

LANDSCAPE USE AND ENVIRONMENTAL MANAGEMENT OF TROPICAL
RAINFOREST BY PRE-AGRICULTURAL HUNTER-GATHERERS IN NORTHERN
SAHULLAND

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INTRODUCTION

Human beings have always had the potential to manage, control and therefore change their environment. It is easy to document evidence for such control and change with the beginnings of agriculture and the widespread clearance of forest in the Holocene. However, even early species of humans must have had a physical effect on the geographic regions in which they lived and such effects must have increased with developing social systems and proliferating populations. The documentation of such changes through archaeological and environmental evidence is not so easy. Certainly there seems to be no reason why the *Homo sapiens* hunter-gatherers of the late Pleistocene should not have been as effective in environmental management on a small scale as were their later descendants. The physical and mental attributes of these late Pleistocene people were similar to those of any later peoples and their traditions and community knowledge had accumulated over thousands of years of experience and adaptation, if we accept the thermoluminescence dates of around 90,000 years from the eastern Mediterranean (Valladas *et al.* 1988) and southern Africa (Stringer and Andrews 1988) for the full establishment of the species. Comparable dates have not yet emerged in Asia, and the debate over whether regional development or total replacement from Africa was the mechanism for the evolution of our species is not resolved (Stringer 1990). As Stringer points out (1990:27), however,

... if our true ancestors were still restricted to Africa 130,000 years ago, Asia must have been the primary dispersal centre for the subsequent radiation of modern humans around the rest of the world and the place of origin of many of the behavioural innovations that this dispersal would demand.

As Allen (1989) notes, the earlier dates now allow far more time for physically modern humans to spread into Sahulland¹ and the suggestion, from Roberts *et al.* (1990), that the

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first settlers arrived in northern Australia between 60,000 and 40,000 years ago, can be easily accommodated. The thermoluminescence dates of more than 40,000 years obtained from tephra sealing large waisted axes at the Huon terraces on the north coast of Papua New Guinea (Groube *et al.* 1986) also fit this scenario. Allen (1989) examines some of the research problems involved in the history of early dating for Australian Pleistocene sites. Two of these are particularly relevant to research within the northern regions of Sahulland. Firstly, there is the difficulty of dating artefacts from sites which lack associated materials suitable for dating by conventional radiocarbon techniques (for example, the waisted axes already mentioned from the Huon terraces in Papua New Guinea). Secondly, there is the problem of environmental change (especially vegetation firing) resulting from human activity when it is unassociated with clear evidence for the presence of humans (for example, palynological sites in the highlands of New Guinea).²

LATE PLEISTOCENE HUMAN OCCUPATION IN NORTHERN SAHULLAND AND NEAR OCEANIA

At present, it can be hypothesised that human activity played an integral part in environmental development within this region from initial dates in the range 40,000-28,000 years ago. Archaeological and environmental evidence comes from a range of sites from the northern coast of Sahulland (Groube *et al.* 1986; Groube 1989) to the highlands of New Guinea (Hope 1982; Haberle *et al.* 1991; Mountain in press) and several of the islands in the region that Green has called Near Oceania.³

Whatever the precise dating of these early activities, it is clear that the early travellers were capable of formidable sea crossings amongst the island archipelagos to the north and east of the mainland of the Pleistocene continent of Sahul. Evidence for Pleistocene site occupation has been found at Kilu on Buka Island at the northern end of the Solomons chain (Wickler and Spriggs 1988), Pamwak on Manus Island, the main island in the Admiralty Group (Ambrose and Spriggs pers. comm.), one site on New Britain and several sites on New Ireland (Allen *et al.* 1989). Most of the crossings necessary for such settlement could have been accomplished without losing sight of land, although some of them are far from straightforward for the navigator. Manus, however, could never have been visible from either New Guinea, New Ireland or New Hanover and it was certainly reached by the end of the Pleistocene and probably much earlier (Ambrose and Spriggs pers. comm.). Whichever route was taken (presumably inadvertently at least for the first time) must have involved a crossing of over 200 km.

This range of crossings was surely the result of more than mere haphazard mistakes, although whether they were deliberate voyages of exploration or the result of misadventure during routine coastal manoeuvres or island hopping is hard to prove. They suggest that the Pleistocene hunter-gatherers of northern Sahulland and Near Oceania were, at the least, competent and consistent coastal voyagers.

