa (bats)</td>
<td>0.003 - 0.05</td>
</tr>
<tr>
<td></td>
<td>Indeterminate Rodentia</td>
<td>0.03 - 1</td>
</tr>
<tr>
<td></td>
<td>Muridae (rats/mice)</td>
<td>0.03 - 0.5</td>
</tr>
<tr>
<td></td>
<td>Scliridae (squirrels)</td>
<td>&gt; 0.1 - 1</td>
</tr>
<tr>
<td></td>
<td>Aves (birds)</td>
<td>&lt; 1</td>
</tr>
<tr>
<td></td>
<td>Rana (frogs)</td>
<td>&lt; 0.5</td>
</tr>
<tr>
<td></td>
<td>Pisces (fish)</td>
<td>&lt; 1</td>
</tr>
</tbody>
</table>

For instance, Cervidae (deer) include *Cervus unicolor*, with an average weight of 85 to 100 kg, and *Muntiacus muntjak*, with an average weight of 20 to 28 kg. So these two species were grouped into two different weight classes. However, those specimens that can only be identified as Cervidae pose a problem. In this case the smaller size category is chosen based on fact that the specimens available tend to indicate that they belonged to smaller sized species.

In the case of Tragulidae, which have body weights between 0.7 and 4.6 kg, encompassing two size classes (very small and small), the family was assigned to the larger size class. This is because the larger portion of the weight range fell into the larger class, “small”, at > 1 – 10 kg.

To decide which size class the Rodentia should be assigned to was more difficult. This order consists of three families (Sciuridae, Muridae and Hystricidae) present in the assemblages. Sciuridae (squirrels) consisted of large variety of species, some quite small at only 100 gram in weight, but others reaching 3 kg. Since the smallest size class, very small, consisted of animals weighing less than 1 kg, and the next size class, small, catered for animals between 1 and 10 kg, the remains of Sciuridae fit into both classes. However, since most specimens are from very small individuals Sciuridae remain categorised in the very small class.

### 6.3.3 Vertebrate Remains from KMS/C4

The excavation of KMS/C4 produced 12,506.1 g of vertebrate bone remains. Non-identifiable specimens consist of 55% of the assemblage (Table 6.7).

**Table 6.7 Non-identifiable and identifiable vertebrate specimens from KMS/C4.**

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NON-IDENTIFIABLE SPECIMENS</th>
<th>IDENTIFIABLE SPECIMENS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WEIGHT</td>
<td>%</td>
<td>WEIGHT</td>
</tr>
<tr>
<td>I</td>
<td>298.3</td>
<td>2.39</td>
<td>245.5</td>
</tr>
<tr>
<td>II</td>
<td>834.9</td>
<td>6.68</td>
<td>664.3</td>
</tr>
<tr>
<td>III</td>
<td>5426.6</td>
<td>43.39</td>
<td>4535.6</td>
</tr>
<tr>
<td>IV</td>
<td>99.2</td>
<td>0.79</td>
<td>170</td>
</tr>
<tr>
<td>V</td>
<td>156.9</td>
<td>1.25</td>
<td>74.8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>6816.9</td>
<td>54.5</td>
<td>5690.2</td>
</tr>
</tbody>
</table>

Those that can be identified consist of 6040 specimens from 299? individuals, representing 36 taxa (Table 6.8).
Table 6.8 Identifiable vertebrate specimens from KMS/C4.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>WEIGHT (%)</th>
<th>NISP</th>
<th>% MNI</th>
<th>TAXA</th>
<th>% BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>24.5</td>
<td>4.31</td>
<td>1569</td>
<td>25.98</td>
<td>65?</td>
</tr>
<tr>
<td>II</td>
<td>364.3</td>
<td>11.67</td>
<td>2015</td>
<td>33.36</td>
<td>116?</td>
</tr>
<tr>
<td>III</td>
<td>453.6</td>
<td>79.71</td>
<td>2224</td>
<td>36.62</td>
<td>94?</td>
</tr>
<tr>
<td>IV</td>
<td>174</td>
<td>3</td>
<td>61</td>
<td>1.01</td>
<td>1?</td>
</tr>
<tr>
<td>V</td>
<td>74.8</td>
<td>1.31</td>
<td>171</td>
<td>2.83</td>
<td>13?</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5690.2</td>
<td>100</td>
<td>6040</td>
<td>100</td>
<td>299?</td>
</tr>
</tbody>
</table>

Note: KMS/C4 has 36 taxa and not all of the taxa can be found in each unit. Unit I consisted of 20 taxa (55.56%), Unit II 26 taxa (72.22%), etc.

There are four classes of vertebrates (Mammalia, Reptilia, Pisces and Aves). Amongst them, mammals overwhelmingly dominate the number of individuals (87%), followed in importance by reptiles (12%), fish (0.7%) and birds (0.3%) (Table 6.9).

Table 6.9 Identified vertebrate classes from KMS/C4

<table>
<thead>
<tr>
<th>CLASS</th>
<th>WEIGHT GRAM</th>
<th>NISP %</th>
<th>NISP %</th>
<th>MNI</th>
<th>MNI %</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalia</td>
<td>3622.6</td>
<td>63.66</td>
<td>4607</td>
<td>76.3</td>
<td>261</td>
<td>87.29</td>
</tr>
<tr>
<td>Reptilia</td>
<td>2065.1</td>
<td>36.3</td>
<td>1426</td>
<td>23.6</td>
<td>35?</td>
<td>11.71</td>
</tr>
<tr>
<td>Pisces</td>
<td>1.1</td>
<td>0.02</td>
<td>6</td>
<td>0.09</td>
<td>2</td>
<td>0.67</td>
</tr>
<tr>
<td>Aves</td>
<td>1.4</td>
<td>0.02</td>
<td>1</td>
<td>0.01</td>
<td>1</td>
<td>0.33</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5690.2</td>
<td>100</td>
<td>6040</td>
<td>100</td>
<td>299?</td>
<td>100</td>
</tr>
</tbody>
</table>

The mammals consists of seven orders and 15 families, with most of the specimens only identifiable to family level (Table 6.10 and Appendix 6.2 and 6.3) and sometimes only to order. From all of the vertebrates, only 11 species can be identified represented by 23 individuals.

The other 276 individuals could not be identified to species level. It should be noted that five individuals of the identified species were actually identified as uncertain (Macaca fascicularis?, Trachypithecus cristatus?, Nasalis larvatus?, Pongo pygmaeus?, and Cervus unicolor?).

The reptiles consists of two orders and six families and none can be identified to genus or species level. Fish and birds could not be identified to any lower levels. For detailed description of the vertebrates from the Upper Birang sites see Appendix 6.1.

The distribution of the vertebrate remains in KMS/C4, in terms of number of individuals as well as taxa, varies between units (Table 6.8 and Appendix 6.2). In the lowest unit, four individuals of Microchiroptera (bats) from 142 specimens were found. Most of the specimens were burnt and fragile and crumbled into pieces when excavated, but it seems that bats dominated in this unit. Most other taxa were absent, and those that did occur (9 taxa) were only found in small numbers compared to the upper units (Appendix 6.2). A least 13 identified individuals from nine taxa were found in this unit.
<table>
<thead>
<tr>
<th>CLASS</th>
<th>ORDER</th>
<th>FAMILY</th>
<th>GENUS</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalia</td>
<td>Primate</td>
<td>Cercopithecidae</td>
<td>Macaca sp.</td>
<td>Cynocephalus variegatus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>Macaca sp.</td>
<td>Macaca fascicularis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>Macaca sp.</td>
<td>Macaca fascicularis?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>Presbytis sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>Presbytis sp.</td>
<td>Trachypithecus cristatus?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>Proboscis Monkeys</td>
<td>Nasalis larvatus?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hylombatidae</td>
<td></td>
<td>Hyllobates Muelleri</td>
</tr>
<tr>
<td></td>
<td>Rodentia</td>
<td>Sciuridae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hystricidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muridae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carnivora</td>
<td>Ursidae</td>
<td></td>
<td>Helarctos malayanus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mustelidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viverridae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viveridae</td>
<td></td>
<td>Vivera tangalunga</td>
</tr>
<tr>
<td></td>
<td>Perissodactyla</td>
<td>Tapiridae</td>
<td></td>
<td>Tapirus indicus</td>
</tr>
<tr>
<td></td>
<td>Artiodactyla</td>
<td>Suidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td>Muntiacus Muntiac</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td>Cervus unicolor?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bovidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reptilia</td>
<td>Squamata</td>
<td>Python</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colubridae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Varanidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agamidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testudines</td>
<td>Testudinidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trionychidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pisces</td>
<td>Aves</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Unit IV, the composition of vertebrate taxa was not much different from Unit V, with Bovidae, Sciuridae, carnivores, and python added to the assemblage. But *Pongo pygmaeus* disappeared and only one specimen of Microchiroptera was present. The total number of individuals from this unit is 117.

It has to be noted that the excavated area of Units IV and V was only half of that of the upper Units. However, even if the number of individuals is multiplied by two, the results were still much lower than those for Units I, II and III.

In Unit III, many new taxa first appeared in the archaeological deposit and the MNIs of Microchiroptera increased dramatically to 30 individuals. This unit contained at least 94 individuals from 31 of the total of 36 taxa recorded in KMS/C4. Only Mustelidae, *Trachypithecus cristatus?*, *Nasalis larvatus?*, fish and birds were absent. In this unit, most taxa existed in more abundant numbers compared to other units. They were not only abundant in terms of MNI, but also in numbers of anatomical elements.

In Unit II some taxa became reduced in numbers or disappeared completely from the archaeological deposit, and three new taxa (Mustelidae, fish and birds) appeared. However, Microchiroptera increased dramatically in number to 88.
individuals. The large number of Microchiroptera has contributed to the larger number of vertebrate individuals (116?) in this unit, compared to the 94? individuals in Unit III, although they came from fewer taxa (26 taxa).

Weight also reflects the presence of smaller taxa in Unit II, which contained 664.3 g of identified vertebrates, compared to 4535.6 g in Unit III. The lighter weight of vertebrate remains in Unit II reflects the reduction in big and heavy animals such as Cervidae, Suidae, Primates and Testudinidae. For some taxa, the reductions were quite significant. For example, primates consist of 19 individuals in Unit III, but reduced to five individuals in Unit II. Testudinidae were reduced from eight to one. For some taxa, the reduction in individual numbers was not very great, but the reduction in weight was quite significant. For example, Suidae consisted of three individuals with a weight of 1412.6 g. in Unit III, but were reduced to one individual with a weight of 91.4 g in Unit II. Cervidae consisted of two individuals (363.4 g) in Unit III and one (only 28.4 g) in Unit II. Bovidae consisted of two individuals (284.5 g) in Unit III and one (only 28.4 g) in Unit II.

The increase in bat remains in Unit II compared to Unit III contrasts with other taxa, which tend to become reduced, not only in number of individuals but also in number of anatomical elements.

Unit I did not have as many vertebrates as Units II and III, producing 65? individuals from 20 taxa. Most of them were Microchiroptera (46 individuals), and all other taxa have only one individual each.

Burnt specimens were present in the assemblage. As mentioned earlier, the counting of burnt bones excluded Microchiroptera and Testudinidae, since most of these were left in Indonesia. However, it can be seen that the counted burnt specimens were overwhelmingly dominant in Unit III, the other units have fewer specimens.

6.3.4 Vertebrate Remains from KMS/C8

KMS/C8 contained 3607.98 g of vertebrate remains and, as in KMS/C4, they were dominated by non-identifiable specimens (55%) (Table 6.11).

