THE LATE PLEISTOCENE TO EARLY HOLOCENE FORAGERS OF NORTHERN LUZON

Armand Salvador B. Mijares

Archaeological Studies Program, University of the Philippines, Diliman, Quezon City, Philippines
Email: mandy24_us@yahoo.com
Keywords: Philippines, northern Luzon, lithic analysis, zooarchaeology, macrobotanical analysis, rainforest foraging.

ABSTRACT

Recent excavation in Callao Cave, one of the Peñablanca caves (Mijares 2005), has given us the earliest securely dated site in Luzon, at c. 25,000 BP. Two other Holocene period cave sites (Dalan Serkot and Eme) were excavated. Evidence from faunal identification, macrobotanical and phytolith analyses has shed some insight on the environment and diet of these early foragers. The lithic analysis shows some changes in lithic technology from the Late Pleistocene to the early Holocene. The reconstruction of subsistence strategy shows continuing broad diet subsistence from the Late Pleistocene to the mid Holocene. This differs from previous models) for northern Luzon proposed by Peterson (1974) and Thiel (1980). The results of this study also show the probability that hunter-gatherers foraged and survived in the interior tropical rainforest without the support of agriculturists, as earlier proposed by Headland and Bailey (1989).

INTRODUCTION

The archaeological record of Pleistocene to early Holocene northern Luzon is poorly understood. This is because very few sites belong to this period, and very few are dated (i.e. Callao 25,000 BP and Musang Cave 12,000 BP). The alleged mid-Pleistocene Cabalwanian industry (Fox and Peralta 1974) is a concept fraught with dating and association problems. Most of the pebble tools were collected from the surface, and from eroded terraces. As Hutterer (1977:47) pointed out

> not a single indisputable *in situ* association between artefacts and fossil fauna has been reported.

Shutler and Mathisen (1979) also shared the same views:

> it should be kept in mind that there is still no evidence to demonstrate whether the pebble tools are associated with the extinct mid-Pleistocene fauna, or that either are associated with the flake tools (Shutler and Mathisen 1979: 105-106).

Wasson and Cochrane (1979:23) even raised the possibility the pebble tools were of the same time period as the flakes and pebble tools found in the Peñablanca Caves, which are of Upper Pleistocene to Early Holocene date. If Wasson and Cochrane are right, then human occupation of Luzon could only occurred during the late Pleistocene period.

This paper will present highlights of the excavation results (Table 1 and Fig. 1) of three cave sites in the Peñablanca limestone area (see Mijares 2005 for a detailed excavation report). Callao Cave represents the Late Pleistocene, while Dalan Serkot and Eme Caves represent the Holocene (Fig. 2). The paper will also present previous foraging models proposed for Luzon (Thiel 1980; Peterson 1974) and evaluate them based on current archaeological data, and address issues raised by Headland and Bailey (1989) on the problem of foraging in interior tropical rainforests.

PREVIOUS MODELS CONCERNING ANCIENT PHILIPPINE SUBSISTENCE

In reconstructing Palaeolithic subsistence economy in the Philippines, a number of models have been proposed. For northern Luzon in particular, two previous models were presented in PhD. theses by Peterson (1974) and Thiel (1980). Peterson, working with a systems model in which the interrelationships between humans and their environments changed through time, hypothesized that there was an increase in population at the end of Pleistocene resulting in an overkill of large mammals (Peterson 1974: 186). The extinction of the megafauna led to an expansion into marginal areas and an adoption of broad-spectrum subsistence. These stresses in food procurement were aggravated by the postglacial rise in sea level, submerging vast tracts with optimal resources. Peterson believed that:

> Northern Luzon has produced evidence of a narrow spectrum Pleistocene hunting and collecting subsistence pattern, a broad spectrum post-Pleistocene hunting and collecting subsistence mode, and a post Pleistocene subsistence style based on seasonal reaping of