THE RESOURCE BASE FOR EARLY HUNTER-GATHERERS OF NORTHERN SAHULLAND AND NEAR OCEANIA

Green (in press) and Wickler and Spriggs (1988) emphasise that we have to examine not merely the distance of early sea crossings but also the potential resource base available to support pre-agricultural populations. The coast and inland regions of northern Sahulland would have supplied a far richer and more diverse resource base than even the closest of the islands. Distant island groups, such as Vanuatu and New Caledonia, are much less likely to provide evidence of successful Pleistocene settlement due to the paucity of natural food resources, although more work needs to be carried out on the resource potential of local Pleistocene environments, as well as on the detail of Pleistocene shorelines. So far no Pleistocene sites have been reported on Pacific islands outside Near Oceania.

Jones (1989:755) suggests that at least in the Southeast Asian region "the ability to make and use watercraft of a certain capacity was one of the distinctive skills of 'early man' (and woman). I suggest that these people were also skilled in fields other than coastal voyaging, such as deliberate and competent environments management on a local and very small level.

Once the presence of hunter-gatherers is established, the question has to be raised as to the nature of their activities and their interaction with their environment. In what environmental zones did these hunter-gatherers operate? What resources were they exploiting? For what activities do we have evidence? What effects did such activities have on the environment and the resources? The oldest site in New Ireland, Materkoplum, suggests that its first inhabitants used both terrestrial and inshore marine resources. "The earliest settlers on the New Ireland coast exploited snailfish, crustacea and fish. They also took bats, reptiles, birds and rats" (Allen 1989:151). Plant preparation is suggested by the discovery of starch residues on some of the edges of flaked stones at Kulu cave on Buka (Wickler and Spriggs 1988:705). The Pamwak site on Manus Island was under 10 km from the shore during the Pleistocene but has little surviving evidence for subsistence in the lowest levels (Crombrose and Spriggs pers. comm.). The stone artefacts from the earliest levels at all these sites have not yet been published in detail but appear to include amorphous cores and flakes that vary in size and shape, providing a range of edges usable for a variety of functions, including processing plant food. Further detailed analysis will show how the Pleistocene foragers and collectors on New Ireland, Buka and Manus survived in tropical environments far less rich in flora and fauna than the mainland of New Guinea. One strategy that seems to have been adopted on a number of islands in Near Oceania to combat this problem is the introduction of live mammals from elsewhere (Flannery *et al.* 1988). This in itself is a very sophisticated form of environmental management.

DID HUNTER-GATHERERS SETTLE IN TROPICAL RAINFOREST?

Questions have been raised as to whether hunter-gatherers could ever have supported themselves within tropical rainforest (Bailey *et al.* 1989). Many researchers conclude that

within recent times it is clear that most hunter-gatherers exist in reciprocal, although often spasmodic, relationship with food producers outside the forest areas (eg Peterson 1981; Eder 1988) and that many plants which are staples for hunter-gatherer communities, such as tubers and nuts, do not grow abundantly in primary tropical rainforest (Hart and Hart 1986; Headland 1987). Bailey and his co-researchers (1989) have examined briefly the overall evidence from pre-agricultural periods and found no conclusive indication of the exclusive use of tropical rainforest. They analyse the claims for resource abundance there and agree that, although these terrestrial ecosystems are the most productive on earth, faunal and plant foods suitable for human consumption are neither abundant nor easily accessible. Production is more often in the form of leaves and branches rather than large quantities of fruits, flowers and seeds, while plants that do have edible products are often far apart and difficult to collect. Many of the foods that are produced have hard outer coverings and require prolonged processing (Bailey *et al.* 1989:60). Plant carbohydrates are scarce and difficult to locate and extract (Headland 1987). Headland (1987:466) suggests that at least in the rainforests of eastern Luzon, pre-agricultural occupation would only have been possible by either depending on pig fat (not available throughout the year) or by "practising some type of minor horticulture". Many potential plant foods, such as tubers, nuts and fruits, grow more efficiently at forest edges and in areas of disturbance where the light is greater than in high-canopy, light-reduced, primary forest. In fact, hunter-gatherers who are dependent on tubers often live in tropical rainforest of a monsoonal nature, where a marked dry season provides natural conditions in which tubers thrive (Eder 1988:44), and it is obvious that Bailey *et al.* (1989) have generalised far too broadly about tropical rainforest conditions, which clearly vary considerably from one geographical region to another (Walker and Chen 1987).

