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SHORT COMMUNICATION

Traditional forms of plant exploitation in Australia and New Guinea: the search for common ground

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Introduction

Characterisations of ''hunter-gatherers'' in Australia and ''horticulturalists'', or ''agriculturalists'', in New Guinea are familiar, and yet problematic. These terms are inadequate to convey the richness and diversity of subsistence practices across both regions, either for the recent pasts of ethnography and history, or for the distant pasts of archaeology (Harlan 1995); but they continue to be casually applied in academic and everyday discourses. Attempts to develop conceptual and terminological frameworks that do justice to the diversity of practices continually founder; they are bound by, and fall back into, existing terminology and stereotypical and evolutionary overtones.

A recent workshop entitled ''Plant exploitation and domestication east of the Wallace Line: movement, manipulation and management of plant biodiversity'' (Canberra, August 2006) provided an opportunity for key researchers in several disciplines (including agronomy, anthropology, archaeobotany and archaeology, botany, ecology, ethnobotany, geography, palaeoecology and palaeobotany) to focus on the nature of plant exploitation practices across Australia and New Guinea. The workshop is the first in a series intended to foster cross-disciplinary dialogue and to develop long-term research agendas regarding the effects of traditional plant exploitation practices on plant morphogenetics and biodiversity in Sahul. The workshop series is part of a broader initiative, The Environmental Futures Network, funded by the Australian Research Council (http://nesuab.ees.adelaide.edu.au/page/default.asp?site = 1). Several key themes of contention and significance are reported.

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Land management practices

The idea of ''fire-stick farming'' (Jones 1969) was developed for the Australian Aboriginal context and connotes the burning of a landscape to promote new growth in favoured food plants for human consumption. Supporting evidence includes the controlled use of fire to maintain and promote favoured plants in tree-fall gaps in the rainforests of tropical Queensland (Richard Cosgrove, La Trobe University) and the creation of open forest to promote *Dioscorea hastifolia* in coastal areas of Western Australia (Sylvia Hallam, University of Western Australia).

In contradistinction, David Bowman (Charles Darwin University) concludes that 'burning is for kangaroos'; Aboriginal burning practices are, and were, primarily a tool for hunting and managing game. He and co-workers contest that burning had little to do with increasing yields of fruits, nuts and berries (see Vigilante and Bowman 2004). Although debate continues over whether burning was primarily designed to intensify faunal or floral resources, Aboriginal groups across Australia unquestionably, yet variably, used fire as a land management tool.

In New Guinea, land management issues focus on the variable impacts of climatic changes and plant exploitation practices, including agriculture, on landscapes at different altitude through time. In reviewing the evidence, Simon Haberle (Australian National University) noted a high degree of regional variability across New Guinea in the timing, nature and duration of palaeoecological indicators of human disturbance in the Pleistocene and early-to-mid-Holocene, with more synchronous and cumulative disturbance during the mid-to-late Holocene.

Haberle noted how the implications of new palaeoclimatological research (e.g., millennial-scale variability, ENSO and seasonality) dramatically alter the contexts of plant exploitation and occupation of Australia and New Guinea during the Pleistocene and early Holocene. Climates were not just warmer/colder or wetter/drier; they may have been fundamentally different in terms of inter-annual variability and intra-annual seasonality. The effects on the distribution and production of food plants, and other human-environment interactions, are yet to be fully considered.

Resource intensification in Australia

> … I have seen tracts of land several square miles in extent so thickly studded with holes where the natives had been digging up yams (*Dioscorea*) that it was difficult to walk across (Sir George Grey, 1841 quoted in Harlan 1995: 11).

The density of major food plants—whether carbohydrate-rich nuts, roots, or seeds—was deliberately enhanced and managed in diverse environmental contexts by Aboriginal people, principally through burning. Examples include: *murnong*, or yam daisy (*Microseris lanceolata*) on the temperate western plains of Victoria (Beth Gott, Monash University; Gott 1983); yam (*Dioscorea hastifolia*) along the coast of Western Australia (Sylvia Hallam, University of Western Australia; Hallam 1989); *Typha* spp. in wetlands across southern Australia (Sarah Martin, University of New England; Gott 1999); seed-producing plants in the Central Desert (Peter Latz, Northern territory Herbarium at Alice Springs; Latz 1995); and food-yielding trees (toxic and non-toxic) in the tropical rain forests of northwest Queensland (Richard Cosgrove, La Trobe University and Judith Field, University of Sydney).

The ability of Aboriginal groups to increase resource densities across Australia indicates adaptation to diverse environmental contexts, as well as a keen awareness of plant types, phenology and reproduction. Even in arid and semi-arid climates of central Australia, wild-food gathering yielded caches of grass seed, in one case estimated to weigh up to a ton (Peter Latz comment). The intensification of plant resources, in conjunction with marine (Western Australia) or freshwater aquaculturally produced (western Victoria) sources of protein, enabled year-round occupation of some areas by near-sedentary populations (Hallam 1989).