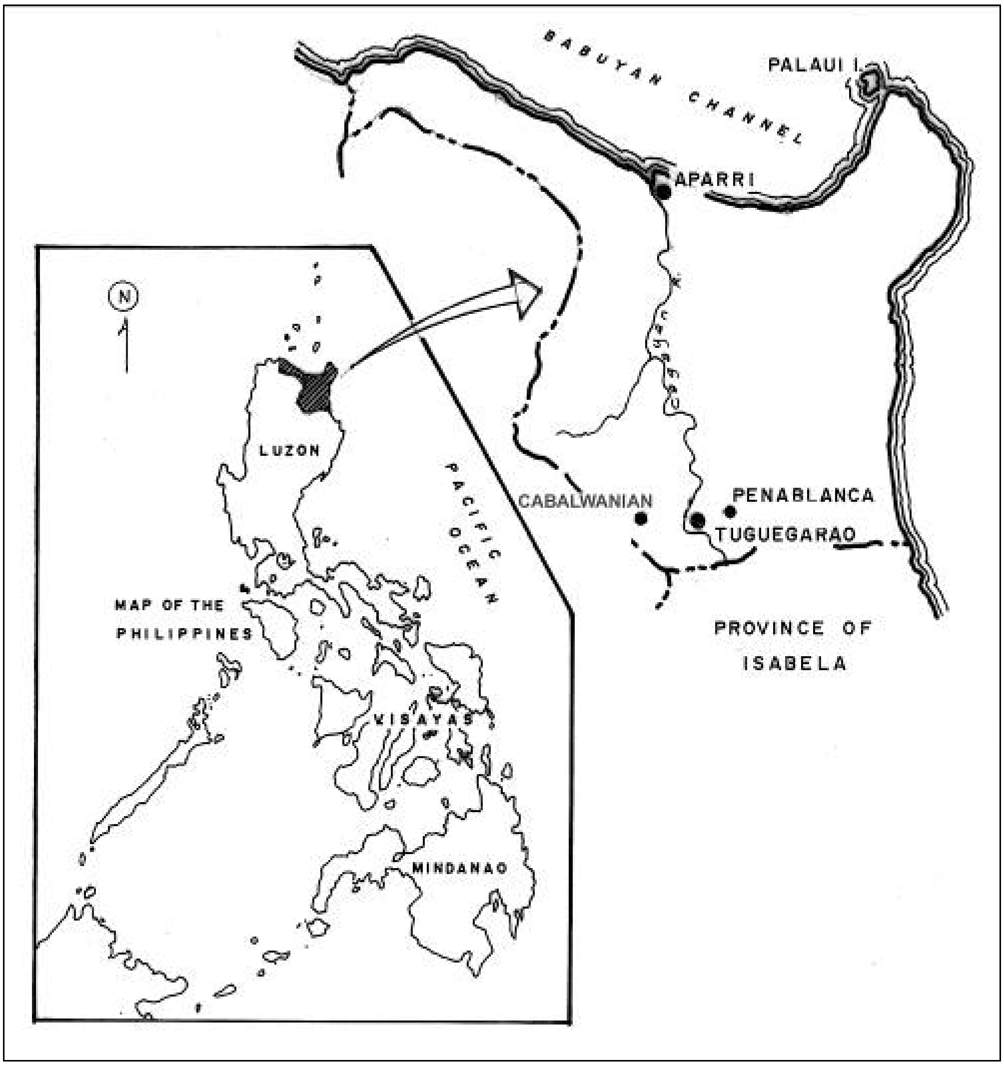

Figure 1. Palaeolithic sites in Northeastern Luzon, Philippines

Table 1. Major features of each excavated cave site

Site	^{14}C date	Lithics	Fauna	Macrobotanical	Phytoliths
Callao	25,968±373 uncal. BP	Chert flakes, with prevalent blade-like forms, most used on hard contact material	Charred animal bones, no shells recovered	Charred parenchymatous tissues	Moraceae, grasses, starch grains
Dalan Serkot	7260-6990 BP	Andesite and chert flakes, amorphous shapes, most used on hard contact material	Deer, pig, abundant riverine shells	Unidentified seeds	None found
Eme	3990-3690 BP	Andesite, basalt, and chert flakes with amorphous shapes, most used on hard contact material	Deer, pig, abundant riverine shells	*Boehmeria* cf. *platanifolia*, parenchymatous tissues, seeds, nuts, wood	Not analysed

wild or early domesticated species of grain plants (Peterson 1974: 191).

He related these changes in subsistence strategy to supposed changes in tool assemblages:

1) The early development of the chopper/chopping tool kit reflected the hunting and butchering of large game animals.
2) The Late Pleistocene and post Pleistocene sites with utilized flake tools reflected broad spectrum exploitation of small game animals, with no large game animals utilized.

Peterson assumed that there was a correlation between the size of a tool kit and the size of the fauna hunted - small flake tools for small animals and chopper/chopping tools for megafauna. I do not agree with this correlation for a number of reasons. As was stated above, the associations of the pebble tools with extinct megafauna are questionable since both are found in redeposited terrace sediments. Second, chopper/chopping tools can also be used for disarticulating medium to small mammals, as well cutting wood or bamboo.

Working further within a similar model, Barbara Thiel (1980) tried to reconstruct the subsistence strategy of early hunters and gatherers and the changes towards agriculture. Similarly to Peterson (1974), Thiel viewed population growth as a major factor for change in subsistence strategy:

> The model states that there was population pressure, which was brought about by environmental and cultural factors, and that this produced a stress situation in various groups of people (Thiel 1980: 38).

These pressures would have resulted either in the exploitation of new resources and a broader spectrum subsistence pattern, or alternatively a concentration on a particular resource resulting in a narrow spectrum subsistence pattern. Thiel hypothesized that a generalized hunter-gatherer or a broad-spectrum subsistence pattern was in place during the late Pleistocene (ca. 20,000 BP). A change followed after 18,000 BP towards either unspecialised hunting-gathering that was more area or locality restricted, or specialized hunting-gathering that was more resource specific. Hunting and gathering according to Thiel (1980: 161) was augmented by cultivation of plants and horticulture by 16,000 to 12,000 BP, and subsequently augmented by agriculture by 8000 BP.

Thiel, in her model, assumed that hunter-gatherer groups in Southeast Asia in general, and northern Luzon in particular, independently adopted domestication of plants as an additional resource. The shift, according to her, was due to population and resource pressure. Unfortunately, there are no archaeological data concerning plant domestication in the Philippines during the late Pleistocene or even the early Holocene (Bellwood and Glover 2005:5). Current evidence suggests that migrating early farmers brought domesticated plants and animals into the Philippines. There are only a few places in the world that saw purely indigenous local evolution from foraging to agricultural subsistence (Bellwood 1995).