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NON-IDENTIFIABLE SPECIMENS</th>
<th>IDENTIFIABLE SPECIMENS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WEIGHT</td>
<td>%</td>
<td>WEIGHT</td>
</tr>
<tr>
<td>UNIT I</td>
<td>51.9</td>
<td>1.5</td>
<td>58.4</td>
</tr>
<tr>
<td>UNIT II</td>
<td>1947.1</td>
<td>53.9</td>
<td>1550.58</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1999</td>
<td>55.4</td>
<td>1608.98</td>
</tr>
</tbody>
</table>
There are 1608.98 g of identifiable specimens from 1763 specimens. Sixty five of them being burnt. These belonged to 129? individuals from 37 taxa (Table 6.12).

Table 6.12 Identifiable vertebrate specimens from KMS/C8.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>WEIGHT</th>
<th>%</th>
<th>NISP</th>
<th>%</th>
<th>MIN</th>
<th>%</th>
<th>TAXA</th>
<th>%</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT I</td>
<td>58.4</td>
<td>3.6</td>
<td>377</td>
<td>21.4</td>
<td>22</td>
<td>17.05</td>
<td>14</td>
<td>37.8</td>
<td>0</td>
</tr>
<tr>
<td>UNIT II</td>
<td>1550.58</td>
<td>96.4</td>
<td>1386</td>
<td>78.6</td>
<td>1077</td>
<td>82.95</td>
<td>36</td>
<td>97.3</td>
<td>65</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1608.98</td>
<td>100</td>
<td>1763</td>
<td>100</td>
<td>1297</td>
<td>100</td>
<td>37</td>
<td>100</td>
<td>65</td>
</tr>
</tbody>
</table>

Note: KMS/C8 has 37 taxa and not all of the taxa found in Unit I and Unit II. Only 14 of them were found in Unit I (37.8%), while Unit II consisted almost all of the taxa (36 taxa/97%).

The vertebrate remains from KMS/C8 were very similar to those found in KMS/C4. The identifiable specimens were dominated by mammals (86%) followed by reptiles (12%), fish (2%) and birds (1%) (Table 6.13).

Table 6.13 Identified vertebrate classes from KMS/C8.

<table>
<thead>
<tr>
<th>TAXON</th>
<th>WEIGHT</th>
<th>%</th>
<th>NISP</th>
<th>%</th>
<th>MIN</th>
<th>%</th>
<th>TAXA</th>
<th>%</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMMALIA</td>
<td>982.28</td>
<td>61.05</td>
<td>1348</td>
<td>76.46</td>
<td>1117</td>
<td>11%</td>
<td>86.05</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>REPTILIA</td>
<td>619.8</td>
<td>38.52</td>
<td>408</td>
<td>23.14</td>
<td>159</td>
<td>15%</td>
<td>11.63</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>PISCES</td>
<td>1.1</td>
<td>0.07</td>
<td>2</td>
<td>0.11</td>
<td>2</td>
<td>2%</td>
<td>1.55</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>AVES</td>
<td>5.8</td>
<td>0.36</td>
<td>5</td>
<td>0.29</td>
<td>1</td>
<td>1%</td>
<td>0.77</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>1608.98</td>
<td>100</td>
<td>1763</td>
<td>100</td>
<td>1297</td>
<td>100</td>
<td>37</td>
<td>100</td>
<td>65</td>
</tr>
</tbody>
</table>

As in KMS/C4 the mammals consist of seven orders with 18 families, but most of the specimens can only be identified to family level (Table 6.14 and Appendices 6.4 and 6.5).

Only seven species, represented by ten individuals, could be identified, the rest being identified to a more general level. Among the ten identified individuals, one was uncertain (Macaca fascicularis?). The reptiles consist of two orders with seven families.

KMS/C8 consisted of two units. The lower (Unit II) contained more vertebrate taxa than the upper (Appendix 6.4). Unit II comprised 107 individuals from all of the 37 taxa identified in this pit, whereas Unit I above had only 22 individuals from 14 taxa. The large number of individuals in Unit II was dominated by the Microchiroptera, which contained of 56 individuals. In Unit I Microchiroptera reduced dramatically, with only six individuals.

In Unit I there were no burnt specimens, compared to Unit II which produced at least 65.

Although KMS/C8 was not as deep as KMS/C4, the vertebrate remains showed similar characteristics. Units I and II of KMS/C8 correspond to Units I and II of KMS/C4. Both squares showed that the lower units have more specimen as well as taxa than the upper units.
Table 6.14 Vertebrate identifications from KMS/C8.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>ORDER</th>
<th>FAMILY</th>
<th>SUBFAMILY</th>
<th>GENUS</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indeterminate mammalia</td>
<td>Dermoptera</td>
<td>Cynocephalidae</td>
<td></td>
<td></td>
<td>Cynocephalus variegatus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>indet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Primate</td>
<td>Cercopithecidae</td>
<td></td>
<td>Macaca sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td>indet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td>Macaca fascicularis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td>Macaca fascicularis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td></td>
<td>Presbytis sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td></td>
<td>Presbytis sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pongidae</td>
<td></td>
<td></td>
<td>T. pygmaeus</td>
</tr>
<tr>
<td></td>
<td>Chiroptra</td>
<td>Megachiroptra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Microchiroptra</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mammalia</td>
<td>Rodentia</td>
<td>Sciuridae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hystricidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muridae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carnivora</td>
<td>Ursidae</td>
<td></td>
<td></td>
<td>H. malayanus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mustelidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mustelidae (otter?)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Viverridae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perissodactyla</td>
<td>Rhinoceritidae</td>
<td></td>
<td></td>
<td>Tapirus indicus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suidae</td>
<td></td>
<td></td>
<td>Sus barbatus</td>
</tr>
<tr>
<td></td>
<td>Artiodactyla</td>
<td>Tragulidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bovidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reptilia</td>
<td>Squamata</td>
<td>Ophida</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Python</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colubridae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Varanidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agamidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testudines</td>
<td>Testudinidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trionychidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aves</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.5 Vertebrate Remains from LPY/C3

A large proportion of the LPY/C3 vertebrate remains (82%) could not be identified because they were too fragmented (Table 6.15).

Table 6.15 Non-identifiable and identifiable vertebrate specimens from LPY/C3.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NON-IDENTIFIABLE SPECIMEN</th>
<th>IDENTIFIABLE SPECIMEN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WEIGHT</td>
<td>%</td>
<td>NISP</td>
</tr>
<tr>
<td>I</td>
<td>400.2</td>
<td>28.12</td>
<td>95.7</td>
</tr>
<tr>
<td>II</td>
<td>679.4</td>
<td>47.73</td>
<td>137.6</td>
</tr>
<tr>
<td>III</td>
<td>94.3</td>
<td>6.62</td>
<td>16.3</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1173.9</td>
<td>82.47</td>
<td>249.6</td>
</tr>
</tbody>
</table>

The 249.6 g that can be identified consist of 315 specimens from 34 individuals in 21 taxa (Table 6.16).

Table 6.16 The Identifiable vertebrate specimens from LPY/C3.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>WEIGHT</th>
<th>%</th>
<th>NISP</th>
<th>%</th>
<th>MNI</th>
<th>%</th>
<th>TAXA</th>
<th>%</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>95.7</td>
<td>38.34</td>
<td>200</td>
<td>63.49</td>
<td>157</td>
<td>44.12</td>
<td>13</td>
<td>61.9</td>
<td>?</td>
</tr>
<tr>
<td>II</td>
<td>137.6</td>
<td>55.13</td>
<td>99</td>
<td>31.43</td>
<td>167</td>
<td>47.06</td>
<td>15</td>
<td>71.43</td>
<td>?</td>
</tr>
<tr>
<td>III</td>
<td>16.3</td>
<td>6.53</td>
<td>16</td>
<td>5.08</td>
<td>37</td>
<td>8.82</td>
<td>3</td>
<td>14.29</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>249.6</td>
<td>100</td>
<td>315</td>
<td>100</td>
<td>347</td>
<td>100</td>
<td>21</td>
<td>100</td>
<td>4</td>
</tr>
</tbody>
</table>
The vertebrate remains are dominated by mammals (79%), followed by reptiles (17%) and birds (3%) (Table 6.17).

<table>
<thead>
<tr>
<th>CLASS</th>
<th>TOTAL</th>
<th>WEIGHT</th>
<th>%</th>
<th>NISP</th>
<th>%</th>
<th>MIN</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMMALIA</td>
<td></td>
<td>148.3</td>
<td>59.42</td>
<td>257</td>
<td>81.58</td>
<td>277</td>
<td>79.41</td>
</tr>
<tr>
<td>REPTILIA</td>
<td></td>
<td>98.5</td>
<td>39.46</td>
<td>57</td>
<td>18.1</td>
<td>67</td>
<td>17.65</td>
</tr>
<tr>
<td>AVES</td>
<td></td>
<td>2.8</td>
<td>1.12</td>
<td>1</td>
<td>0.32</td>
<td>1</td>
<td>2.94</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>249.6</td>
<td>100</td>
<td>315</td>
<td>100</td>
<td>347</td>
<td>100</td>
</tr>
</tbody>
</table>

Mammals consist of six orders with 13 families, but most specimens can only be identified to family level (Table 6.18, Appendix 6.6. and 6.7). As in Kimanis, not many specimens can be identified to species level. There were only five identified species, with five individuals. Two belonged to uncertain species (*Trachypithecus cristatus*? and *Arcticis binturong*?). The rest were identified to a more general level.

The distribution of the vertebrate remains, in terms of numbers of individuals as well as taxa, varies between units (Appendix 6.6). Unit III only contained three taxa: Microchiroptera, Suidae and Testudinidae, representing 37 individuals (Appendix 6.6 and 6.7). In Unit II there was a substantial increase of NISP (from 16 in Unit III to 99 in Unit II) and number of individuals (16?), although all 15 taxa represented had only one individual, apart from Microchiroptera that had two.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>ORDER</th>
<th>FAMILY</th>
<th>SUBFAMILY</th>
<th>GENUS</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalia</td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td>Presbytis sp.</td>
<td><em>Trachypithecus cristatus</em>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cercopithecidae</td>
<td></td>
<td></td>
<td><em>Hylobates muelleri</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hylobatidae</td>
<td></td>
<td></td>
<td><em>Pongo pygmaeus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pongidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chiroptera</td>
<td>Microchiropera</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rodentia</td>
<td>Muridae</td>
<td></td>
<td></td>
<td><em>Helarctos malayanus</em></td>
</tr>
<tr>
<td></td>
<td>Carnivora</td>
<td>Ursidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mustelidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perissodactyla</td>
<td>Viverridae</td>
<td></td>
<td></td>
<td><em>Arcticis binturong</em>?</td>
</tr>
<tr>
<td></td>
<td>Antiodactyla</td>
<td>Suidae</td>
<td></td>
<td></td>
<td><em>Sus barbatus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tragulidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reptilia</td>
<td>Squamata</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Python</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Testudinidae</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unit I produced slightly fewer individuals (15?) and taxa (13) than Unit II. Some taxa found in Unit II were not present in Unit I, but other taxa made their first appearance, including Muridae, Ursidae, Mustelidae, Tragulidae, Varanidae and Aves.
Although the number of individuals as well as taxa decreased in Unit I compared to Unit II, the NISP doubled due to the large number of Microchiroptera specimens (156 compared to 45 in Unit II).

Out of 315 bones in LPY/C3, only one was burnt. Charcoal was quite rare and confined to the upper layers (spits 1 to 11, which belonged to Unit I, and the upper part of Unit II). However, the burnt specimen came from Unit III, where almost no charcoal particles were present.

6.3.6 Vertebrate Remains from LPY/D5

LPY/D5 had only analytical unit and, as in Kimanis and LPY/C3, the vertebrate remains were dominated by non-identifiable specimens (62%) (Table 6.19). The identified ones consisted of 208 specimens from 18 taxa, representing at least 19 individuals (Table 6.20 and Appendix 6.8). No specimens from LPY/D5 were burnt.