Although land management practices encouraged the local and regional extension of favoured species, exploitation practices contributed to the maintenance of plant resources within an area. People did not necessarily dig-up the entire plant when harvesting roots; reproductive parts were often left undisturbed, or replaced, when roots and tubers were removed. Berndt and Berndt (1993: 109–110) describe the care taken while harvesting the roots of *murnong* to ensure that the old seed bulb was left in the ground to maintain plant productivity. Although the distributions of some food plants were maintained or expanded, other plants may have been almost ‘‘eaten out of existence’’, as suggested for refuge populations of *Ipomoea polpha* in the Central Desert (Peter Latz).

The role of people in deliberately dispersing plants is less clear. The transportation, storage, processing, cooking and trading of roots and seeds would have aided dispersal through inadvertent spillage, discard and loss. Burning, water diversion, digging and mounding—both deliberate and accidental—enhanced plant density and productivity, but there are only scant ethnographic references to deliberate seed-dispersal or planting. Latz (1995) makes reference to the scattering of seeds by the Alyawar to establish colonies of the fruit-yielding *Solanum chippendalei*, and Mary Gilmore refers to the planting of quandong (*Santalum acuminatum*) seed, a highly nutritious plant, and other plants, including grasses (Gilmore 1934: 153–15s4). Circumstantial evidence is suggestive of planting, such as the occurrence of *Erythrina vespertilio* (Bat's Wing Coral Tree) around wells where it is otherwise absent in the landscape (Peter Latz), but planting may never have occurred, or have been more common, in the distant past.

The effects of land management, plant exploitation and resultant distributions on plant phenotype can be assessed for *Dioscorea hastifolia* (Sylvia Hallam) and *murnong* (Beth Gott). The tubers of these plants, like many others, exhibit phenotypic responses depending upon the type of soil in which they are growing. Where soils are loose and friable, tubers are larger; whereas tubers are smaller in shallow, stony and compacted soils. For most tuberous plants in Australia, the recurrent digging of tubers from a perennial plant will have loosened the surrounding soil and encouraged greater tuber growth. Phenotypic responses can be anticipated in successive harvests of these perennial tubers, but these have nothing to do with planting, inter-generational selection or domestication. These phenotypic responses are elastic, they require the maintenance of anthropically modified soil environment; once modifications to the soil environment cease, tubers revert to wild type.

The elastic phenotypic responses of plant parts to human exploitation, as well as selective management of ecotypes, e.g., *murnong* in Victoria (Gott 1983), have major implications for archaeobotany in Australia and elsewhere. Increases in the size of macrofossils (e.g., plant parts, storage organs) and microfossils (e.g., parenchyma and starch granules) should not be assumed to indicate domestication; they may merely reflect phenotypic responses to plant exploitation practices or selective management and consumption of ecotypes.

Diversity of plant exploitation in New Guinea

Plant exploitation practices are highly variable across New Guinea, with similar variability likely in the past (Mike Bourke and Jean Kennedy, ANU). Horticultural groups in New Guinea were traditionally dependent on varying combinations of cultivated starch-rich plants, primarily taro (*Colocasia esculenta*), several species of yam (*Dioscorea alata, D. bulbifera, D. pentaphylla, D. nummularia* and *D. esculenta*), bananas (*Musa* spp.), sugar cane (*Saccharum officinarum*) and sago (*Metroxylon sagu*). Sweet potato (*Ipomoea batatas*), which is widely grown in the highlands, is a post-Magellan introduction and, based on its distribution and shallow social depth, yam (*D. esculenta*) is plausibly also of recent introduction, although with a greater time-depth than sweet potato (Mike Bourke personal communication 2006). A more recent introduction of the past century, cassava (*Manihot esculenta*), is becoming increasingly common.

The essential components of food supply in New Guinea are (Mike Bourke, ANU):

- starch-rich staples,
- tree crops providing energy, oil and other nutrients,
- vegetables,
- sources of protein, primarily from hunting game, fishing, and for the last few millennia the rearing of domesticated animals, and
- gathering of plants, fungi, grubs, honey and other resources.

The relative contributions of different starchy staples and food supply components vary considerably across New Guinea, often reflecting altitude. The significance of tree crops, hunting and gathering activities are largely related to access to forest.