FORAGING IN A TROPICAL FOREST ENVIRONMENT

A crucial debate in reconstructing prehistoric hunter and gatherer subsistence strategy concerns the issue of whether inland tropical forest resources are sufficient to sustain human subsistence. Headland (1986; Headland and Reid 1989) and later Bailey *et al.* (1989: 73) questioned the possibility of hunters and gatherers subsisting in interior tropical rain forest without support from agriculturists. They noted problems with continued access to carbohydrate resources, which could be patchy, scarce and seasonal, and wild forest animals that are lacking in fat (Bailey *et al*. 1989; Bailey and Headland 1991; Headland 1986; Headland and Bailey 1991; Headland and Reid 1989). However, there are ethnographic accounts pointing to the occurrence of seasonal hunting of animals such as wild pigs that are rich in fat (Griffin 1984, 1985; Griffin and Estioko-Griffin 1978; Mudar 1985).

Headland reasoned that the availability of wild yams in the rainforest would not have been sufficient to sustain the carbohydrate needs of hunter and gatherers. He argued:

> such wild foods are so scarce in rainforest environments that they could not support human foraging populations unless they supplemented their diet by part time cultivation and/or trade with neighboring farmers. (Headland 1986: 179)

Bailey *et al*. (1989:61), in addition to raising the scarcity of carbohydrates, also pointed to the protein and fat requirements of a hunting group. The rainforest animals they hunted are distributed in patchy areas and are lean and lacking in calorie-rich fat. Both Headland and Bailey (1991) think that extant hunters and gatherers survive in interior rainforest because of resources derived from agriculturists. They also sometimes practice a limited form of farming, and now inhabit forest that has been substantially modified by clearing, burning, and swidden farming to allow cultigens or exotic plants to grow.

In a special edition of *Human Ecology* (1991), a number of arguments were raised against Headland and Bailey's hypothesis. Brosius (1991) and Endicott and Bellwood (1991) argued for independent inland Hoabinhian and ethnographic foragers in Peninsular Malaysia. Brosius contended that though foragers in tropical rainforests exploit diverse resources, some existing foragers focus on a limited range of plants and animals, to the extent that they are managing these resources. An example of such management of forest resources is the utilization of sago (*Eugeissona utilis*) by Penan foragers in Borneo (Brosius 1991:142).

Brosius also raised the important point that extant foragers now live in interior areas, though before they might have been living in the alluvial and coastal areas