Table 6.19 The non-identifiable and identifiable vertebrate specimens from LPY/D5.

<table>
<thead>
<tr>
<th>NON-IDENTIFIABLE FRAGMENT</th>
<th>IDENTIFIABLE SPECIMEN</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEIGHT (%)</td>
<td>WEIGHT (%)</td>
<td>WEIGHT (%)</td>
</tr>
<tr>
<td>433.5 62.41</td>
<td>261.1 37.59</td>
<td>694.6 100</td>
</tr>
</tbody>
</table>

Most of the vertebrates were mammals (74%) followed by reptiles (16%), fish (5%) and amphibians (5%).

Table 6.20 Identified vertebrate classes from LPY/D5

<table>
<thead>
<tr>
<th>CLASS</th>
<th>WEIGHT</th>
<th>%</th>
<th>NISP</th>
<th>%</th>
<th>MNI</th>
<th>%</th>
<th>TAXA</th>
<th>%</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMMALIA</td>
<td>186.1</td>
<td>71.28</td>
<td>131</td>
<td>62.98</td>
<td>14</td>
<td>73.69</td>
<td>13</td>
<td>72.22</td>
<td>0</td>
</tr>
<tr>
<td>REPTILIA</td>
<td>74.3</td>
<td>28.46</td>
<td>74</td>
<td>35.58</td>
<td>3?</td>
<td>15.79</td>
<td>3</td>
<td>16.66</td>
<td>0</td>
</tr>
<tr>
<td>AMPHIBIA</td>
<td>0.3</td>
<td>0.11</td>
<td>2</td>
<td>0.96</td>
<td>17</td>
<td>5.26</td>
<td>1</td>
<td>5.56</td>
<td>0</td>
</tr>
<tr>
<td>PISCES</td>
<td>0.4</td>
<td>0.15</td>
<td>1</td>
<td>0.48</td>
<td>1</td>
<td>5.26</td>
<td>1</td>
<td>5.56</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>261.1</td>
<td>100</td>
<td>208</td>
<td>100</td>
<td>19?</td>
<td>100</td>
<td>18</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

The specimens that can be identified to the species level consisted of one individual each of Helarctos malayanus and Tapirus indicus. Reptiles are represented by two orders from three families. None of the specimens can be identified to species level. LPY/D5 is the only excavation pit that with frog bones (Rana) in the Upper Birang Sites, in this case with two long bones.

Most taxa only consisted of less than ten specimens, except for Microchiroptera (73), Suidae (18) and Testudinidae (69) (Appendices 6.8 and 6.9). Most of the other taxa from LPY/D5 was represented by only one individual, except for Chiroptera which had two.
Table 6.21 Vertebrate identifications from LPY/D5

<table>
<thead>
<tr>
<th>CLASS</th>
<th>ORDER</th>
<th>FAMILY</th>
<th>GENUS</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDETERMINATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAMMALIA</td>
<td>Primate</td>
<td>Ceropithecidae</td>
<td>Ceropithecidae</td>
<td>Macaca sp.</td>
</tr>
<tr>
<td></td>
<td>Chiroptera</td>
<td>Microchiroptera</td>
<td>Ceropithecidae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rodentia</td>
<td>Sciuridae</td>
<td>Hystricidae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indeterminate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carnivora</td>
<td>Ursidae</td>
<td></td>
<td>Helarctos malayanus</td>
</tr>
<tr>
<td></td>
<td>Perissodactyla</td>
<td>Suidae</td>
<td></td>
<td>Tapirus indicus</td>
</tr>
<tr>
<td></td>
<td>Artiodactyla</td>
<td>Cervidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REPTILIA</td>
<td>Squamata</td>
<td>Python</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMPHIBIA</td>
<td>Rana</td>
<td>Varanidae</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PISCES</td>
<td></td>
<td>Testudinidae</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.7 Vertebrate Remains from LGB/TP

LGB/TP has a shallow deposit and produced fewer bones than other excavation squares. However, its location in a rather secluded rock shelter made it the only excavation pit that produced vertebrate remains on its surface.

The excavation produced 160.6 g of bone. Unlike other sites, where non-identifiable specimens dominated the vertebrate assemblage, in LGB/TP more than half of the vertebrate specimens (60%) were identifiable (Table 6.22). The more complete specimens found in this rock shelter may reflect the nature of the site.

Table 6.22 The non-identifiable and identifiable vertebrate specimens from LGB/TP.

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NON-IDENTIFIABLE SPECIMENS</th>
<th>IDENTIFIABLE SPECIMENS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WEIGHT</td>
<td>%</td>
<td>WEIGHT</td>
</tr>
<tr>
<td>SURFACE</td>
<td>4</td>
<td>2.5</td>
<td>38.8</td>
</tr>
<tr>
<td>UNIT I</td>
<td>60.7</td>
<td>37.9</td>
<td>56.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>64.7</td>
<td>40.4</td>
<td>95.5</td>
</tr>
</tbody>
</table>

The 95.9 g of bone consist of 52 specimens from 14? individuals belonging to 12 taxa. There are only two classes of vertebrates in LGB/TP, mammals and reptiles (Appendices 6.8 and 6.9). As in other sites, the specimens were dominated by mammals (86%) (Table 6.23). None were burnt. Only two species could be identified, Helarctos malayanus and Sus barbatus.

All of the taxa found in Unit I consisted of one individual and each taxon only represented by small number of specimens (NISP).
Table 6.23 Identified vertebrate classes from LGB/TP

<table>
<thead>
<tr>
<th>UNIT</th>
<th>CLASS</th>
<th>NISP</th>
<th>%</th>
<th>WEIGHT</th>
<th>%</th>
<th>MNI</th>
<th>%</th>
<th>BURNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE</td>
<td>MAMMALIA</td>
<td>5</td>
<td>10</td>
<td>38.8</td>
<td>41</td>
<td>3</td>
<td>21.43</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>REPTILIA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td></td>
<td>5</td>
<td>10</td>
<td>38.8</td>
<td>41</td>
<td>3</td>
<td>21.43</td>
<td>0</td>
</tr>
<tr>
<td>UNIT I</td>
<td>MAMMALIA</td>
<td>37</td>
<td>71</td>
<td>48</td>
<td>50</td>
<td>9</td>
<td>64.29</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>REPTILIA</td>
<td>10</td>
<td>19</td>
<td>8.7</td>
<td>9</td>
<td>2</td>
<td>14.28</td>
<td>0</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td></td>
<td>47</td>
<td>90</td>
<td>56.7</td>
<td>59</td>
<td>11</td>
<td>78.57</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>MAMMALIA</td>
<td>42</td>
<td>81</td>
<td>56.6</td>
<td>91</td>
<td>12</td>
<td>85.71</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>REPTILIA</td>
<td>10</td>
<td>19</td>
<td>8.7</td>
<td>9</td>
<td>2</td>
<td>14.28</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>52</td>
<td>100</td>
<td>95.5</td>
<td>100</td>
<td>14</td>
<td>100</td>
<td>0</td>
</tr>
</tbody>
</table>

On the surface there were bones of three taxa (*Helarctos malayanus*, Suidae and *Sus barbatus*), each representing one individual. It is likely that the Suidae and *Sus barbatus* could be the same animal.

Table 6.24 Vertebrate identifications from LGB/TP

<table>
<thead>
<tr>
<th>CLASS</th>
<th>ORDER</th>
<th>FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAMMALIA</td>
<td>Primate</td>
<td>Cercopithecidae</td>
<td>Cercopithecidae</td>
</tr>
<tr>
<td></td>
<td>Chiropetera</td>
<td>Microchiroptera</td>
<td>Microchiroptera</td>
</tr>
<tr>
<td></td>
<td>Rodentia</td>
<td>Indeterminate</td>
<td>Indeterminate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rodentia</td>
<td>Rodentia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Muridae</td>
<td>Muridae</td>
</tr>
<tr>
<td></td>
<td>Carnivora</td>
<td>Indeterminate</td>
<td>Indeterminate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carnivora</td>
<td>Carnivora</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ursidae</td>
<td>Ursidae</td>
</tr>
<tr>
<td></td>
<td>Artiodactyla</td>
<td>Suidae</td>
<td><em>Sus barbatus</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cervidae</td>
<td>Cervidae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bovidae</td>
<td>Bovidae</td>
</tr>
<tr>
<td>REPTILIA</td>
<td>Squamata</td>
<td>Python</td>
<td>Python</td>
</tr>
<tr>
<td></td>
<td>Testudines</td>
<td>Testudinidae</td>
<td>Testudinidae</td>
</tr>
<tr>
<td>AMPHIBIA</td>
<td>Rana</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3.8 Vertebrates Roles in the Occupation of the Sites

An important question to be answered is, which of these animals were consumed by the prehistoric inhabitants and which died naturally in the sites or were dragged in by carnivores? Some assumptions can be put forward.

The large numbers of specimens and individuals of certain species may be used as an indication that they were consumed by the prehistoric human inhabitants. This observation will be strengthened if the animal is eaten by the local inhabitants today, and if the site is not a natural habitat for that taxon. However, carnivores can also carry animals into caves, although since there are no very large carnivores in Borneo, it is likely that bones of large mammals such as cattle, deer, pig and bear result from human behaviour. Bones of smaller animals, such as mouse deer, squirrels and rodents and birds, could also result from carnivore activity.
6.3.8.1 Very Small Animals (0.1 – 1 kg)
6.3.8.1.1 Flying Lemur (Cynocephalus)

There is only one species of Cynocephalus in Borneo, Cynocephalus variegatus. These are very rare in the Upper Birang assemblages and only found in Kimanis, represented there by two individuals.

6.3.8.1.2 Bats (Chiroptera)

Chiroptera include Megachiroptera (fruit bats/flying foxes) and Microchiroptera (bats). These two taxa produced completely different numbers of individuals. The fruit bats/flying foxes occurred only in Kimanis and are represented by only four individuals. But Microchiroptera, that nest within the caves, comprised the most abundant taxon in the Upper Birang sites, totalling 241 individuals. Most (231 individuals) were found in Kimanis. It seems clear that these bats were consumed by the inhabitants of Kimanis, since they were found in large numbers within quite a small area, situated away from their normal flying path. On the other hand, the bat bones in Lubang Payau more likely resulted from natural death since they are in an area commonly invaded by bats. In Liang Gobel, a small and dry rock shelter, only one long bone fragment of bat was found.

6.3.8.1.3 Rodentia, Sciuridae and Muridae

Rodentia, Sciuridae and Muridae consisted of many species of different sizes. Some may have been eaten by humans, and some may have died naturally or been eaten by carnivores. Since they were represented by quite large numbers of individuals in Kimanis they might have been consumed there.

6.3.8.1.4 Birds

Bird bones were very rare, with only three individuals from three excavation pits. It is hard to know whether they were consumed by humans or other predators, including birds of prey. Today the locals occasionally hunt birds, including the forest pheasant and smaller species.

6.3.8.1.5 Frogs

Frogs may have been eaten by human. However, they were very rare and naturally they can be found around the sites. In fact, one frog was found in the one of
the excavation pits in Kimanis one morning. Therefore, their presence in the sites was more likely natural.

6.3.8.1.6 Fish

Fish are abundant in the Birang River today, but only occur in small numbers in the archaeological deposits. The nine specimens from five individuals were recovered from depths less than 1 meter, which might indicate their fragility.

6.3.8.2 Small Animals (>1 – 10 kg)

6.3.8.2.1 Primates

Only one species of primate does not belong to this class, this being the Orang Utan. The Cercopithecidae include *Macaca* sp. and *Presbytis* sp. Very few bones can be identified to species, which include *M. fascicularis*, *T. cristatus* and *N. larvatus* and *H. muelleri*.