Bailey *et al.* (1989) also discuss the faunal diversity within tropical rainforest, which may be high if measured by the total number of species present, occupying the extraordinary number of different ecosystems available from forest floor to canopy height (Bourlière 1983). However, the total animal biomass is often low, since there is a low numerical density for a given species (Eisenberg 1983:275). Lack of carbohydrate and oils in plant foods can be made up with oily meat, but apart from pigs or oily fish, forest animals tend to be extremely lean. Bailey *et al.* (1989:62) suggest that there may have been considerable disturbance of such environments over time by human activity and that perhaps the production of plants suitable for human consumption has been gradually increased through such interference with vegetation distributions. They conclude (Bailey *et al.* 1989:73) with a null hypothesis for which they invite positive response:

We consider it very possible that human adaptability did not include the capacity to subsist for long periods of time in tropical forests until the development of ways to alter the density and distribution of edible resources in tropical forests through domestication of plants and clearing of climax forest.

TROPICAL RAINFOREST IN NEW GUINEA

Clearly, from the evidence already noted, human activity was present within the region of Sahulland and Near Oceania from at least 40,000 years. But, were these hunter-gatherers living exclusively in tropical rainforest?

The first humans to arrive along the northern coasts of New Guinea would have encountered full tropical lowland rainforest with high humidity and high non-seasonal rainfall inland from the coastal mangrove and sago swamps, where light is restricted and access difficult (Johns 1982:314-316). Although not all the fauna and flora would have been familiar to the first hunter-gatherers, they would have recognised a range of plants and marine resources which could immediately be used in everyday life. Evidence for marine resources at Matenkupkum has already been noted (Allen 1989). Unfortunately there is no economic evidence from the Huon terraces (Groube 1989) nor any indication of the duration of human activity involved, but there seems little reason to doubt that early subsistence strategies would have included forest products as well as coastal resources. The early use of the shelter at Pamwak on Manus could be part of such coastal/forest subsistence, since the site was under 10 km from the shore (Ambrose and Spriggs pers. comm.). Such examples do not indicate exclusive settlement within the tropical rainforest.

However, there is abundant evidence to show that from about 30,000 to 10,000 years ago hunter-gatherers were active well away from coastal resources in the montane regions of New Guinea at altitudes from about 1300 to 2000 m (White *et al.* 1970; White 1972; Watson and Cole 1977; Bulmer 1982; Gillieson and Mountain 1983; Mountain in press).

How does this evidence fit the Bailey *et al.* (1989:73) null hypothesis? This is a complex question that cannot easily be answered with the available data. There is no doubt that highland New Guinea contained tropical rainforest during the late Pleistocene as today. Schodde and Calaby (1972:294) make a clear distinction in biogeographic terms between the character of the montane rainforest (the Tumbunan Division of the Australian Region), retaining relict Gondwanic biota, and that of the lowland rainforest (the Irian Division of the Oriental Region), containing plant species from Asia. There is a clear zonation of vegetation from coast to mountain peak (Paijmans 1976; Johns 1982; Hope 1986). Using the terminology of Johns (1976), the zone of lower montane forest (c.700-1500 m) becomes mid-montane forest (c.1500-2700 m) and the final tree zone is upper montane forest (c.2700-3200 m), dominated by moss forest and mist. Above this are shrubs, ferns and alpine grassland capped by the glacial zone.

There can be no doubt that, at present, within most of these zones, a variety of nut and seed trees (both wild and under cultivation) occur, in places in abundance. Local agricultural communities gather and store edible harvests of products from plants such as *Castanopsis*, *Elaeocarpus*, *Sterculia* and *Pandanus*. Powell (1976) has documented an extensive range of plants used in the highlands now and in the recent past not only for food but also for medical/magical purposes, in the production of artefacts and for shelter or fencing. Occasional indigenous forest-edge tubers (such as the now rare *Pueraria lobata*) are documented today as famine foods (e.g. Sillitoe 1983) and a wide range of

leafy vegetables and shoots are gathered from forest and abandoned gardens (eg. Hyndman 1982). Archaeological evidence for plant use in the late Pleistocene is virtually non-existent, but we can assume that it was wide-ranging and sophisticated. Direct evidence can be cited only for Yuku rockshelter, where Bulmer states (1982:193) that "pandanus nuts were present in layers dated to 12,000 BP or earlier". Discussing the implications of the claim for archaeological evidence of agriculture by 9000 years ago in the New Guinea highlands (cf. Golson 1989; this volume), Yen (1982:291) states his belief

that agriculture independently evolved in Melanesia, specifically in New Guinea. A suite of plants was domesticated that included basic staples, vegetable and fruit species that were able to sustain human populations in their settlement of diverse and foreign ecologies from beginnings of hunting and gathering.