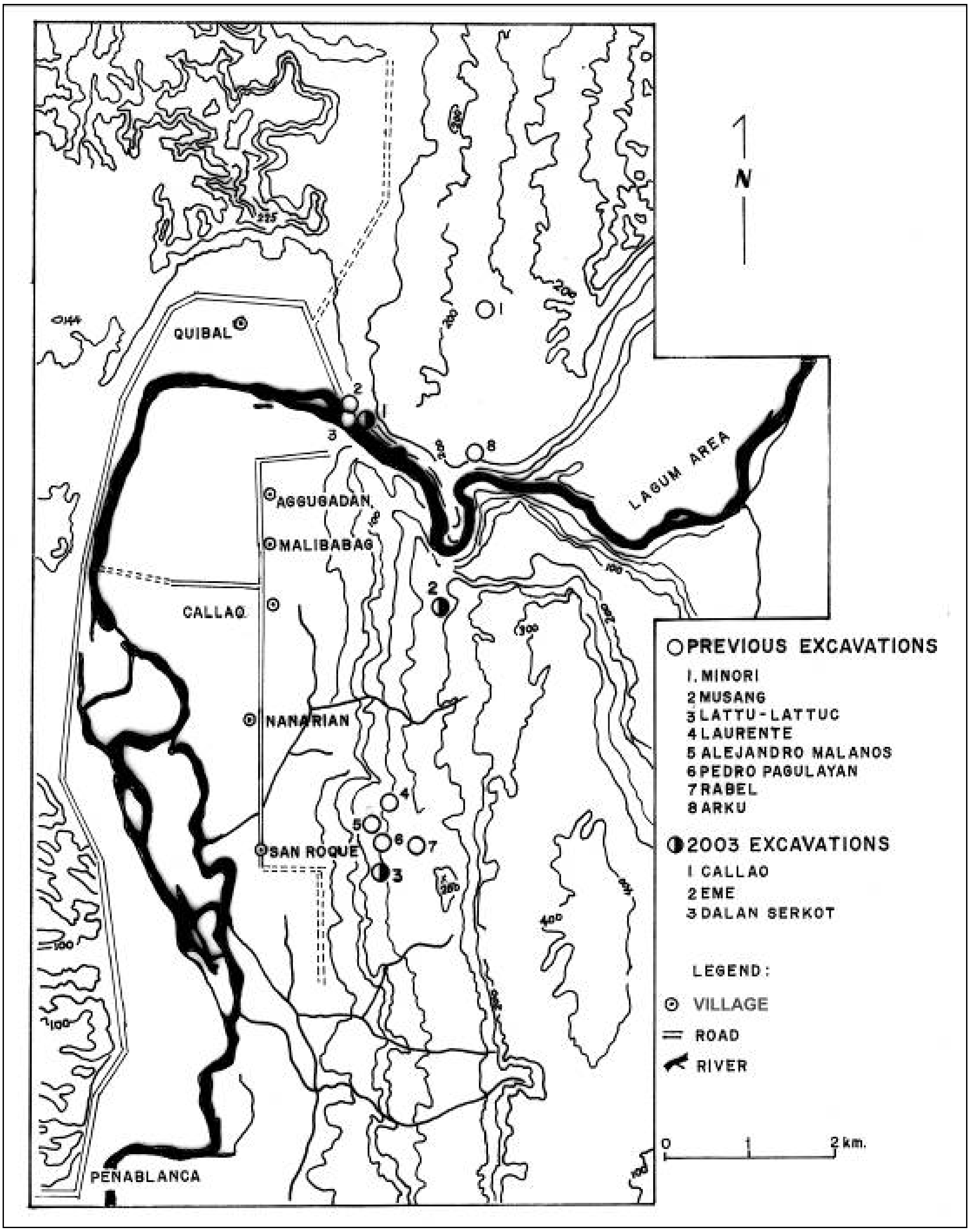

Figure 2. Locations of the archaeological sites excavated

now inhabited by agriculturists. These alluvial plains are rich in resources, including fish and shellfish. Therefore, current observations of extant interior foragers might not be sufficient to reconstruct past subsistence strategies in full.

The Batek of Peninsular Malaysia were also observed to have survived with minimal or no support from agriculturist neighbours. Endicott and Bellwood (1991:154) observed that they had access to wild yams (*Dioscorea* sp.), honey, games and fish throughout the year. They also challenged the view of Headland that yams were always scarce and seasonal. *Dioscorea* yams are available every month, although the quantities might vary. They also cite the archaeological record that spans up to 10,000 years with evidence of pre-agricultural occupation in the interior Malay Peninsula.

Latinis (2000) and Kealhofer (2003) propose that subsistence in lowland rainforest must have been based on an arboreal subsistence economy:

> An arboreal-based subsistence economy is a subsistence economy whose practitioners meet a majority of their dietary, nutritional and economic needs through

> the exploitation of arboreal resources including resources other than trees that are located in or proximate to a forest environment (Latinis 2000:43).

Arboreal based economies would require some management of activities that might include clearing and low level burning to enhance edible plant densities. Forest plants such as sago, root crops, and nuts could have been easily managed.

The Malay Peninsula rainforest witnessed disturbance and burning during the early Holocene (Kealhofer 2003) that may relate to increased forest management. The change in mainland Southeast Asia from flake tools during the late Pleistocene to pebble tools during the early Holocene might actually indicate adaptation to rain forest conditions.

NORTHERN LUZON AT AROUND 25,000 BP

The lower layers of Callao Cave have evidence of human occupation dating to 25,968±373 uncal. BP (Wk-14881). The earliest lithic assemblage, at Callao Cave, was mainly manufactured on chert. The flakes were manufactured with simple percussion techniques. Use-wear analysis on the chert flakes shows that most were used on hard contact materials, possibly wood (Moraceae family), bamboo or rattan (Mijares 2006). However, the recovery of more blade-like flakes in the preceramic period in Callao Cave could signify some variation in the lithic tradition through time (Fig. 3).

Figure 3. Callao Cave Late Pleistocene chert flake tools

The possible evidence for a use of spear or arrow points from two blade-like flakes hints at a more formal lithic technology. Unfortunately, we do not have evidence yet from the Philippines for stone points made with the prepared platform techniques reported by Glover (1977, 1981) from late Pleistocene Leang Burung 2 in South Sulawesi, or the bifacial techniques reported by Bellwood (1988) for the Tingkayu industry from Sabah, or the backing and serrating techniques used in the Holocene Toalian industry of South Sulawesi. Callao Cave is also the only Cagayan Valley assemblage dating to c 25,000 BP found so far. The lithic assemblage is small (n=25 flakes), thus limiting our analysis and interpretation. We need to verify this lithic technology in other cave sites of the same time period.

The Tabon Cave lithic assemblage from Palawan also has only flakes made on chert using a simple percussion technique (Fox 1970), plus a few retouched flake scrapers. Use-wear analysis of the Tabonian chert flakes shows that most were used on hard contact material (Mijares 2004). The chert assemblage from the lower layer of Callao cave could easily fit within the Tabonian tradition in terms of technology and use-wear. We can infer that the oldest discovered hunters and gatherers of Luzon probably migrated via Palawan at least 30,000 years ago. The archaeological survey of Batanes shows no preceramic occupation, so arrival from Taiwan is not likely (AFAP 2002; Bellwood 2005; Bellwood and Dizon 2005). This lower layer in Callao Cave also has traces of hearths, identified in the field and in soil thin-section, the latter containing reddish orange nodules of burnt sediment as well as a high incidence of charcoal. Faunal remains were also recovered, but unfortunately they were too burnt beyond recognition for species identification. No human remains were recovered from this time period to inform about skeletal morphology or diet.

