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Plant microfossils in prehistoric archaeological deposits from Yuku rock shelter, Western Highlands, Papua New Guinea

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Abstract

Plant microfossil analysis was carried out on anthropogenic deposits from Yuku rock shelter, possibly occupied from before 14,200 cal. BP to recent times, in the Papua New Guinea Highlands. *Elaeocarpus* pollen has extremely high percentages throughout. Starch residues of lesser yam (*Dioscorea esculenta*) and one or more, undifferentiated *Dioscorea* species were identified, suggesting processing of these taxa since first use of the site. The latter include *Dioscorea alata*, *Dioscorea bulbifera*, *Dioscorea nummularia* and *Dioscorea pentaphylla*. Pollen and phytoliths of banana (*Musa*) appear 5200 cal. BP. We cannot differentiate between naturally growing and cultivated yams and bananas. Putative truffle (hypogeous Ascomycotina) spores in the deposits suggest foraging of truffles.

Keywords: Plant microfossils; *Dioscorea*; *Musa*; Prehistoric plant subsistence; New Guinea Highlands

1. Introduction

The history of plant use and cultivation in the Highlands of Papua New Guinea has been extensively studied, particularly since the 1970s and 1980s, with archaeological excavations at Kuk, a wetland site in the upper Wahgi Valley (Golson, 1977, 1997; Golson and Hughes, 1980). The site has a variety of landscape features, including ditch systems, identified as agricultural and dated from c. 10,000 BP until c. 100 BP (Golson, 1997). Wilson (1988) found banana (Musaceae) phytoliths in the wetland deposits. More recent investigations at Kuk provided further evidence that plant exploitation and cultivation occurred there from c. 10,000 BP, as shown by starch residues of taro (*Colocasia esculenta*) and yams (*Dioscorea*) identified on stone tools. Banana (*Musa*) phytoliths were also identified in the sediments from the same time (Denham et al., 2003, 2004; Fullagar et al., 2006). The various lines of evidence from Kuk very strongly suggest that agriculture arose independently in the region (Denham et al., 2003).

Remains of ditch systems have also been found at other archaeological sites in the Wahgi Valley, at Manton (e.g., Powell, 1970a, 1970b) and Kana (Muke and Mandui, 2003). Macrofossils of introduced wax gourd (*Benincasa hispida*) were identified at these sites and dated to after c. 5500 BP (Golson, 2002; Matthews, 2003).

Earlier sites of human activity in the Highlands (pre-10,000 BP) include several rock shelters. The earliest of these is Nombe (White, 1972; Mountain, 1981, 1991), the first occupation of which is dated c. 30,000 BP. Kosipe, an even earlier open site in the Papuan Mountains north of Port Moresby, was first occupied c. 35,000 BP (White et al., 1970; Hope, 1982; Fairburn et al, 2006). This site is associated with harvesting of *Pandanus* nuts near the upper edge of the Pleistocene forest and continuing into the Holocene.

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Yuku is a rock shelter interpreted as a seasonal hunting and foraging camp, occupied before the beginning of agriculture, earlier than c. 14,200 BP (Bulmer, 1966, 1975, 2005). Macrofossils of several plants were found in this site, including both nut and fruit *Pandanus* species, a knife made of bamboo (Bambuseae), and sugar cane (*Saccharum*). We thought that analysis of plant microfossils in the previously collected deposits from Yuku might provide further evidence of ancient plant use and cultivation in the New Guinea Highlands. We present here results of pollen, phytolith and starch residue analysis of samples from this rock shelter.

2. The Yuku rock shelter site

Yuku is a limestone rock shelter (1280 m) situated in the valley of the Yuem River, a tributary of the Lai River, and west of the Baiyer Valley, Western Highlands Province, Papua New Guinea (Fig. 1). The valley has a lower-montane humid climate. Kuk, 30 km SE at 1560 m, has a mean annual temperature and rainfall of ~19 °C and ~2700 mm (Denham et al., 2003). The forest vegetation of the lower part (up to 1500 m) of the lower-montane zone (1000–3000 m) of the Highlands has much *Castanopsis*, *Lithocarpus*, *Elaeocarpus*, *Sloenea*, *Cryptocarya*, *Syzygium* and *Planchonella* (Paijmans, 1976). The Yuem Valley has been largely deforested. Today, people live and practice horticulture there, and at the time of excavation the shelter was within a gardened area and used for occasional sacrificial cooking of game.