What we are quite ignorant about are the distribution and density of plant resources in the montane forests of the late Pleistocene. Two factors making any assessment extremely difficult now are the millennia of human interference with the forest by hunter-gatherers and subsequent agriculturalists, the latter responsible for its removal over large areas, and the influence of climatic change.

Climatic change during the last 40,000 years has produced a far from stable climax vegetation within the region, as is also true for most other areas of tropical rainforest in the world (Walker and Chen 1987). Much has been documented through palynological analysis (Flenley 1979; Hope 1982; Walker and Chen 1987). But, as Walker and Chen (1987:79) write, "whilst plant geographic changes are more-or-less readily discerned in tropical pollen diagrams, details of community composition at the ecological level are not". Nevertheless, pollen analysis has provided data for some interesting theories about human use of late Pleistocene environments, such as by Hope and Hope (1976), who have suggested that early hunter-gatherers used the zone of high alpine grassland for hunting and communication until climatic change caused much of it to decline in area as forest was able to thrive at higher altitudes.

It is recognised that the landscape today in many areas of Papua New Guinea is largely anthropogenic, through the creation of large areas of grassland (Powell 1982:207). The influence of human interference is widespread: swidden plots have been cleared, planted and fallowed for at least 6000 and maybe 9000 years, from the evidence at the site of Kuk (Golson 1989; this volume). How much longer have people actively encouraged and cared for the plants they required for everyday survival or those that were recognised as supplying good food at certain seasons? What effects could this activity have had on the distribution of desirable species? Powell (1982:210) suggests that there would not have been any scarcity of food resources within the lowland rainforests and that a broad spectrum subsistence system could have evolved in the higher altitudes. She admits (1982:211) that human interference could have altered natural plant distributions but thinks that such effects were "relatively minor and short term when considered against the background of climatic change". She emphasises the importance of fruit and nut species as nutritionally superior to edible roots, palm products and green vegetables. "They may



FIGURE 5: TOP, PEINAN EXCAVATIONS IN PROGRESS DURING THE 11TH SEASON, 2017

Boulder paved floors and boulder piled walls occur in the upper left corner, circular storage structures in the centre, and at right smaller slab graves of the upper level.

BOTTOM, BOULDER PAVED FLOOR 20 TO 30 CM ABOVE THE SLATE SLAB COVER OF BURIAL PN

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rainforests of northern Sahulland during the late Pleistocene. However, there is evidence to show that very early settlers did indeed move through this environment and remain there for long periods of time. Is it possible to document their activities and to examine the relationship between them and their environment? There is a body of both environmental and archaeological evidence that provides the basis for a hypothesis suggesting that late Pleistocene people in the highlands of New Guinea were capable of altering the density and distribution of edible resources long before true domestication or large-scale clearance of forest.

ENVIRONMENTAL EVIDENCE

Courty *et al.* (1989:126) discuss the fact that even such ephemeral human activities as small forest clearings "can irreversibly affect and destabilise soils and the landscape". However, they presume that such activities by small Pleistocene populations "generally left little impact in the geomorphic record and that soil and landscape changes are more likely attributable to climatic and geological causes". In contrast, Walker and Chen (1987:87) favour the idea that small disturbances build up regional perturbations over time, so that if "interactions of this kind have been widespread over long periods in the past, it may be mistaken to underestimate their persisting effects on the dynamics of rainforests today". This implies that we cannot presume that plant and animal distributions documented today accurately describe their distributions in forest in the past before human impact began.