The exploitation of forest products such as wild tubers can be glimpsed in the presence of charred parenchymatous tissues (Fig. 4) and starch grains (Paz and Carlos 2005). Parenchymatous tissues are burnt botanical remains that sometime have traces of plant structure (Paz 2001). Unfortunately, these plant remains could not be identified to species level. Grasses and Moraceae phytolith (Figs 5 and 6) were identified by Jeff Parr (2005) in Callao Cave. These grasses and fibres from Moraceae tree bark were probably utilized as raw materials for mats, baskets and nets. These late Pleistocene foragers exploited forests and open grasslands.

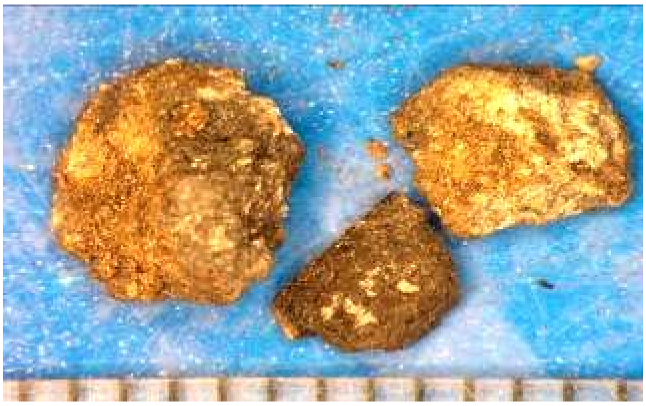

Figure 4. Callao Cave parenchymatous tissues (scale in mm, courtesy of Paz and Carlos)

There is large time gap in our archaeological record for the Peñablanca area. After the 26,000 BP level in Callao Cave, the next dated assemblage is only 12,000 BP, from Musang Cave (Thiel 1990). The reason for this large time gap could simply be archaeological visibility, since most cave sites in Peñablanca were not excavated to bedrock. Of the eleven caves excavated, only three were excavated to the bedrock and eight have radiocarbon dates mostly dating to after 10,000 BP. Even the previous

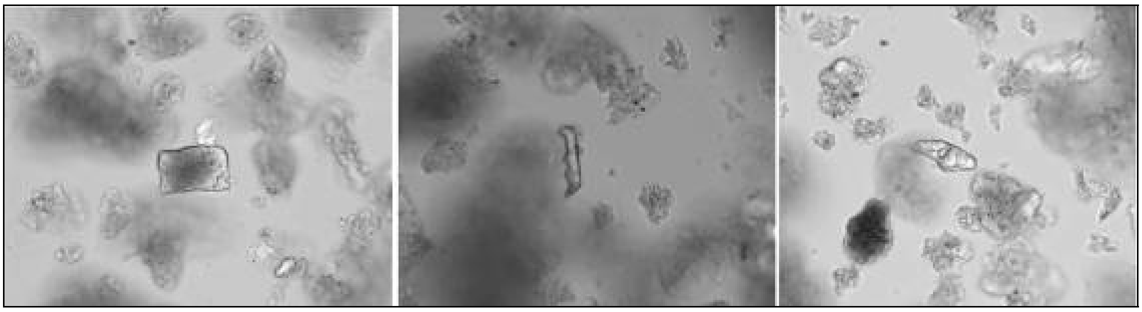

Figure 5. Poaceae phytoliths: [a] block type, [b] long type and [c] prickle type (7 x 11 µm across taken at 400x magnification courtesy of Jeff Parr)

1980 excavation of Callao Cave, that reached 7.5 meters below surface, failed to reach bedrock. An alternative explanation for the Peñablanca area is that foragers during this hiatus were hunting and gathering in the alluvial plains of the Cagayan Valley. The thin lower archaeological deposit at Callao Cave might therefore represent a brief incursion into the foothills of the Sierra Madre.

Figure 6. Possible Moraceae phytolith (18 to 20 µm across taken at 400x magnification, courtesy of Jeff Parr)

There is still a need to search for sites within this time period to enhance our knowledge of this era in Luzon. Callao Cave may still reveal more secrets since we have not yet reached the basal layer. The 26,000 BP layer is only 130 cm below the current surface, and we know from the earlier excavations that the deposits are at least seven meters deep.

Based on the current archaeological record from Callao Cave, we now have evidence for human occupation in northern Luzon c. 25,000 years ago. The possibility of finding an older cultural horizon (c. 40,000 BP) in Luzon is promising, because since modern humans have inhabited Palawan Island since 47,000 years ago (Dizon 2003). These Late Pleistocene hunters and gatherers could have crossed from Palawan, which is part of Sundaland, into the rest of the Philippines by raft. Elsewhere, modern humans also reached some of the more remote islands in Southeast Asia around 35,000 years ago, or earlier, such as Talaud, the northern Moluccas, northern Sulawesi and East Timor (Bellwood 1979, 1997; Bellwood *et al.* 1998, Glover 1977; Tanudirjo 2001)

NORTHERN LUZON AT 12,000 TO 3500 BP

Dalan Serkot

There are a number of chert and andesite flakes from Dalan Serkot Cave. A piece of charcoal attached to a chert flake from a depth of 70 cm yielded an AMS radiocarbon determination of 6124±48 uncal. BP, or 7260-6990 cal. BP (Wk-14879, Oxcal: Bronk Ramsey 1995). Riverine gastropod shells dominated in this layer. Faunal remains include three deer teeth and a pig tooth. The lower preceramic horizon at Dalan Serkot has no recovered parenchymatous tissue. One unidentified seed was observed.