These primates are eaten today, as they were in the prehistoric Niah Caves (Medway 1959c). Most probably, whole animals were brought into the sites since these are small animals. The presence of many different Cercopithecidae anatomical elements in Kimanis indicates that complete individuals were present in the site.

The rarity of primates that can be identified to species may be due not only to the rarity of diagnostic specimens, but probably to other reasons. For example, *T. cristatus* is only represented by one individual from KMS/C8 and two (of *T. cristatus?*) from KMS/C4 and LPY/C3. The rarity of this species in the Upper Birang area was probably due to the unfavourable habitat, since *T. cristatus* prefers to live in the coastal forests (see Appendix 6.1).

In Niah, *T. cristatus* was well represented but only confined to a depth of less than 150 cm (Hooijer 1962:437). Terry Harrison (2000:141) suggested that this might indicate a change in hunting strategies or diet preferences. *T. cristatus* was absent from the layers that belonged to the Last Glacial Maximum, when Niah was located about 200 km inland, in contrast with today when it lies only 17 km from the coast. This monkey prefers to live in the riverine forests, peat swamps and mangrove, therefore it mainly found in the coastal plain (Harrison 2000:141). Harrison concluded that “during the Last Glacial Maximum, the human inhabitants of Niah were beyond the immediate range of *Trachypithecus*, but as sea levels rose again at the end of the Pleistocene it became increasingly possible for hunters to obtain this species in close proximity to Niah.” (Harrison 2000:141).
T. cristatus specimens from the Upper Birang sites were also confined to the upper units, which also belonged to the Holocene period. During the Last Glacial Maximum, the Upper Birang area was more than 100 km from the coast. Today it is still far from the coast, about 50 km. However, T. cristatus can also live in riverine forest rather far from the coast, during the Holocene period they were more likely to be found in the Upper Birang area, although not in large numbers. During the Pleistocene the habitat around this area was probably less favourable for this species. This is purely hypothetical, but worth consideration.

N. larvatus is only represented by one possible individual from Unit I of KMS/C4. The scarcity of this species in the Upper Birang sites was quite surprising, since N. larvatus could provide essential meat and today they are easily spotted in the Birang River area. They are the most common monkeys found along the Birang River today.

H. muelleri is also commonly found in the upper Birang area today. Their prominent noises around the base camp early in the morning mark the beginning of the day. However, H. muelleri remains were very rare, represented only by two individuals from KMS/C4 and one from LPY/C3. The reason for their rare appearance in the archaeological assemblages is unknown.

Primates, excluding P. pygmaeus, comprised the second most numerous order after Chiroptera to be found in the Upper Birang sites, being represented by 58 individuals. These small animals seem to have been one of the favourites hunted, perhaps because they were abundant and easy to spot and hunt.

6.3.8.2.2 Porcupines (Hystricidae)

Porcupines were only found in Kimanis (5 individuals) and Lubang Payau (one individual). Today, porcupines occasionally hunted by the inhabitants and they were once quite common in the area.

6.3.8.2.3 Carnivores

Of three the families of carnivores, Ursidae, Mustelidae and Viverridae, that occur in the Upper Birang sites, only the Ursidae arc in the Medium Large weight class. The Mustelidae (martens, weasels, badgers and otters) comprised six individuals, including one possible Lutrinae (otter), while Viverridae (civet and mongoose) consisted of eight individuals, including two V. tangalunga (Malay civet) and one possible A. binturong (binturong). Most of the Mustelidae and Viverridae were found in
Kimanis (5 and 6 individuals respectively), and none in Liang Gobel. In Kimanis, Mustelidae and Viverridae were distributed mainly in the three upper units. Mustelidae and Viverridae may have been eaten by humans, but probably were not regarded as important in the diet.

6.3.8.2.4 Tragulidae (Mouse-Deer)

Mouse-deer were very rare (two individuals) and only provided small amounts of meat. They were occasionally hunted by the present inhabitants. According to the bird-nester who today exploited Kimanis Cave, mouse-deer are quite easy to spot, since they usually pass along the same route looking for food. The reason for the rarity of this species in the Upper Birang sites is unknown.

6.3.8.2.5 Snakes (Python and Colubrid snakes)

Snake specimens mainly consist of vertebrae, and comprised the second largest number of reptiles (NISP: 303 specimens) after Testudinidae. Most were found in Kimanis (238 specimens). Unfortunately, the MNI could not be counted for either Kimanis or LPY/C3. Unit III in KMS/C4 produced 189 vertebrae, which might seem a lot but probably represented only several individuals. At least two different kinds of snake were present, pythons being non-poisonous and Colubridae poisonous.

Today, snakes can be found around the rock shelters, especially in Kimanis. They were spotted high on the ceiling in front of the cave entrance, and two of them visited the site during the excavation. Snakes could have been brought in by humans, or might just have died naturally there. More likely, most of them were eaten, since today snakes also consumed by the locals.

6.3.8.2.6 Monitor Lizard (Varanidae)

There are two lizard families found in the Upper Birang Sites, Monitor lizard and Dragon lizard (Agamidae). The Monitor lizards are represented by 12 individuals: Kimanis (10), Lubang Payau (2), and none from Liang Gobel. Since monitor lizards comprise several species, the identification of the specimens to only the family level makes it difficult to estimate whether or not only certain species were present. Several monitor lizard species live in the region today, and the common water monitor (*Varanus salvator*) can occasionally be spotted by the Birang River. Today, they are hunted by the locals.
6.3.8.2.7 Dragon Lizards (Agamidae)

Agamidae were rarely found in the Upper Birang sites. Only four individuals were recorded and all of them came from Kimanis. It is not known whether they were eaten.

6.3.8.2.8 Turtles

Turtles were present in all sites, with 17 Testudinidae (land turtle) and one Tryonichidae (soft-shelled turtle). Most came from Kimanis (KMS/C4 had 12 Testudinidae and 1 Tryonichidae, KMS/C8 had 4 Testudinidae). They are mostly represented by durable fragments of carapace and plastron, which survived well in the archaeological deposit. The total NISP was 1410, the second largest after Microchiroptera.

In Borneo, turtles commonly occur in archaeological deposits, as in the Niah Caves (Medway 1959c:151), Sarang Caves (T. Harrisson & Reavis 1966:261) and Gua Sireh (Datun 1993:113) in Sarawak; and the Madai and Baturong Caves in Sabah (Cranbrook 1988b). Today, turtles, including the soft-shelled turtles that live in the water, are commonly eaten.

6.3.8.3 Medium Animals (>10 – 35 kg)

6.3.8.3.1 Cervidae

Unlike Bovidae, Cervidae (deer) inhabit various kinds of forest, in hilly to mountainous regions and more open areas. Probably this is why they were more abundant than Bovidae. Bovidae prefers to live in open areas since it is more a grazer than browser; if it inhabited dense forest it was only found in a secondary growth (Lekagul & McNeely 1977:705). Eleven individuals of Cervidae were present in all the sites, but only one could be identified to species level, Muntiacus muntjak.

Today, M. muntjac is still hunted and regarded as an important source of meat. But the archaeological deer bones include fewer anatomical specimens than pig bones, even though the number of deer individuals is quite significant compared to other medium sized mammals.

6.3.8.4 Medium Large Animals (>35 – 200 kg)

6.3.8.4.1 Pongo pygmaeus (Orang Utan)

P. pygmaeus remains were very few, with only one individual each in KMS/C8 and LPY/C3, and three individuals in KMS/C4. The continuing presence of a current P.
 population in the Upper Birang sites is not certain. The Basap in this area mention that they occasionally kill *P. pygmaeus*, but not everybody wants to hunt the animal because of its close similarity with humans. However, Basap attitudes toward this animal cannot simply be extrapolated back in time to explain the small number of orang utans in the sites.

6.3.8.4.2 *Helarctos malayanus* (Sun Bear)

The sun bear is the only carnivore found in the Upper Birang Sites that belongs to the Medium Large weight class. There were 12 individuals, most found in Kimanis (KMS/C4: 6 individuals, KMS/C8: 2 individuals). Lubang Payau and Liang Gobel (each two individuals). Sun bears were present in all sites and all units of excavation, except Units II and III in LPY/C3. Considering that in each unit only one individual was present, except in Unit III of KMS/C4 (2 individuals), the presence of the sun bear was probably not very significant, but at least it was consistently available through all occupational periods, especially in Kimanis.

Today, the sun bear is consumed by the locals, but some parts of their bodies, especially the gall bladder, are used for medicinal purposes. The teeth, especially the canine and claws, are also used as ornaments.

6.3.8.4.3 *Tapirus indicus* (Malay tapir)

*Tapirus indicus* (Malay tapir), the only vertebrate species currently extirpated in Borneo, is rare. It apparently became extinct by about 8000 BC at Niah (Appendix 6.1). Medway claimed that they became extinct not because of over-hunting, but more because of an inability to adapt to changing climates and environments after the Pleistocene. As he explained:

Unlike the Sumatran Rhinoceros, the Malayan Tapir does not push over or break down the woody plants on which it feeds and hence cannot by its own activity maintain an environment suitable for itself. During glacial phases, as noted above, climatic factors evidently favored the development of a mosaic of forest and open gaps or glades. Under such conditions, the forest-edge facies must have been extensive and resources for tapirs correspondingly rich. With the advent of a warmer and wetter postglacial climate, the colonization of open spaces by tall evergreen rain-forest must progressively have degraded the quality of the environment for tapirs, which presumably became rarer. Under modern conditions, the food supply of tapirs is rich only where the climax vegetation has been disturbed or destroyed by natural events such as windfall or landslide, or by the activities of other large mammals such as rhinoceros or man (Medway 1977b:65).
If the post-glacial environmental conditions in Niah can be extrapolated to the Upper Birang River area, it should be expected that *T. indicus* was more abundant in the lower layers, during the Pleistocene. However, *T. indicus* remains were very rare, represented by four individuals, all of which came from upper layers, with the lowest being from Unit III of KMS/C4, dated to the end of the Pleistocene. None came from the Pleistocene layers below, even though those found at Niah derived from the Pleistocene layers, dated about 19,000 years BP (Medway 1959b: 140). Based on the finds in Kimais and Lubang Payau it appears that *T. indicus* was present in that region prior to 4000 years ago, but not prior to 11,000 year BP. The absence of *T. indicus* in the Pleistocene layers of the Upper Birang sites was puzzling. Perhaps they were not hunted, or simply not present in the area.

### 6.3.8.4.4 Pigs (Suidae)

In Borneo, *S. barbatus* was the most common mammal found in archaeological sites, as in Niah (Medway 1977a:31; 1977b:60), the Madai Caves (Harrison 1998:88) and Gua Sireh (Datan 1993:113). It is the only pig occurs wild in Borneo, while the domestic Pig is believed to have been bred from the Common Wild Pig, *Sus scrofa*, originated from the mainland Asia (Payne & Francis 1985:295). In the Upper Birang sites, only four individuals can be identified as *Sus barbatus*, while the other specimens can only be identified at family level as Suidae (pigs). Suidae comprises of 16 individuals and represented the most abundant mammals amongst the medium, medium large and large vertebrates. However, unlike other sites in Borneo, where the number of pigs exceeded other species prominently, in the Upper Birang they were not that outstanding. For example, Cervidae have 11, Sun Bear 12 and Bovidae 9 individuals. Yet pig bones were found in all excavation pits and all units. Pigs were also represented by many more anatomical elements than other taxa. This suggests that pigs were brought to the sites as whole carcasses. If hunted, they were probably divided by two down the middle and carried back in separate bags by two people, just like the Basap do today.