Evidence from the highlands of mainland New Guinea strongly suggests that humans were altering the landscape in small areas as early as about 30,000 years ago. These are not the major forest clearances of the later Holocene, when pollen and sediment records clearly show progressive change from forest trees to grass over a defined area that is usually irreversible, but individual events in which the pollen diagrams reveal a local change from tree to grass pollen accompanied by a sudden increase in charcoal indicating a local firing event and followed by regrowth of forest. Tropical rainforest in New Guinea has high and non-seasonal rainfall and is therefore not easily naturally burnt since the undergrowth does not get a chance to dry out. There are, however, areas of the highlands where rainfall now is more seasonal and lower than in other areas. It is difficult to know whether such conditions would have existed during the late Pleistocene, increasing the chances of natural firing. It is certainly agreed by several researchers that aridity was greater during the time of the last glacial maximum than today (Walker and Chen 1987:82). Experiments on firing various types of primary and man-made environments within the eastern Amazon showed that "sustained combustion was not possible in the primary forest even after prolonged rainless periods (e.g. >30 days)", although forest burnt far more readily once disturbed by human activity and the forest edge was more vulnerable to fire (Uhl and Kauffman 1990:437, 446). There is now documentation of several clearance events in the New Guinea highlands from pollen and sediment evidence from Kosipe (Hope 1982) through Telefomin (Hope 1983a) to Irian Jaya (Haberle *et al.* 1991).

At Kosipe, in the Papuan mountains north of Port Moresby, Hope (1982) has extracted pollen spectra both from an archaeological site on a ridge at 1940 m and the neighbouring swampy valley now dominated by *Pandanus*. "The commencement of a large increase of carbonised particles at 30,000 years is a strong indication that this is the start of settlement with burning of the reed swamp" (Hope 1982:217). Stone artefacts occurred on the archaeological site from about 26,500 years ago (White *et al.* 1970). Palynological analysis suggests that this site had been cleared of forest and was occupied by grasses and tree ferns, but no pollen of economic plants was found. In the Baliem Valley of Indonesian New Guinea (Haberle *et al.* 1991) charcoal occurs in slopewash deposits about 28,000 years ago together with pollen evidence for increased grasses, suggesting an episode of clearance at this date. Another example, from Telefomin (Hope 1983a), midway between the two previous sites, shows evidence for three clearance phases, the first of which (18,000-15,000 years ago) is relevant in the present context and appears to have been the result of deliberate human firing of a wet swamp forest. Hope (1983a:32) makes the point that the region was reasonably close to extensive areas of alpine grassland during the late Pleistocene and that access to the Telefomin valley swamps would have probably been from these higher altitudes where hunters could have been making use of fauna and flora at the forest margin.

What motivation would human hunter-gatherers have for firing small patches of montane forest in the late Pleistocene? Such small gaps in the forest canopy are extremely productive in new plant growth and therefore attract various animal species with a concomitant increase in hunting success. Natural clearings created by tree falls are the starting point of regeneration cycles: pioneer species appear rapidly, seedlings and saplings previously stunted by shade start growing again and new seeds are deposited by birds and animals (Bourlière 1983:83). Plants producing foods acceptable to humans - tubers, nuts, fruits and seeds - thrive in such conditions and hunting is more successful. Therefore it would seem a profitable enterprise for humans to create such clearings either within the forest canopy or at its edges. Long periods of such use of forests by humans will increase the number of disturbance "gaps" to be found in the once-climax habitat and the activity will have introduced and increased the density and distribution of desirable plants.

Many of the plants now consumed by tropical forest people, including yams and many nuts, are highly light-dependent, and once existed only in treefalls or along streams. Forest clearing created new ecotones inside large areas of the world's forests, selecting for plants that allocate less energy to maintenance and defense and more to growth and reproduction (Bailey *et al.* 1989:62).

ARCHAEOLOGICAL EVIDENCE FOR HUMAN USE OF FOREST EDGE AND DISTURBANCE ZONES OF RAINFOREST IN NORTHERN SAHULLAND

Here I propose a model of environmental management in which the zones which received greater light were expanded at the forest edges and in naturally thinner zones such as swamps and clearings, using the technique of burning to assist in clearance of vegetation.

Apart from admittedly limited palynological evidence, what other indications can be used to support this suggested model?

Archaeological evidence from a number of sites provides a range of artefacts that would be suitable for use in such activities. Groube (1989) proposes a similar hypothesis when accounting for the early occurrence of the waisted axes of the Huon terraces, some sealed by tephra dated to more than 40,000 years. He suggests that these large, blunt but very substantial artefacts could have been used to clear and trim undergrowth and ringbark more substantial tree trunks. Waisted axes are certainly not designed as cutting tools and often possess very blunt edges, but they can weigh several kilos and with their ability to be hafted are likely to have relied on mass for effect. Artefacts of similar characteristics, although smaller and lighter, have been dated to the late Pleistocene from the highlands sites of Kosipe (White *et al.* 1970), Nombe (Mountain 1983) and Yuku (Bulmer 1982), which at 1980, 1720 and 1300 metres of altitude respectively are close to covering the altitudinal range of montane forest. Nombe has also produced a late Pleistocene edge-ground axe showing deep striations at right angles to the cutting edge, which could have been employed for cutting substantial branches or felling small trees. Other flaked tools from this period at this site include large, heavy, steep-edged flakes and cores on river pebbles, providing a number of working edges for a variety of functions, which could have included processing plant foods and cleaning and utilising animal products.