The Yuku rock shelter (facing NNE) has ~21 m^2 of ground protected by the overhang, ~9.5 m^2 of which was excavated in 1959 (Bulmer, 1966, 2005). It contained 3.6 m of stratified occupation deposits (mostly mixed wood ash and clay), which were excavated in seven main layers defined by changes in components such as artefacts, colour and texture (Fig. 2). The more complex thicker layers were subdivided (e.g., layer 3a–c). All layers contained habitation material. For consistency, we refer to the radiocarbon chronology of the Yuku rock shelter and other Highland sites as published in previous studies (Bulmer, 1966, 1975, 2005), with calibrations in the latter based on CALIB 3.1 (Stuiver and Reimer, 1993) using the mid-point of the calibration ranges at 200 year intervals. As the dated material from Yuku includes bone which is potentially problematic (Beavan-Athfield et al., 2001), for this study we consider the chronology preliminary; further dating in planned.

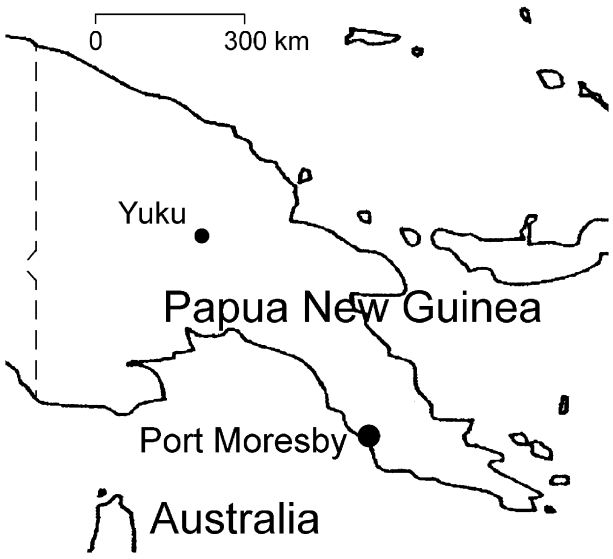

Fig. 1. Site location map.

The upper two layers were visibly disturbed. The surface layer (1) comprised a soft grey deposit up to 20 cm thick from which cooking pits, fireplaces and postholes were dug on the open side of the shelter, the deepest of which penetrated through layer 2 (loosely packed, medium brown) to the top of layer 3.

The top of layer 3 was loosely packed fine material with small rock fragments. Three burials were interred on the surface and in shallow pits in this layer. They was no sign of compaction of the surface of layer 3a, but the absence of cooking features and postholes indicates that the use of the shelter for camping was interrupted for a period after the deposition of layer 3a.

Layers 3–5 were a series of progressively thicker layers showing increasing cementing and quantities of rock fragments. Layer 3 (dark greyish brown) was ~50 cm thick with layer 3a dated to c. 5200 cal. BP. Layer 4 (light grey) was ~60 cm thick, with layer 4c dated to c. 11,000 cal. BP. Layer 5, ~80 cm thick, comprised partly cemented rock fragments and variously coloured ashy clay, and reddish clay sloping in from both sides of the shelter. The latter is thought to be an inwashed deposit. Layer 5c is dated c. 14,200 cal. BP.

Layer 6, ~50 cm thick, comprised partly cemented greyish-red ashy clay and rock fragments. Layer 7 (reddish) was partly cemented with water worn rocks, interpreted as originating from the time the shelter was on the bank of the Yuem River. Since then the river has receded ~30 m from the site, from down-cutting of the bed. There are no radiocarbon dates for the base of the site; since this is ~120 cm below layer 5b (c. 14,200 cal. BP), it may be considerably older.

Yuku rock shelter contained a variety of cultural materials that indicated it was occupied by hunter-gatherers until c. 5200 cal. BP (layers 7–3) (Bulmer, 2005). Subsequently (layers 2 and 1, undated), the site appears to have been used by people dwelling elsewhere as a cooking site. Plant remains identified included *Pandanus* (prob. *Pandanus julianettii*) nuts and seeds of *Pandanus conoideus* fruits in layers 1–5b, a bamboo knife in layer 5a, and a wad of sugar cane fiber in an undated crevice (Bulmer, 1966). The site also contained bone artefacts and bones of numerous animals (Bulmer, 1979). A total of 35 species were identified, including pig from layer 5a (i.e., before c. 11,000 cal. BP) to layer 1. A wide variety of stone artefacts (a total of 265, as well as ~800 waste flakes) were also found in the shelter, all made of locally available rock except for polished axes obtained from elsewhere. The stone artifacts included axes and axe-like artefacts, large hand tools, cores, flake tools, hammers and grinders. For detailed interpretation of these and tools from prehistoric sites elsewhere in the Highlands, see Bulmer (2005).