Today, pork is the most important protein source for people in many parts of Borneo, including Upper Birang. All Basap camps have *S. barbatus* skulls and mandibles hung from branches of nearby trees. Pfeffer and Caldecott (1986:96) mentioned that a nomadic Punan group of 30 people killed nearly 500 pigs each year). Puri (1999:94) recorded that 707 individuals were killed in Long Peliran, Lurah River, northwest of the Birang area, between February 1991 and November 1992. The large
numbers of wild *S. barbatus* and their predictable behaviour has made this animal the
main target for hunting. (See Appendix 6.1 for more detailed description).

6.3.8.4.5 *Cervus unicolor?*

This big cervid was only represented by one specimen from KMS/C4. Its rarity
of the specimens maybe due to difficulties of identification, and possible confusion with
*M. muntiac*. Both species are commonly found in the region and hunted today.

6.3.8.5 Large Animals (>200 kg)

6.3.8.5.1 *Rhinocerotidae*

Rhinoceroses are another large mammal found in the Upper Birang area that has
now become extirpated locally. They are only represented by a small number of
individuals (for detailed description on Rhinocerotidae see Appendix 6.1). From
Kimanis there is a molar and long bone fragments from KMS/C8 (Unit II). Since no
C14 dates are available from this square, its antiquity can only be judged by comparing
the sequence with C4, which indicates older than 4650 BP. In Lubang Payau, a molar
fragment was found in LPY/C3 (Unit I, spit 13), from a depth older than 4610 ± 110 BP
(ANU-11152) (calibrated age 3360 BC). The small number of Rhinocerotidae in the
assemblages may indicate that only parts of the animals were brought to the sites.

Traditionally, the hunting of this animal was mainly for the excitement of the
long chase and as a source of good food (Rookmaaker 1976:295-6). Rhinoceros hunting
has been described by several authors and summarised by Rookmaaker (1976:296):

The men go into the jungle and follow some fresh rhinoceroses track until they
spot the animal. They then lie in ambush alongside a suitable trail until the
rhinoceros trots along. A spear is thrust into its side or belly, but usually this
does not kill it. A pursuit follows which can last days or weeks. Frequently
spears or poisonous arrows (arrows indeed) are directed to the animal which
slowly weakens and dies.

Rhinoceroses must have been regarded as a symbol of strength and invincibility,
similar to the modern Dayak view. In Niah, eight fragments of rhinoceroses, including
seven lower jaw molars, were regarded as “...not just the remnants of rhinoceroses eaten
in the cave, but were themselves valued objects, deliberately extracted from the jaws of
rhino calves and kept for their own sake.” (Medway 1958b:637). Some of the
rhinoceros teeth from the Niah West Mouth and Gan Kira were associated with human
burials (Medway 1958a:634-5). A rhinoceros radius from the West Mouth was used as a
bone pillow for an early burial (B. Harrisson 1967:164; Medway 1959c:157-8).
6.3.8.5.2 Bovidae

Bovidae, the largest native mammals in the area, were most likely also brought to the site in small pieces. Although bones of Bovidae were found in all excavation squares, they generally comprised few individuals, except for KMS/C4 (54 specimens from 5 individuals) and KMS/C8 (20 specimens from one individual). However, concerning the size of the animal, which can weigh between 400 and 800 kg, bovid bones are very rare. Perhaps the dense forest of the Upper Birang sites was not the most favourable environment for this large mammal, which normally preferred more open grassland.

6.4 The Analysis of Invertebrate Remains from the Upper Birang Sites

Invertebrate remains from the Upper Birang area consist of molluscs and crustaceans. They were first identified by Rokhus Duwe Awe from the Centre for National Archaeological Research in Jakarta. Detailed identification of the molluscs was then conducted by Ian Loch from Department of Malacology Australian Museum.

The molluscs, a group of soft-bodied animals which in most cases have calcium carbonate exoskeletons (commonly called "shells"), dominated the assemblage

<table>
<thead>
<tr>
<th>CLASS</th>
<th>FRESHWATER ENVIRONMENT FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASTROPODA</td>
<td>Thiaridae</td>
<td><em>Brotia</em> sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Balanocochlis</em> sp.</td>
</tr>
<tr>
<td></td>
<td>Paludomidae</td>
<td><em>Paludomus broti</em> (Issel, 1874)</td>
</tr>
<tr>
<td></td>
<td>Unidentified Snail</td>
<td></td>
</tr>
<tr>
<td>PELEGYPODA</td>
<td>Unionidae</td>
<td><em>Pseudodon vandenbuschianus</em> (Lea, 1840)</td>
</tr>
<tr>
<td>CRUSTACEA</td>
<td>Brachyura</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TERRESTRIAL ENVIRONMENT FAMILY SPECIES</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS</th>
<th>MARINE ENVIRONMENT FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>GASTROPODA</td>
<td>Cypriidae</td>
<td><em>Cypraea moneta</em> (Linne 1758)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Cypraea annulus</em> (Linne, 1758)</td>
</tr>
<tr>
<td></td>
<td>Potamididae</td>
<td><em>Boreotrigon eulena</em> (Bonn, 1778)</td>
</tr>
<tr>
<td></td>
<td>Telestoceipeus</td>
<td><em>Telescopium telestoceipeus</em> (Linne, 1758)</td>
</tr>
<tr>
<td></td>
<td>Muricidae</td>
<td><em>Cassisrae capucinus</em> (Rodrig, 1768)</td>
</tr>
<tr>
<td>PELEGYPODA</td>
<td>Corbulidae</td>
<td><em>Polymesoda erosa</em> (Solander, 1788)</td>
</tr>
<tr>
<td></td>
<td>Arcidae</td>
<td><em>Arca granulosa</em></td>
</tr>
<tr>
<td></td>
<td>Nautilidae</td>
<td><em>Nautilus</em> sp.</td>
</tr>
</tbody>
</table>

133
Three classes of molluscs were present in the Upper Birang sites: gastropods, pelecypods, and cephalopods (Table 6.25). Gastropods are univalves ("snails") that have a spiral growth pattern which forms either a cone or a disk (Claassen 1998:16). In many species the foot is attached to an operculum, a calcified plate which closes the aperture when the animal withdraws. Gastropods occupy various habitats in freshwater, terrestrial and marine environments.

Pelecypods are bivalves, which have a pair of symmetrical or asymmetrical shells connected to each other by a ligament. The edge of the valve is called the "margin," the apex or beak where the teeth are to be found is called the "umbo" (plural "umbones") (Claassen 1998:18). Pelecypods can be found in both freshwater and marine environments.

Cephalopods are predatory molluscs exclusively confined to marine habitats. Most cephalopods, such as octopi, cuttlefish and squids, have lost their exoskeletons, except for the Nautilidae, the only cephalopods found in the Upper Birang sites, which are represented by small shell fragments. Crustaceans in the Upper Birang sites are represented only by one family of true freshwater crabs.

Numbers of gastropod individuals were calculated from the numbers of apices, spires or umbilici (Claassen 1998:106), and opercula. The most abundant of these elements from a taxon formed the MNI for that taxon. For the bivalves, the valve which produced the greater number of umbones formed the MNI.

The molluscs in the Upper Birang sites were dominated by gastropods. Most were found almost complete, so counting the MNIs was not a problem. The fragmented gastropods consisted of apices or bases, as well as tiny fragments. Very few opercula were retrieved, except for those from the land snail Cyclophorus spp.

Pelecypods were fewer than gastropods and most were broken. Some still have umbones, but most are just small unidentifiable fragments. In the case of the latter, only the weight was recorded. Other specimens can be identified to species level but not counted because of their fragmentary state, such as Polymesoda erosa in all excavation pits and Anadara granosa from LPY/D5. For these, the MNI could not be calculated and is simply recorded as 1? in the following analyses.

Cephalopod remains were very limited and only consist of several small shell fragments of Nautilus sp. Remains of crustaceans, represented only by the true freshwater crab, Brachyura, consisted of claw and carapace fragments. Accurate MNIs could not be calculated for these. All counting was conducted on site and the MNIs calculated there. Unidentifiable fragments were weighed in bulk by spit.
In some analyses, the degree of fragmentation of molluscs can provide information on formation processes (Claassen 1998:114). However, the molluscs from the Upper Birang sites could not be recorded for fragmentation in detail because some of the mollusc records were not complete. Owing to the high cost of transport, many specimens had to be left on site after counting and weighing. Some were brought to the Balai Arkeologi office in Banjarmasin, where they were sorted and repacked for transport to Jakarta. But unfortunately some specimens went missing in transit, resulting in data gaps. Therefore, some measurements must be labelled as N/A (not available). This problem affects the analysis of spits 2, 6 and 7 in KMS/C8 (Appendix 6.16). One species of freshwater gastropod also went missing, so it can only be recorded as an unidentified snail.

Some of the missing specimens are only recorded simply as gastropods or pelecypods, even though they were counted and weighed. Such specimens particularly come from spits 1 to 15 in KMS/C4. From these spits, only *Brotia* sp., *Cylophorus borneense* and *Polymesoda erosa* have been identified (Appendices 6.13, 6.14, and 6.15). One missing species of freshwater gastropod is recorded as an unidentified snail.

The counts for complete and broken apices of *Brotia* sp. from certain spits in KMS/C4, LPY/C3 and LGB/TP are also not available, and thus labelled as not identified in Tables 6.28, 6.30, 6.32, 6.34, and 6.36.

The invertebrate faunal analysis of the Upper Birang sites excludes KMS/TP owing to the small sample size. However, the molluscs from this square were the same as in the other excavation pits, except for *Balanocochlis* sp., a gastropod from the Thiaridae family, which was not found elsewhere. There were also two Cyclophoridae found only in this pit: *Cylophorus* sp. and *Leptopoma* sp. (Table 6.26). In the integrated table of the invertebrate fauna from the Upper Birang sites (Appendix 6.12), KMS/TP is given check marks instead of numbers.

Cowry shells are excluded from the following analysis since they were used for ornaments, and discussed in Chapter IX. Some of the large bivalve shells of *Polymesoda erosa* were used as scrapers, as also discussed in Chapter IX. Only *P. erosa* fragments that show no signs of usage as artefacts will be recorded in this analysis.
Table 6.26 Molluscs from KMS/TP

<table>
<thead>
<tr>
<th>CLASS</th>
<th>FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastropoda</td>
<td>Thiaridae</td>
<td>Brotia sp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Balanocochlis sp.</td>
</tr>
<tr>
<td></td>
<td>Paludomidae</td>
<td>Paludromus broti (Issel, 1874)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unidentified snail</td>
</tr>
<tr>
<td>Pelecypoda</td>
<td>Unionidae</td>
<td>Pseudodon vandenbuschianus (Lea, 1840)</td>
</tr>
</tbody>
</table>

TERRESTRIAL ENVIRONMENT

<table>
<thead>
<tr>
<th>CLASS</th>
<th>FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastropoda</td>
<td>Cyclophoridae</td>
<td>Cyclophorus spp.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cyclophorus boreense (Metcalfe, 1851)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pterocyclus termilabatus (Metcalfe, 1851)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leptopoma sp.</td>
</tr>
<tr>
<td></td>
<td>Camaenidae</td>
<td>Leptopoma geotrichiforme (E.A. Smith, 1895)</td>
</tr>
<tr>
<td></td>
<td>Helicarionidae</td>
<td>Amphidromus sp.</td>
</tr>
</tbody>
</table>

MARINE ENVIRONMENT

<table>
<thead>
<tr>
<th>CLASS</th>
<th>FAMILY</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastropoda</td>
<td>Cypraeidae</td>
<td>Cypraea moneta (Linne 1758)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cypraea annulus (Linne, 1758)</td>
</tr>
<tr>
<td>Pelecypoda</td>
<td>Corbiculidae</td>
<td>Polymesoda era (Solander, 1766)</td>
</tr>
<tr>
<td></td>
<td>Arcidae</td>
<td>Anadara granosa (Linne, 1758)</td>
</tr>
</tbody>
</table>

6.4.1 Invertebrate Remains from KMS/C4

The invertebrate remains from KMS/C4 were dominated by molluscs (Appendix 6.12) from freshwater, terrestrial and marine habitats: (Table 6.27; Appendices 6.13, 6.14 and 6.15). The freshwater molluscs consist of three species of gastropod and one species of pelecypod. The terrestrial molluscs contain four species of gastropod, while the marine ones are represented by one species of pelecypod and one cephalopod. Crustaceans are represented by the freshwater crab species, Brachyura (Appendix 6.21).