Despite the variability in subsistence practices, vegetative, or asexual reproduction characterises the cultivation of plants in New Guinea. All the traditional starch-rich staples (major and minor), most vegetables and several economically important trees (including *Pandanus* spp.) are vegetatively propagated. Over time vegetative propagation is thought to have selected for parthenocarpic varieties in several species, including bananas and members of the *Pandanus brosimos/julianettii/iwen* complex, as well as sterility in others, including triploid banana and yam cultivars. Parthenocarpy should not be confused with sterility; the former refers to the development of fruit without fertilisation, whereas the latter refers to sexual sterility irrespective of seed production. Vegetative propagation, whether of parthenocarpic and sterile varieties or not, is a way of genetically isolating a cultivated or managed plant from surrounding populations, and it is also a mechanism through which plants can be moved beyond the natural range in which sexual reproduction is viable. Climate, absence of pollinators or low density in the landscape may all inhibit sexual reproduction in a plant.

The history of plant domestication in New Guinea is complex and yet to be fully unravelled for most staples (cf. Lebot 1999). Some New Guinean staples are the product of intra and inter-specific hybridisation with Southeast Asian cultivars (e.g., bananas and sugarcane), whereas others are thought to have undergone independent domestication in New Guinea and SE Asia (e.g., taro and some yams). Carol Lentfer (University of Queensland) outlined a multi-locus and multi-phased domestication process for two sections of *Musa* banana (see De Langhe and de Maret 1999): domestication of Australimusa (reclassified as Callimusa section) species, which became the widely distributed Fe'i bananas of the Pacific; and domestication of AA diploid varieties of Eumusa (reclassified as Musa section), which eventually gave rise to the most important groups of cultivated bananas in the world.

The archaeobotany of tree exploitation

Tree products were, and still are, significant contributors to diet across Australia and New Guinea (Pedley 1995; Bourke 1996). Edible products include nuts, fruits, berries, leaves/shoots and starch-rich pith. Often the same genera, although seldom the same species, are present in both regions. The biggest difference relates to edibility; cultivation in New Guinea has bred out toxins and made larger kernels and fruits.

In Australia, much archaeological attention has focussed on the exploitation of toxic trees, such as cycads (*Cycas* spp.; Wendy Beck, University of New England; Beck 1992), yellow walnut (*Beilschmiedia bancroftii*) and black bean (*Castanospermum australe*) in the tropical rainforests of northwest Queensland (Richard Cosgrove and Judith Field), although a wide variety of non-toxic tree products were used across the continent. Aboriginal groups devised complex systems to process toxic tree products, and the antiquity of processing technologies is thought to extend to the Terminal Pleistocene.

In New Guinea, most archaeological attention has focused on determining the antiquity of arboriculture and tree domestication. Key indicator species are members of the *Pandanus brosimos/julianettii/iwen* complex in the highlands (Simon Haberle; Stone 1982) and the canarium almond (*Canarium indicum*) in the lowlands (Andy Fairbairn, University of Queensland; Yen 1996). Despite claims for the domestication of both these plants in the late Pleistocene and early Holocene, archaeobotanical data are equivocal. Although domestication of numerous trees has occurred in the New Guinea region, e.g., some *karuka*, *marita* and breadfruit, the locus, timing, processes and subspecies of domestication are uncertain.

In considering archaeobotanical assemblages of tree-products from Australia and New Guinea as a whole, they are surprisingly similar (discussed by Andy Fairbairn and Richard Cosgrove). The major differences are the contexts in which they are interpreted. In Australia archaeobotanical assemblages of tree products are automatically considered to represent gathering of wild resources with varying degrees of processing. In New Guinea, similar assemblages are automatically woven into narratives about arboriculture or tree domestication, even though there is a conspicuous absence of evidence for both. The contexts of interpretation are derived from ethnobotany, ethnography and history; they are prejudicial (i.e. they pre-judge the evidence) and misdirect interpretation.

Searching for common ground

The idea of Australia as a continent of hunter-gatherers and New Guinea as an island of horticulturalists rests on categories that are inherently prejudicial, both in terms of the evolutionary values assigned to each lifeway and with respect to the contexts of interpretation for archaeobotanical assemblages. Common conceptual frameworks to understand plant exploitation practices were discussed: foraging theory (James O'Connell, University of Utah; Kennett and Winterhalder 2006) and a practice-centred interpretation (Tim Denham; Denham 2005). At present, however, comparisons of plant exploitation practices across Australia and New Guinea are hindered by the lack of commonality in the multi-disciplinary research undertaken and techniques applied. Most regions have variable archaeological, botanical, ethnographic, historical and palaeoecological coverage, and rarely have macrofossil and microfossil, let alone molecular, techniques been applied systematically to the investigation of plant exploitation in the past. Consequently, the next task of workshop participants is to develop integrated, multi-disciplinary research programs to generate robust, locale-specific records that can form the basis for pan-regional comparison.

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