Eme Cave

Flake tools and debitage of andesite, chert and basalt were the only cultural materials recovered. Land snail and riverine shells, and teeth of deer (*Cervus* sp.) and pig (*Sus* sp.) were also recovered, as well as continuing large quantities of bat bones. The radiocarbon determination on charcoal from 67 cm below surface is 3569 ± 52 uncal. BP or 3990-3690 cal. BP (Wk-14883). This preceramic layer also has sclerotia bodies and a few *Boehmeria* cf. *platanifolia* seeds. Again, charred parenchymatous tissues, charred pieces of nut and seed, and wood fragments were also present.

Stone tool manufacture remained simple and expedient throughout this period (c. 12,000 and 3500 BP). Chert and newly added volcanic rocks (andesite and basalt) were subjected to simple percussion techniques to produce amorphous flakes (Mijares 2005, 2006). The volcanic rocks were probably derived from the riverbed, and there are a few chert sources along the Callao Limestone Formation such as those near Dalan Serkot Cave. Retouching or further modification of flakes was no longer practiced in this period, perhaps due to the ready availability of volcanic pebbles. Retouching of coarse-grained volcanic rocks would also produce a duller and thicker edge compared to a newly produced flake, so the practice was apparently discontinued. The Peñablanca cave sites have produced very few pebble tools.

Use-wear analysis of flakes from the preceramic horizons shows that about half were used on hard contact materials, possibly bamboo, palm and rattan, which are ubiquitous in the region (Mijares 2002). These activities might have included the manufacture of spears, bamboo knives, traps, or the making of mats. Some flakes were used in meat processing, as they exhibit soft contact use wear attributes. Bones of pig (*Sus*) and deer (*Cervus*) were associated with the assemblages. This range of use wear was also observed on the flakes recovered from the ceramic horizons.

If early Holocene foragers were also practicing an arboreal subsistence economy, as Latinis (2000) has proposed for their contemporaries in eastern Indonesia and Near Oceania, the evidence is not visible in the Peñablanca cave sites. Arboriculture might have been practiced on the alluvial plains and terraces of the Cagayan Valley, where industries with more chopper and chopping tools existed, such as the Cabalwanian. The Cabalwanian has about 7 percent pebble-cobble tools in its assemblage; the remainder are flake tools (Fox and Peralta 1974).

Between 12,000 and 3500 BP the Peñablanca caves seem to have been used by foraging groups as ephemeral hunting and collecting campsites. Perhaps people moved in and out seasonally from the rich estuarine/riverine environment of the Cagayan Valley. Like many foragers at this time in Southeast Asia they practiced a broad-spectrum subsistence strategy (Barker 2005; Barker *et al.* 2002; Gorman 1971), hunting pig (*Sus philippinensis*), deer, monkey, reptiles, felids and birds, as well as engaging in shellfish gathering. Wild tubers (as seen in the charred parenchymatous tissue in the Eme Cave preceramic horizon), seeds and nuts are also likely to have been exploited.

DISCUSSION AND CONCLUSIONS

The model that Warren Peterson (1974) and Barbara Thiel (1980) proposed for Northern Luzon, in which internally generated population increases are stated to have caused changes in subsistence economy among these late Pleistocene to mid-Holocene forager communities, cannot be substantiated from the data at hand. Peterson favoured a narrow to broad-spectrum trajectory, and Thiel a broad spectrum to specialized (narrow) subsistence strategy. But neither hypothesis stands up in the face of the current archaeological record. We do not have any reliable evidence of population growth during this period from which to posit any population pressure. Population growth can be estimated with increase in the number of sites through time or the intensity of materials deposited in cave sites. As was said earlier, there are few sites known during this time period and it will be difficult to assess if the carrying capacity of the area had been reached (population pressure) to warrant a change in subsistence. Even Peterson (1974) and Thiel (1980) did not present any data in their estimate for population increase but rely on the assumption of the model that there was population pressure. There were also no major changes in lithic technology, and the available floral and faunal evidence shows a continuing broad-spectrum subsistence strategy.

Contrary to Headland and Bailey (1991), who questioned the possibility of hunters and gatherers subsisting in tropical rain forest without support from agriculturists, hunter-gatherers I believe did subsist in Holocene tropical rainforests, as in Mainland Southeast Asia (Endicott and Bellwood 1991). Their success in exploiting and living in the forest would have depended on their foraging skills and knowledge of different ecosystems. Resources in rainforest can be patchy and seasonal, but foragers can strategise and optimise their movements to correspond to the shifting food resources (Winterhalder 2001).

The Sierra Madre Agta of the recent ethnographic past would plan their group movements based on the seasons and available food sources (Allen 1985; Griffin and Estioko-Griffin 1978; Mudar 1985). They hunted in the montane forest during the rainy season and in the lowland forest during the summer, deriving most of their food supply from fishing, shellfish gathering, wild yams, nuts and *Caryota* palms. Mid-Holocene foragers could easily have done the same.