Table 6.27 Molluscs from KMS/C4

<table>
<thead>
<tr>
<th>ENVIRONMENT</th>
<th>TAXA</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
</tr>
<tr>
<td>FRESHWATER</td>
<td>Brotia</td>
<td>55</td>
<td>0.89</td>
<td>106</td>
<td>1.73</td>
<td>3090</td>
<td>50.29</td>
</tr>
<tr>
<td></td>
<td>P. broti</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Unident. snail</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>34</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>P. vandenbus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>0.2</td>
</tr>
<tr>
<td>TERRESTRIAL</td>
<td>C. boreense</td>
<td>27</td>
<td>0.44</td>
<td>3</td>
<td>0.05</td>
<td>10</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>P. termilabiat</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Amphidromus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Naninia</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
<td>2</td>
<td>0.03</td>
</tr>
<tr>
<td>MARINE</td>
<td>Nautilus</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>P. erosa</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>TOTAL</td>
<td>82</td>
<td>1.33</td>
<td>119</td>
<td>1.94</td>
<td>3160</td>
<td>51.43</td>
<td>2358</td>
</tr>
</tbody>
</table>

The molluscs were dominated by the freshwater gastropod Brotia sp. (97%), the most common mollusc found in the Upper Birang sites and still eaten today by the locals. They were found in all units, even in the lowest part of Unit V where most of the other molluscs were not present or only found in small numbers.

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Table 6.28 *Brotilia* sp. from KMS/C4

<table>
<thead>
<tr>
<th>BROTI SHELL</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>UNIT III</th>
<th>UNIT IV</th>
<th>UNIT V</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete shell</td>
<td>28</td>
<td>37</td>
<td>1644</td>
<td>879</td>
<td>120</td>
<td>2708</td>
</tr>
<tr>
<td>Broken apices</td>
<td>20</td>
<td>14</td>
<td>1383</td>
<td>1422</td>
<td>296</td>
<td>3135</td>
</tr>
<tr>
<td>Not identified</td>
<td>7</td>
<td>55</td>
<td>63</td>
<td>0</td>
<td>0</td>
<td>125</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>55</td>
<td>106</td>
<td>3090</td>
<td>2301</td>
<td>416</td>
<td>5968</td>
</tr>
</tbody>
</table>

Many of the *Brotilia* shells had their apices broken off, perhaps to allow meat extraction, although placing of the shells in hot water would probably also serve the same purpose. In Units I, II and III, complete shells exceeded those with broken apices, although in total broken apices were more abundant than complete shells.

The most abundant *Brotilia* came from Units III (50%) and IV (37%). *Brotilia* started to increase significantly at the bottom of Unit IV and reached a peak at the bottom of Unit III, then decreasing gradually in the upper spits (Appendix 6.13). The top three spits of Unit III contained fewer *Brotilia*, and from that horizon to the surface it was quite rare, ranging between 0 and 18 individuals per spit. The number of individuals in Unit V was much greater than in Units II and I (ranging between 13 and 36 per spit).

It should be noted that the excavation area at the bottom of Unit III (from spit 32 downwards) was only half that of the upper spits, thus doubling the effective density of shell in these lower spits. This intensive concentration of *Brotilia* in the lower part of Unit III and in Unit IV suggests that the peak of occupation intensity in the site was confined to one period, with the shells later being spread up and down the profile by disturbance.

Other molluscs were found only in small numbers, none more than 2% of the assemblage. The two other freshwater mollusc species, *Paludomus broti* and *Pseudodon vondenburgianus*, were only represented by four and 13 individuals respectively. Shells of *P. broti* were found only in Unit III, and *P. vondenburgianus* in Units III and V (Appendix 6.13).

The unidentified freshwater snail was the second most common species in KMS/C4 (92 individuals/1.5 %). They occurred only in the three lower units, with unit IV producing the most (55 individuals). It is not known whether this snail was eaten.

The landsnails consist of *Cyclophorus borneense*, *Pterocyclos termilabatus*, *Amphidromus* sp. and *Naninia* sp. (Appendix 6.14). Among them, *C. borneense*, from the family Cyclophoridae, was the third most common species (41 individuals) found in KMS/C4. They were found in all units, except Unit IV.

The other terrestrial molluscs were represented by small numbers of scattered individuals, none known to be edible. Perhaps these entered the deposits naturally.
The marine molluscs from KMS/C4 were mainly used for artefacts. There were six *Cypraea annulus* shells which had their tops removed, and 12 *Polymesoda erosa* scrapers (see Chapter IX and (Appendix 6.15). *P. erosa* small fragments were found in Units II and III (NISP: 4 and 8 respectively).

Crustacea (*Brachyura* crabs) mostly consisted of chela fragments. Only in Unit I of KMS/C4 were some carapace fragments present. Crabs were confined to the three upper units, with 21, 23 and 18 specimens from Units I, II, and III respectively.

### 6.4.2 Invertebrate Remains from KMS/C8

The invertebrate remains from KMS/C8 are similar to those found in KMS/C4, except that *Naninia* sp. is absent in KMS/C8, and *Leptopoma geotrochiforme* is present in KMS/C8 but not in KMS/C4 (Table 6.29, Appendix 6.16).

<table>
<thead>
<tr>
<th>TAXA</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
</tr>
<tr>
<td><em>Brotia sp.</em></td>
<td>27</td>
<td>5.32</td>
<td>404</td>
</tr>
<tr>
<td><em>P. brotis</em></td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Unidentified snail</td>
<td>1</td>
<td>0.2</td>
<td>3</td>
</tr>
<tr>
<td><em>P. vordenbuschianus</em></td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td><em>C. borneense</em></td>
<td>9</td>
<td>1.77</td>
<td>13</td>
</tr>
<tr>
<td><em>P. termilabius</em></td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><em>L. geotrochiforme</em></td>
<td>1</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td><em>Amphidromus</em></td>
<td>5</td>
<td>0.98</td>
<td>14</td>
</tr>
<tr>
<td><em>P. erosa</em></td>
<td>1</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td><em>Neutilus sp.</em></td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>44</td>
<td>8.67</td>
<td>464</td>
</tr>
</tbody>
</table>

In this excavation, the number of individuals of all taxa in Unit II greatly exceeds the numbers in Unit I. As in KMS/C4, *Brotia* dominate, with 431 individuals (85%), mostly found in Unit II (404 individuals). As in KMS/C4, broken apices slightly exceed complete ones in numbers (Table 6.30).

<table>
<thead>
<tr>
<th>BROTTIA SHELL</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete shell</td>
<td>20</td>
<td>182</td>
<td>202</td>
</tr>
<tr>
<td>Broken apices</td>
<td>7</td>
<td>222</td>
<td>229</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>27</td>
<td>404</td>
<td>431</td>
</tr>
</tbody>
</table>

Other molluscan species were present in much smaller numbers than *Brotia*, and none exceeded 5% of the total. Two terrestrial gastropods, *C. borneense* (4.3%) and *Amphidromus* sp. (3.9%), were second and third in quantity in KMS/C8, followed by the freshwater pelecypod *P. vordenbuschianus* (2.9%) and the gastropod *P. brotis* (1.7%). *Brachyura* crab remains were present in both units in small numbers, represented by chela fragments (Appendix 6.22).
6.4.3 Invertebrate Remains from LPY/C3

The invertebrate remains from Lubang Payau were rather different from those found in Kimanis (Table 6.31, Appendix 6.17 and 6.18). There were four marine taxa, two only occurring in this site (Terebralia sulcata and Arca granulosa). However, they are only represented by one individual each. Among the three marine species known to have been modified into artefacts in Kimanis (P. erosa, C. moneta and C. annulus), only P. erosa was found in this site. In the cases of Terebralia sulcata, Arca granulosa and Anadara granosa it is not known whether they were modified into artefacts or used without being modified.

Freshwater molluscs are represented by four taxa: Brodia sp., P. broti, an unidentified snail, and P. vondenbuschianus. Brodia sp. dominate the assemblage overwhelmingly (more than 80%), as in Kimanis. However, unlike Kimanis, where Brodia were most abundant in the lower layers, in Lubang Payau they were mostly found in the upper layers. Most were deposited in Unit II (2589 individuals), with fewer in Unit I (1254 individuals), and only 79 in the lowest unit.

Almost all other taxa were found in their largest numbers in Unit II, except for Cyclophoridae in Unit III and Anadara granosa in Unit I.

P. broti, which comprised less than 2% of the Kimanis assemblage, was the second most common species in LPY/C3 (13%). Unidentified snails and P. vondenbuschianus were less than 2%, not much different from Kimanis.

<table>
<thead>
<tr>
<th>TAXA</th>
<th>UNIT I</th>
<th></th>
<th>UNIT II</th>
<th></th>
<th>UNIT III</th>
<th></th>
<th>TOTAL</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
<td>%</td>
<td>MNI</td>
<td>%</td>
</tr>
<tr>
<td>Brodia sp.</td>
<td>1254</td>
<td>25.61</td>
<td>2589</td>
<td>52.87</td>
<td>79</td>
<td>1.61</td>
<td>3922</td>
<td>80.1</td>
</tr>
<tr>
<td>P. broti</td>
<td>171</td>
<td>3.49</td>
<td>423</td>
<td>8.64</td>
<td>52</td>
<td>1.06</td>
<td>646</td>
<td>13.19</td>
</tr>
<tr>
<td>Unidentified snail</td>
<td>24</td>
<td>0.49</td>
<td>30</td>
<td>0.61</td>
<td>3</td>
<td>0.06</td>
<td>57</td>
<td>1.16</td>
</tr>
<tr>
<td>P. vondenbuschianus</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>0.1</td>
<td>2</td>
<td>0.04</td>
<td>7</td>
<td>0.14</td>
</tr>
<tr>
<td>Cyclophoridae</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0.04</td>
<td>16</td>
<td>0.37</td>
<td>20</td>
<td>0.41</td>
</tr>
<tr>
<td>C. borneense</td>
<td>97</td>
<td>1.98</td>
<td>73</td>
<td>1.5</td>
<td>11</td>
<td>0.23</td>
<td>181</td>
<td>3.7</td>
</tr>
<tr>
<td>L. geotrochiforme</td>
<td>1</td>
<td>0.02</td>
<td>3</td>
<td>0.06</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td>Amphidromus</td>
<td>4</td>
<td>0.08</td>
<td>31</td>
<td>0.63</td>
<td>3</td>
<td>0.06</td>
<td>38</td>
<td>0.77</td>
</tr>
<tr>
<td>Naninia sp.</td>
<td>2</td>
<td>0.04</td>
<td>5</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>0.14</td>
</tr>
<tr>
<td>P. erosa</td>
<td>1</td>
<td>0.02</td>
<td>1</td>
<td>0.02</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0.04</td>
</tr>
<tr>
<td>Anadara granosa</td>
<td>7</td>
<td>0.14</td>
<td>4</td>
<td>0.08</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>0.23</td>
</tr>
<tr>
<td>Arca granulosa</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>T. sulcata</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0.02</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1581</td>
<td>31.87</td>
<td>3168</td>
<td>64.69</td>
<td>168</td>
<td>3.43</td>
<td>4897</td>
<td>100</td>
</tr>
</tbody>
</table>

The terrestrial molluscs consist of five taxa: Cyclophoridae, C. borneense, L. geotrochiforme, Amphidromus sp. and Naninia sp. As in Kimanis, the most abundant are C. borneense, followed by Amphidromus sp., Naninia sp. and L. geotrochiforme.
Table 6.32 Broitia sp. from LPY/C3

<table>
<thead>
<tr>
<th>TAXA</th>
<th>UNIT I</th>
<th>UNIT II</th>
<th>UNIT III</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete shell</td>
<td>246</td>
<td>638</td>
<td>7</td>
<td>891</td>
</tr>
<tr>
<td>Broken apices</td>
<td>974</td>
<td>1951</td>
<td>16</td>
<td>2941</td>
</tr>
<tr>
<td>Not identified</td>
<td>34</td>
<td>0</td>
<td>56</td>
<td>90</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1254</td>
<td>2589</td>
<td>79</td>
<td>3922</td>
</tr>
</tbody>
</table>

The Broitia in LPY/C3 had a much larger proportion (2941 individuals) with broken apices that those in Kimanis (Table 6.32). Brachyura crabs are represented by five chela fragments from Unit I (Appendix 6.23).