MEGAFUNA AND HUNTING

Hunting has received more attention in Pleistocene contexts than plant use and certainly must have been an important activity for the early occupants of northern Sahulland. There is ample evidence in the highlands of New Guinea for the former existence of a range of large fauna during the late Pleistocene that could have provided a rich source of proteins, oils and fats (Flannery 1990; Mountain in press; Swadling and Hope 1992). Most of the extinct species documented so far are thought to have preferred the top regions of montane forest or the regions of thinner shrubs and ferns at the forest edge (Flannery *et al.* 1983; Flannery 1990). In principle, their presence would have provided a worthwhile incentive at least for frequent return visits to the upper forest edge. Three species of extinct macropodid (one of *Dendrolagus*, two of *Protemnodon*) and postcranial fragments from a small species of diprotodontid have been excavated from Nombe rockshelter (Flannery *et al.* 1983). However, though these species were certainly coeval with human occupation of the area, it is by no means certain that they were the victims of human hunting. They could equally well have been predated by thylacines, whose remains also occur on the site from the beginning of human occupation around 26,000 years ago up to and beyond the 16,000-14,000 year old date by which the extinct species disappear from Nombe.

THE TRANSITION TO THE HOLOCENE

By the end of the Pleistocene hunting techniques and forest management strategies must have been adapting in response to climatic change. Environmental change after the glacial maximum of about 18,000 years ago indicates the rapid demise of much of the subalpine zone as the increased temperatures allowed forest growth to occur at higher altitudes. Evidence from Nombe suggests that by the end of the Pleistocene people were actively hunting a wide range of smaller forest species in much larger numbers than during the previous 16,000 years (Gillieson and Mountain 1983). The site would by then have been in mid-montane forest some distance from the now diminished subalpine grasslands and no further diprotodontid or *Protemnodon* remains occur. Perhaps human hunting added another stress to the problems these large species were having in adapting to the effects of climatic change.

Humans were more efficient at devising new strategies to cope with new environmental circumstances. In addition to the strategy of "prey switching" to other species in hunting (Dwyer 1982), they also might have been adapting their forest management practices to more intense use of the plant products through increased clearance and more active encouragement of foods such as tubers and fruits. Kelly (1988:164) postulates that "the development of agriculture may also have been prompted by efforts to compensate for the unfavourable energetics of small game procurement". Groube's (1989) hypothesis suggests that "forest management" gradually turned to "forest gardening" over more than 30,000 years. Only with the increased need for fenced or ditched gardens would large-scale forest clearance become necessary and agricultural techniques detectable in the archaeological record (Golson 1989).

CONCLUSION

Palynological and archaeological evidence can contribute to a hypothesis suggesting that the early hunter-gatherers of northern Sahulland were consciously utilising the resources of the rainforest in activities which produced considerable, if small-scale, change within their environment. Yen (1982:292) suggests that domestication could have started in mid-altitude forest zones and I believe he is right. It can certainly be suggested that human activity in the tropical rainforests of the region during the late Pleistocene period did indeed develop ways to alter the density and distribution of edible resources in order to survive in that environment. "There is no sharp dividing line between exploitation of wild resources, management of them, planting and care of selected species or domesticated horticulture or silviculture" (Hope 1983b:42). If it can be established that early hunter-gatherers actually managed their forest resources in Sahulland, they are unlikely to have been alone in exercising these skills. There must be evidence from other areas of the world to suggest similar understanding and use of environmental resources in the late Pleistocene.

NOTES

- 1 This term is used to cover the entire Pleistocene continent of Sahul, constituted by present-day Australia, with Tasmania and the island of New Guinea, as well as surrounding land areas now drowned by the Holocene rise in sea level.
- 2 The use of the term "highlands of New Guinea" refers to the inland regions above an altitude of about 1300 m and not exclusively to the present-day Highlands Provinces of Papua New Guinea.
- 3 "Near Oceania" covers the many islands to the north and northeast of the mainland of Papua New Guinea (Green in press). They are all within the political entities of Papua New Guinea and the Solomons.

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