Cave sites, because of their good stratigraphic contexts and good preservation, have been major sources of information for prehistoric reconstruction. Cultural changes in the Cagayan Valley open sites are at least partially reflected in the archaeological records of the caves that played such an important role in the lives of the hunter-gatherers. The Peñablanca Cave sites have therefore contributed information relevant for interpreting the entire sequence and chronology of the Cagayan Valley archaeological landscape.

The problem related to the dating of the Cabalwanian industry remains unresolved. The archaeological community in the Philippines is divided in this issue of wether its associated with the extinct mammals, hence the possibility of *Homo erectus* in Luzon, or it is not associated hence they were made by modern humans. The only way to resolve the chronology of the Cabalwanian industry is to undertake excavations to recover stone implements and megafauna *in situ*, and to date them independently using luminescence and uranium series techniques, respectively (Morgenstein *et al.* 2003).

ACKNOWLEDGEMENTS

This research has benefited from the support of many people. First of all I would like to express my deepest gratitude to Peter Bellwood, Atholl Anderson, Matthew Spriggs, Glenn Summerhayes and Johan Kamminga for their advice. I am also grateful for the contributions of specialists who conducted different material analyses: Victor Paz and Jane Carlos for conducting the macrobotanical analysis, Jeff Parr for his phytolith analysis, Angel Bautista and Carmencita Mariano for their identification of the faunal remains. I also would like to extend my gratitude for the support of the National Museum of the Philippines and in particular, Director Corazon Alvina, Wilfredo P. Ronquillo, Eusebio Dizon, Cecilio Salcedo and Maharlika Cuevas. The National Museum personnel who assisted in the excavations; Clyde Jago-on, Alexandra De Leon, Nida Cuevas, Pablo Pagulayan and Domeng Pagulayan. Eduardo Bersamira and Antonio Peñalosa drew the Scientific Illustrations. I am grateful for the comments of the two reviewers in improving this paper. And to my wife Aileen May Paguntalan-Mijares for her unwavering support in all my endeavours.

REFERENCES

AFAP 2002. Report on the Archaeological Research in Batanes and Ilocos Norte Provinces, northern Philippines. *Unpublished report prepared by Asian Fore-Arc Project.* Canberra.

Allen, M. 1985. The rainforest of northeastern Luzon and Agta foragers. In P.B. Griffin and A. Estioko-Griffin (eds), *The Agta of Northeastern Luzon: Recent Studies,* pp. 45-68. Cebu: San Carlos Publication.

Bailey, R., G. Head, M. Jenike, B. Owen, R. Rechtman and E. Zechenter 1989. Hunting and gathering in tropical rain forest: is it possible? *American Anthropologist* 91: 59-82.

Bailey, R. and T.N. Headland 1991. The tropical rain forest: is it a productive environment for human foragers? *Human Ecology,* 19, pp. 261-285.

Barker, G. 2005. The archaeology of foraging and farming at Niah Cave, Sarawak. *Asian Perspectives,* 44**,** pp. 90-106.

Barker, G. *et al.* 2002. Prehistoric foragers and farmers in South-Aast asia: renewed investigation at Niah Cave, Sarawak. *Proceedings of the Prehistory Society,* 68**,** pp. 147-164.

Bellwood, P. 1979. *Man's Conquest of the Pacific: The Prehistory of Southeast Asia and Oceania,* New York: Oxford University Press.

Bellwood, P. 1997. *Prehistory of the Indo-Malaysian Archipelago,* Honolulu: University of Hawaii Press.

Bellwood, P. 2005. *First Farmers: The Origins of Agricultural Societies,* Oxford: Blackwell Publishing.

Bellwood, P. & Dizon, E. 2005. The Batanes Archaeological Project and the "Out of Taiwan" hypothesis for the Austronesian dispersal. *Journal of Austronesian Studies,* 1**,** pp. 1-32.

Bellwood, P., G. Nitihaminoto, G. Irwin, Gunadi, A. Walayu and D. Tanudirjo 1998. 35,000 years of prehistory of northern Moluccas. In G. Bartstra (ed.), *Bird's Head Approaches,* pp. 233-274 Rotterdam: Balkema.

Bronk Ramsey C 1995. Radiocarbon calibration and analysis of stratigraphy: the Oxcal program. *Radiocarbon* 37(2): 425-430.

Brosius, J. P. 1991. Foraging in tropical rainforests: The case of the Penan of Sarawak, east Malaysia (Borneo). *Human Ecology,* 19, pp. 123-150.

Dizon, E. 2003. New direct dating of human fossils from Tabon Cave, Palawan, Philippines. *Proceedings of the Society of Philippine Archaeologists* 1**,** pp. 63-67.

Endicott, K. and P. Bellwood 1991. The possibility of independent foraging in the rainforest of Peninsular Malaysia. *Human Ecology,* 19**,** pp. 151-185.

Fox, R. 1970. *The Tabon Caves.* Manila: Monograph of the National Museum No. 1.

Fox, R. and J. Peralta 1974. Preliminary report on the Paleolithic archaeology of Cagayan Valley, Philippines, and the Cabalwanian Industry, *First Regional Seminar on Southeast Asian Prehistory and Archaeology,* pp. 100-47. Manila: National Museum.