6.4.4 Invertebrate Remains from LPY/D5

Invertebrate remains from LYP/D5 are basically the same as in LPY/C3, but without Cyclophoridae, L. geotrochiforme, Naninia sp., and Arca granulosa (Table 6.33, Appendix 6.19). Two marine taxa which only occurred in this square are Chicoreus capucinus and Telescopium telescopium.

Table 6.33 Molluscs from LPY/D5

<table>
<thead>
<tr>
<th>TAXA</th>
<th>MNI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broitia sp.</td>
<td>1638</td>
<td>76.40</td>
</tr>
<tr>
<td>Patodomus broti</td>
<td>273</td>
<td>12.73</td>
</tr>
<tr>
<td>Unidentified snail</td>
<td>20</td>
<td>0.93</td>
</tr>
<tr>
<td>Pseudodon vandenbuschianus</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>Cyclophorus</td>
<td>3</td>
<td>0.14</td>
</tr>
<tr>
<td>Cyclophorus borneense</td>
<td>192</td>
<td>8.96</td>
</tr>
<tr>
<td>Amphidromus sp.</td>
<td>11</td>
<td>0.51</td>
</tr>
<tr>
<td>Polymesoda erosa</td>
<td>17</td>
<td>0.05</td>
</tr>
<tr>
<td>Anadara granosa</td>
<td>17</td>
<td>0.05</td>
</tr>
<tr>
<td>Terebralia autostia</td>
<td>2</td>
<td>0.09</td>
</tr>
<tr>
<td>Chicoreus capucinus</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>Telescopium telescopium</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2144</td>
<td>100</td>
</tr>
</tbody>
</table>

Again, the freshwater gastropod Broitia dominate (76%), followed in importance by another freshwater species, P. broti (13%), and a terrestrial gastropod, C. borneense (9%). Other species occur below 1%. Most Broitia had their apices broken (Table 6.34).

Table 6.34 Broitia sp. from LPY/D5

<table>
<thead>
<tr>
<th>TAXA</th>
<th>UNIT I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete shell</td>
<td>376</td>
</tr>
<tr>
<td>Broken apices</td>
<td>1262</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1638</td>
</tr>
</tbody>
</table>

Two of the marine species, P. erosa and Anadara granosa, mostly consisted of small fragments. P. erosa consisted of 15 fragments, probably representing only two individuals. No P. erosa from LPY/D5 showed indications of being used as scrapers, and neither did any other marine molluscs show any modification. Anadara granosa consisted of 12 small specimens and it was difficult to estimate the MNI. However, at least one individual was present (1?). Crabs were represented by four chela fragments (Appendix 6.24).
6.4.5 Invertebrate remains From LGB/TP

For such a small rock shelter and shallow deposit, Liang Gobel produced quite a variety of molluscs from freshwater, terrestrial and marine environments (Appendix 6.20). As in other sites, the assemblage was dominated by Brotia (44%), followed by the terrestrial gastropod C. borneense (35%) and another freshwater gastropod P. broti (15%). The only marine species, P. erosa, was rare (0.21%) (Table 6.35). Unlike other excavation pits, where C. borneense contributed less than 10%, in LGB/TP this species ranks number two after Brotia.

<table>
<thead>
<tr>
<th>TAXA</th>
<th>MNI</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brotia sp.</td>
<td>206</td>
<td>43.83</td>
</tr>
<tr>
<td>P. broti</td>
<td>69</td>
<td>14.68</td>
</tr>
<tr>
<td>Unidentified snail</td>
<td>1</td>
<td>0.21</td>
</tr>
<tr>
<td>C. borneense</td>
<td>166</td>
<td>35.32</td>
</tr>
<tr>
<td>Amphidromus sp.</td>
<td>27</td>
<td>5.75</td>
</tr>
<tr>
<td>P. erosa</td>
<td>1</td>
<td>0.21</td>
</tr>
<tr>
<td>TOTAL</td>
<td>470</td>
<td>100</td>
</tr>
</tbody>
</table>

Again, many of the Brotia shells had their apices broken (86 individuals) (Table 6.36).

<table>
<thead>
<tr>
<th>BROTIA SHELL</th>
<th>UNIT I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete shell</td>
<td>43</td>
</tr>
<tr>
<td>Broken apices</td>
<td>86</td>
</tr>
<tr>
<td>Unidentified</td>
<td>77</td>
</tr>
<tr>
<td>TOTAL</td>
<td>206</td>
</tr>
</tbody>
</table>

6.4.6 The Role of Invertebrates in the Economy of the Upper Birang Sites

It is clear that Brotia was overwhelmingly the dominant mollusc in all excavation pits in the Upper Birang Sites. This species was definitely consumed by the prehistoric inhabitants of the sites, and contributed quite significantly to the diet. Today, Brotia are commonly eaten by the local people and can be easily collected in the Birang River. The shell were boiled in the water after the apices were cut off.

The other four freshwater mollusc species were found in much smaller numbers. Balanocochlis sp. only occurred in one sample from KMS/TP. P. broti was found in very small numbers in Kimanis, less than 2% of the assemblage, while in Lubang Payau it was much more common at 13% of all specimens in both excavated squares. In Liang Gobel the percentage of P. broti was even higher, at 15%. It is not known whether this species is edible. Unidentified snails were always less than 2% in all sites and may not
have been eaten. The only freshwater pelecypod, *P. vondenbuschianus*, was also found in small numbers.

Of the seven species of terrestrial molluscs, *C. borneense* produced more individuals than other species. However, the percentage of this species varies, with the largest occurring in LGB/TP (35%), followed by LPY/D5 (9%), LPY/C3 and KMS/C8 (each 4%), and KMS/C4 (0.67%). As with *P. broti*, *C. borneense* was more common in Lubang Payau than in Kimanis. However, in Liang Gobel this species was found in much larger quantities than in the other sites. It is not known whether it was edible, but the large numbers at Liang Gobel suggest that it was.

The other terrestrial molluscs only contributed less than 1% of each assemblage, except for *Amphidromus* in LGB/TP (6%) and KMS/C8 (4%). These terrestrial molluscs may have lived naturally around the caves.

The nine marine mollusc species each contributed less than 1% of each assemblage, and only three were definitely used for artefacts, these being *C. moneta* and *C. annulus* that were modified as ornaments, and *P. erosa* that were used as scrapers (see Chapter IX).

6.5 Overall Conclusions to be Drawn from the Upper Birang Faunal Remains

The vertebrate and invertebrate analyses for the Upper Birang sites indicate that each site had a slightly different character, although the animal species found in all were basically similar. The vertebrate remains indicate that the prehistoric inhabitants of the Upper Birang sites consumed various species of terrestrial and arboreal animals, but almost no birds. Amongst the aquatic fauna the rare occurrence of fish is in contrast with the large numbers of freshwater shellfish.

The most abundant vertebrate fauna belonged to small-sized animals, mainly dominated by monkeys [49 individuals, comprising Cercopithecidae indet. (20), *Macaca* sp. (8), *M. fascicularis* (2), *M. fascicularis?* (2), *Presbytis* sp. (9), and *T. cristatus?* (1)], turtles (12), monitor lizards (12) and carnivores [24 individuals, comprising Carnivora indet. (10), Mustelidae (5), Lutrinae? (1), Viverridae (5), *V. tangalunga* (2), and *A. binturong* (1)]. However, larger animals, which include medium, medium-large and large species that contribute much more meat per animal, were also found in large numbers. These were dominated by pigs (16), followed by sun bears (12), Cervidae (11), and Bovidae (9). The very small-sized animals were dominated by Microchiroptera (240) (Appendix 6.26).
The invertebrate remains showed that the freshwater gastropod *Brotia* sp. overwhelmingly dominated all other molluscs in all sites. Other mollusc species were found in much smaller numbers, and the significance of some as food was not always clear. The marine molluscs were more likely brought to the sites mainly as artefacts, not as food. However, only the shells of *C. moneta*, *C. annulus* and *P. erosa* were definitely modified into artefacts.

Kimanis, as the biggest rock shelter with the longest occupation and densest archaeological deposits, has certainly produced the most abundant vertebrate and invertebrate remains, not only in term of the number of animal taxa but also the number of individuals. Among the various activities conducted in this rock shelter, fire seems to have been commonly used. This is not only indicated by charcoal and ash remains found all through the excavation layers, but also by the burned bone fragments. The burned specimens belong to the most common species found in the site, such as Suidae, Cercopithecidae, python, Cervidae, and Bovidae. These animals have large bones that survive burning better than those of the smaller species.

Amongst the large mammals pigs were the most prominent, followed by sun bear, Bovidae and Cervidae. While the smaller mammals were dominated by monkeys and the reptiles by Testudinidae and Varanidae (monitor lizard), the most abundant animals in Kimanis were actually the Microchiroptera (bats), which were represented by 231 individuals.

The pig remains were not only abundant in term of individual numbers but also anatomical elements, and they were found in all of the excavation pits from the bottom to the top layers. In fact, no other animal is represented by as many different anatomical elements as the Suidae. Moreover, each of these anatomical elements usually has many specimens.1 Most of the specimens were post-cranial bones, and the cranial elements largely consisted of very fragmentary skull or mandible parts, as well as isolated teeth.

Arboreal animals were heavily dominated by monkeys. In Kimanis there were 38 individuals, comprising Cercopithecidae indet. (16), *Macaca* sp. (7), *M. fascicularis* (2), *M. fascicularis*? (2), *Presbytis* sp. (9), *T. cristatus* (1), and *T. Cristatus*? (1). These numbers show that that *Presbytis* was slightly more common than *Macaca*, although the large number of indeterminate specimens renders this observation a little uncertain.

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1 KMS/C4 produced 7 Suidae individuals, represented by 575 bones from 31 anatomical elements. The Cercopithecidae, with 12 individuals, were represented by 320 bones from only 21 anatomical elements. Chiroptera and Testudinidae were not taken into consideration since the anatomical elements found were limited in variety, although the numbers of specimens of each were abundant.
In contrast to Kimanis, the small and dry rock shelter of Liang Gobel was the smallest site to be excavated, with the shallowest archaeological deposit. It contained a very limited vertebrate fauna compared to the other sites, and was perhaps only occupied for a short period. It is not clear whether it was only visited once or several times. None of the bones were burned, and the Rodentia, Muridae (rats/mice) and Microchiroptera probably died in the site naturally.

Although quite a number of vertebrate taxa found in Liang Gobel, most only comprised a few specimens, except for Suidae and Testudinidae. The small number of specimens for each taxon found in this site, especially those likely to have been consumed by humans, could reflect throwing of bones out of the small shelter to land on the slope five meters below.