Glover, E. 1981. Leang Burung 2: shell analysis. *Modern Quaternary Research in Southeast Asia,* 6**,** pp. 45-50.

Glover, I. 1977. The Late Stone Age in Eastern Indonesia. *World Archaeology,* 9**,** pp. 42-46.

Gorman, C. 1971. The Hoabinhian and after: subsistence patterns in Southeast Asia during the late Pleistocene and early Recent periods. *World Archaeology,* 2**,** pp. 300-320.

Griffin, P. B. 1984. Forager resources and land use in the humid tropics: the Agta of northeastern Luzon, the Philippines. In C. Schrire (ed.), *Past and Present in Hunter Gatherer Studies.* New York: Academic Press, Inc.

Griffin, P. B. 1985. A contemporary view of the shift from hunting to horticulture: the Agta case. In V.N. Misra and P. Bellwood (eds), *Recent Advances in Indo-Pacific Prehistory,* pp. 349-52. New Delhi: Oxford and IBH.

Griffin, P. B. and A. Estioko-Griffin 1978. Ethnoarchaeology in the Philippines. *Archaeology,* 31**,** pp. 34-43.

Headland, T. N. 1986. Why Foragers do not Become Farmers: A Historical Study of Changing Ecosystem and its Effect on the Negrito Hunter-Gatherer in the Philippines. Unpublished PhD Thesis. University of Hawaii.

Headland, T. N. and R. Bailey 1991. Introduction: have hunter-gatherers ever lived in tropical rain forest independently of agriculture? *Human Ecology,* 19**,** pp. 115-122.

Headland, T. N. L. Reid 1989. Hunters and gatherers and their neighbors from prehistory to the present. *Current Anthropology,* 30, pp. 43-46.

Latinis, K. 2000. The development of subsistence system Models for island Southeast Asia and near-Oceania: the nature and role of arboriculture. *World Archaeology,* 32**,** pp. 41-67.

Mijares, A. S. 2002. *The Minori Cave Expedient Lithic Technology,* Quezon City: University of the Philippines Press.

Mijares, A. S. 2004. Lithic analysis of recently excavated Tabon Cave flakes. *Proceedings of the Society of Philippine Archaeologists,* 2**,** pp. 15-19.

Mijares, A. S. 2005. The archaeology of Peñablanca Cave sites, northern Luzon, Philippines. *Journal of Austronesian Studies,* 1**,** pp. 65-93.

Mijares, A. S. 2006. Unravelling Prehistory: Archaeology, Northeastern Luzon, Philippines. Unpublished PhD Thesis. Canberra, The Australian National University

Morgenstein, M. E., S. Luo, T.-L. Ku and J. Feathers 2003. Uranium-series and luminescence dating of volcanic lithic artefacts. *Archaeometry,* 45**,** pp. 503-518.

Mudar, K. 1985. Bearded pigs and beardless men: predator-prey relationships between pigs and Agta in northeastern Luzon, Philippines. In P.B. Griffin and A. Estioko-Griffin (eds), *The Agta of Northeastern Luzon: Recent Studies,* pp. 69-84. Cebu.

Parr, J. 2005. Report on the analysis of microbotanical remains from Callao Cave. Unpublished Manuscript. Canberra: *ANH-RSPAS-ANU.*

Paz, V. 2001. Archaeobotany and Cultural Transformation: Patterns of Early Plant Utilisation in Northern Wallacea.

Unpublished PhD Thesis, University of Cambridge, Cambridge

Paz, V. and J. Carlos 2005. Eme, Callao and Dalan Serkot Caves: analysis of plant macro-remains. Unpublished Manuscript. Quezon City: *UP ASP*.

Peterson, W. 1974. Anomalous Archaeological Sites of Northern Luzon and Models of Southeast Asian Prehistory. Unpublished PhD Thesis, Honolulu, University of Hawaii, Manoa.

Tanudirjo, D. 2001. Islands in Between: Prehistory of the Northeastern Indonesian Archipelago. Unpublished PhD Thesis, Canberra, Australian National University.

Shutler, R. and M.E. Mathisen 1979. Pleistocene studies in the Cagayan Valley of northern Luzon, Philippines. *Journal of the Hong Kong Archaeological Society*, 8, pp. 105-114.

Thiel, B. 1980. Subsistence Change and Continuity in Southeast Asian Prehistory. Unpublished PhD Thesis. Illinois, University of Illinois at Urbana-Champaign.

Thiel, B. 1990. Excavation at Musang Cave, northeastern Luzon, Philippines. *Asian Perspectives*, 28**,** pp. 61-81.

Wasson, R. and R. Cochrane 1979. Geological and geomorphological perspectives on archaeological sites in the Cagayan Valley, northern Luzon, Philippines. *Modern Quaternary Research in Southeast Asia*, 5**,** pp. 1-26.

Winterhalder, B. 2001. The behavioural ecology of hunter-gatherers. In C. Panter-Brick, R. Layton, and P. Rowley-Conwy (eds), *Hunter-gatherers: an interdisciplinary perspective*, pp. 12-38 Cambridge: Cambridge University Press.