In contrast to Liang Gobel, Lubang Payau has a quite large living area, although not as dry and light as Kimanis, and also rather damp. This may be the reason why this site was not as intensively utilised as Kimanis. Although charcoal and ash were also present in this site, especially in the top layers, only three burnt bones were found, belonging as in Kimanis to Suidae and Cervidae.

The archaeological deposits in Lubang Payau were not as deep as those in Kimanis, and not as dense. It can be observed that the main occupational layers of LPY/C3 were in Units I and II, while Unit III produced very few vertebrate remains. Those found in Unit III belong to the upper layer of that unit, which is basically the same stratigraphical layer as the lower layer of Unit II. Therefore, more likely, the vertebrate remains from Unit III actually belong to lower Unit II.

There are, however, two striking difference between Kimanis and Lubang Payau. In Kimanis, bat was the most common animal represented by 231 individuals, whereas in Lubang Payau only nine individuals were found. Although the burnt marks on the bat bones from Kimanis were not counted, but some of the bones, like many other vertebrate bones, also suffered from burnt activities.

As mentioned previously, Kimanis rock shelter is located in an open area, full of light where no bats made their nests. The bats preferred to live in the deep and dark part of the cave about 50 metres from the rock shelter, and do not come near the rock shelter when they fly out. Therefore, the presence of such a large quantity of bat bones concentrated in a small area could suggest that bats were hunted by humans, although it could also suggest that bats frequented the area in late prehistory during a period when human occupation was not very intensive.
The bat bones in Kimanis showed different distributions through time than those of other animals. Bats were present right from the bottom of KMS/C4, although only represented by small numbers of individuals (Unit V: 4 individuals and Unit IV: 1 individual). They started to increase dramatically in Unit III, where they are represented by 30 individuals. In this unit most other vertebrate taxa also increased in number. In Unit II, however, the other taxa reduced in numbers but bats continued to increase to 88 individuals. In Unit I other taxa disappeared or became very reduced, but bats were still present in large numbers (46 individuals). The significant increase of bats in Unit III started above the radiocarbon date of 11,270±220 BP (ANU-11151), and they are found in large numbers from just below the date of 4650±90 BP (ANU-11148), which essentially places their date of accumulation in the Neolithic.

At Lubang Payau, the human occupation area is located in the area commonly inhabited by bats, so their presence in the deposits here might also reflect natural death.

Another significant difference between Kimanis and Lubang Payau is represented by *Brotia* distributions, the main food mollusc of the Upper Birang sites. In Kimanis, *Brotia* occurred right from the bottom of the deepest pit, KMS/C4. A carbon date for a *Brotia* shell from spit 59 (280–285 cm from the surface) is 23,630±480 BP (ANU-11259), although freshwater shell from limestone environments is known to give dates that are contaminated by ancient carbonate and it is not clear how accurate this date is. At this horizon, *Brotia* shells were only found in small numbers. However, another carbon date from a piece of charcoal for spit 34 (155-160 cm below the surface) is 11,270±220 BP (ANU-11151), and at this horizon *Brotia* shells reached their peak. In spit 24 (105-110 cm below the surface), there is a charcoal date of 10,030±260 BP (ANU-11150), and by this time *Brotia* shells already decreased significantly in number. It seems, therefore, that *Brotia* were mainly consumed during the late Pleistocene in Kimanis, and during the Holocene they were found in much smaller numbers.

Conversely, *Brotia* shells in Lubang Payau (LPY/C3) were concentrated in the upper layers, reaching their peak in the upper part of Unit II and the lower part of Unit I, before they gradually reduced. The upper part of this abundant *Brotia* assemblage was mixed with pottery, which first occurred in the horizon where *Brotia* peaked. A carbon date of 4610±110 BP (ANU-11152) was obtained just above the horizon where the last abundant *Brotia* remains occurred. This suggests that most *Brotia* in LPY/C3 are pre-pottery, and that the overlap may be due to disturbance.

However, in LPY/D5, *Brotia* dominated the deposit right from the surface, and was mixed thoroughly with pottery. Only in the lowest 10 cm above bedrock was
pottery absent. LPY/D5 was located at the back of the cave, in a lower horizon, about half a meter lower than LPY/C3. It can be regarded as a shell midden due to the dense occurrence of *Brotilia*. It is likely that the shells were discarded into this lower part of the cave from the higher level in front. No carbon date was obtained from this square, since almost no charcoal was found.

Although no exact dates for *Brotilia* consumption are available from either site, it can be estimated quite firmly that *Brotilia* consumption at Lubang Payau belonged to a younger period than at Kimanis, mainly from the mid-Holocene onwards. In LPY/C3, the pottery layers contain only half as many *Brotilia* shells as the pre-pottery layers, suggesting that the main period of *Brotilia* exploitation was pre-pottery. However, in the shell midden deposit of LPY/D5 pottery was mixed thoroughly with *Brotilia*. This may indicate that in Lubang Payau *Brotilia* exploitation was started from the pre-pottery period and continued through the pottery period.

Liang Gobel did not produce any carbon dates. However, almost all of the deposits from LGB/TP contain pottery, except for spit 11, the bottom spit. Therefore, it can be said confidently that the occupation of LGB/TP belonged essentially to the pottery period, after the mid-Holocene.

Since the periods when *Brotilia* were consumed in large numbers by the inhabitants of the Upper Birang sites were so different, changing environmental conditions cannot easily be put forward as the reason for the pattern. *Brotilia* were present in large numbers during the late Pleistocene as well as the Holocene, so it is unlikely that environmental change during the Late Pleistocene affected their frequency in any major way.

If the *Brotilia* data from Kimanis (KMS/C4) are integrated with the vertebrate data (Table 6.37) it becomes apparent that *Brotilia* became abundant at approximately the same time as the vertebrates, excluding the bats. However, *Brotilia* first occur in large numbers in Unit IV, when animal bones were still insignificant. In Unit III, when *Brotilia* reached their peak, the vertebrate fauna also increased quite dramatically. It should be noted that the large numbers of vertebrate fauna in Units III, II and I are mainly bats. As mentioned earlier, the bat remains show a different pattern of distribution from the other vertebrates. When all other vertebrate species became reduced in number in the upper units, bats continued to increase.
Table 6.37 MNIs of *Brotilia* sp. and vertebrate fauna from KMS/C4

<table>
<thead>
<tr>
<th>UNIT</th>
<th>INVERTEBRATE</th>
<th>VERTEBRATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BROTIA SP.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LARGE</td>
<td>MEDIUM</td>
</tr>
<tr>
<td></td>
<td>MEDIUM LARGE</td>
<td>SMALL</td>
</tr>
<tr>
<td></td>
<td>VERY SMALL</td>
<td>TOTAL</td>
</tr>
<tr>
<td>I</td>
<td>55</td>
<td>1</td>
</tr>
<tr>
<td>II</td>
<td>106</td>
<td>1</td>
</tr>
<tr>
<td>III</td>
<td>3090</td>
<td>2</td>
</tr>
<tr>
<td>IV</td>
<td>2301</td>
<td>1</td>
</tr>
<tr>
<td>V</td>
<td>416</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5968</td>
<td>5</td>
</tr>
</tbody>
</table>

Note: * The number between brackets represents the MNIs of the Microchiroptera.

If the bats are excluded from the vertebrate faunal analysis, it can be seen that the other vertebrates actually show similar tendencies to *Brotilia*, in that all reached their peaks in Unit III and reduced in numbers in the upper units. This suggests that Kimanis has one short but major phase of occupation.

In Lubang Payau, both *Brotilia* and vertebrate remains are concentrated in Units I and II. *Brotilia* in Unit II were double those in Unit I in number, but the number of vertebrate individuals remained much the same. Both units have 19 individuals of vertebrate animals. Each taxon is only represented by one individual, except for the bats, which consist of three individuals. Practically no significant changes occur with respect to vertebrate fauna across the two units.

In all excavations, pigs were the main source of protein, but other animals, such as monkeys, deer, and turtles also contributed significantly. Large and rare animals were also consumed. The Rhinocerotidae, now extirpated from the Upper Birang area, are only represented before the date of 4650 BP in Kimanis and before 4610 BP in Lubang Payau. The remains of *Tapirus indicus*, also locally extirpated in Borneo, occur between 4000 and 11,000 BP.

It is interesting to note that the numbers of animal bones and *Brotilia* in the pottery layers of Kimanis were much smaller than in the pre-pottery layers. This may indicate that the main occupation of the sites was during the pre-pottery layers. In Lubang Payau the vertebrate faunas were similar both the pre-pottery and pottery layers, but *Brotilia* in the pottery layers only half as numerous as in the pre-pottery layer. The presence of pottery may indicate that hunter-gatherer occupants of the sites made contact with agricultural groups and obtained the pottery by some form of exchange.

Contact with agriculturalists may also have had an impact on hunting patterns, although the data at hand do not illustrate clearly if agriculturalists had a major influence on the lives of contemporary hunter-gatherers in the Upper Birang Sites.

One final comment concerns the presence of marine molluscs in the Upper Birang sites. The coast of Borneo is now about 60 km in a straight line from the sites. In
Kimanis (KMS/C4), marine molluscs started to appear in Unit III, in spit 30, represented by *Nautilus* sp. and *P. erosa*. This horizon is dated between 11,270±220 BP (ANU-11151) and 10,030±260 BP (ANU-11150). This means that marine shell started to appear in the Upper Birang sites at the very end of the Pleistocene. In Lubang Payau (LPY/C3), marine molluscs made their first appearance much later than in Kimanis, in the upper part of Unit II in spit 10, just below the radiocarbon date of 4610±110 BP (ANU-11152).

The presence of marine molluscs at the end of the Pleistocene may reflect rising sea levels. During the last glacial maximum at 20,000 years ago the mouth of the Berau River, which is now an extensive estuary with many islands surrounded by shallow water, would have extended eastwards to approximately 60 km beyond the present coastline. The rising postglacial sea level thus brought the coastline closer to the Birang River area, although the sea is still located a considerable distance away. The marine molluscs found in the Upper Birang Sites were mainly used for ornaments and tools, not for food, presumably because of inability to preserve the meat during transport on foot over such a large distance. *A. granosa* are certainly edible (Nontji 1987:168).

It seems very likely that Kimanis was occupied mainly in the Late Pleistocene/Early Holocene, whereas Lubang Payau and Liang Gobel were occupied much later.

In Kimanis the main occupational layers are within pre-pottery Unit III, between radiocarbon date of 11,270±220 BP (ANU-11151) and 8,840±250 BP (ANU-11149). In these layers, *Brotia* sp. and vertebrate remains were most abundant. The pottery layers postdate the radiocarbon date of 4,650±90 BP (ANU-11148), and sherda are found most abundantly number in the layer dated to 1270±240 BP (ANU-111311). In these layers, *Brotia* sp. and vertebrate fauna, except for bats, were found in much smaller numbers than in the pre-pottery layers.

In Lubang Payau the occupational layers belong entirely to the Holocene. There is only one reliable radiocarbon date from this site, of 4610±110 BP (ANU-11152) from a charcoal fragment from pottery-bearing Unit I. In this layer vertebrate bones were about the same in number as in the pre-pottery layers, but the *Brotia* were only half as numerous as in the pre-pottery layers. It is thus likely that human occupation in Lubang Payau was mainly pre-pottery, but continued through the upper pottery layers as well.

Although no radiocarbon date is available from Liang Gobel, the site belongs entirely to the pottery phase.
It can be concluded that the main differences between Kimanis on the one hand and Lubang Payau and Liang Gobel on the other are in chronology, rather than in any contemporary differences in patterns of exploitation.