1. Introduction

This introductory chapter details the scientific rationale behind the choice of subject, outlining the principal aims and caveats of the presented research. A thesis outline summarises the information provided in each chapter, and a short note on dating conventions used in the text is also given.

1.1 Choice of the subject

Amongst the various models that attempt to address the introduction of agriculture (especially cereal agriculture) to Island Southeast Asia, the most widely promoted is the one that associates Austronesian languages spoken in the region today with the migration of people out of South China and through Taiwan in the mid-Holocene. According to this "early farming dispersal hypothesis" (Bellwood 2005:2), populations speaking Austronesian languages replaced previous hunting and gathering communities and were responsible for the introduction of a cereal-based agriculture (mostly rice, *Oryza sativa*, and also millets, *Setaria italica*, foxtail millet, and possibly *Panicum miliaceum*, broomcorn millet). Cereal-based agriculture is thought to have been introduced together with animal domesticates (at least pig, dog and chicken), and an artefactual "package" where, for the first time, red-slipped and stamped or incised pottery as well as characteristic polished stone and shell industries are present (see, amongst others, Bellwood 1997, 2002 and 2005; Blust 1976 and 1995).

Within this model, it is argued that the reason that no evidence of cereals has been found associated with these first Neolithic population movements (beyond Taiwan and with the exception of Borneo and the northern Philippines), has to do with the unsuitability equatorial region for rice production, especially between 5º north and 5º south. The hypothesis suggests that rice and millets would have been dropped when populations moved through this zone and further south and east in prehistoric times (Bellwood 2005: 130, based on Dewar 2003), replaced by a suite of tubers and tree crops which were either domesticated or acquired from in-place communities (Bellwood 2005: 139).

Cereals such as rice and millets, and especially maize (*Zea mays*), are amongst some of the main food plants in East Timor used today alongside some important fruits (e.g. breadfruit, *Artocarpus altilis*, jackfruit, *Artocarpus heterophyllus*, coconut, *Cocos nucifera*, bananas and

plantains, *Musa* spp.), nuts (the betelnut, *Areca catechu*, and the candlenut, *Aleurites moluccana*), tubers (taro, *Colocasia esculenta*, a diversified array of yams of the Dioscoreaceae family, sweet potato, *Ipomoea batatas*, and European potato, the latter two also American introductions), and starch-producing trees (the gebang palm *Corypha utan*, the sugar palm *Arenga pinnata*, and the lontar palm *Borassus flabellifer*). Apart from those species that have been introduced since the first European contacts in the 16th century (maize, the European potato and the sweet potato, for instance), dating the antiquity of agricultural practices involving these crops is of paramount importance to determine past cultural exchange processes, as well as to understand the history of human migrations between East Timor and neighbouring regions.

Changes in plant management practices and the introduction of new crops are thought to be best addressed through direct archaeobotanical research. With that in mind, two field seasons were undertaken in 2004 and 2005 with archaeological sites being test pitted and excavated, aiming specifically at assessing preservation of, and recovering macrobotanical plant remains (Oliveira 2006). Systematic recovery of plant remains from archaeological contexts gives a direct insight into the history of relations between humans and their surrounding environment (Fairbairn 2005a). Together with other archaeobotanical analytical-based methodologies (Fairbairn 2005b), this approach has the potential to illuminate the highly complex world of the first food-producing societies. Yet in the tropics, and especially in Island South East Asia, these methodological practices are not yet being used in a comprehensive way.

The appearance of the first pottery and animal domesticates in East Timor has been dated to approximately 3800-3600 BP (Spriggs et al. 2003; O'Connor 2006). Whether these arrivals were accompanied by cereal agriculture, or whether this was introduced considerably later, is still open to scrutiny. Direct evidence for early cereal agriculture is minimal in the Wallacea region and is usually inferred from indirect proxies present in the archaeological record (Paz 2001, 2002 and 2005). A list of archaeological sites in the region from where archaeobotanical remains have been recovered is presented in chapter 3. On the other hand, work carried out originally by Golson (1977) and more recently Denham (2003, 2004 and 2005) and Denham *et al*. (2003 and 2004), has demonstrated that agricultural practices based on tubers and fruit trees were in use in New Guinea from the early- to mid-Holocene. The multidisciplinary line of research used there, with different methodologies directly aimed at archaeobotanical recovery and analysis, suggests the existence of in-place plant management practices long before the arrival of Austronesian speaking populations. The extent to which this was also the case in the island of Timor will be addressed in this thesis.

Discussion of subsistence system models in the region based on gathering, cultivation and domestication of plants in the archaeological literature is widespread (e.g. Yen 1989, 1991 and 1995; Bellwood 1997, 2004 and 2005; Latinis 2000; Paz 2001; Kennedy & Clark 2004; Denham 2003, 2003a, 2004, 2005, 2005a, 2007 and 2008; Denham *et al*. 2003 and 2004; Barton & Paz 2007). Some authors see a clear distinction between the introduction of cereal agriculture in prehistory and whatever plant management practices existed previously (e.g. Bellwood 2005), while others, looking at the problem of agricultural origins from a global perspective, suggest intermediate phases between full gathering and agricultural societies (e.g. Harris 1989; Smith 2001). The issue of plant production systems based on the exploitation of a suite of tree crops and tubers has recently been re-addressed (Latinis 2000; Paz 2001; Denham 2003; Kennedy & Clark 2004 and 2007; Fairbairn *et al*. 2006), suggesting an archaeological and archaeobotanical record that does not entirely conform to the view that cereal agriculture was a major disruptive factor to previous in-place economic systems, or at least one that simply replaced those earlier plant management practices. Instead, the evidence points rather to the integration of both systems (the cereal- and the arboreal/tuber-based), at different times throughout the wider region, suggesting that whatever the reason(s) behind the Austronesian dispersal were, they do not seem to have been fuelled by agriculture (Bulbeck in press).

The methodology of systematic recovery and analysis of macrobotanical evidence from archaeological contexts has for the first time been used in East Timor, together with AMS dating of identified charred plant fragments. These approaches are considered essential to date directly the first agricultural signals and to understand past plant management practices during the late Pleistocene and throughout the Holocene. The long history of use and great diversity of plant resources in this part of the world clearly warrant local and regional multidisciplinary research, with particular emphasis on analytical methodologies aimed at comprehensively recovering and studying plant macro fossil evidence from archaeological contexts.

1.2 Research Aims

The two fieldwork seasons undertaken in East Timor between 2004 and 2005 were specifically targeted at assessing the preservation and recovery of charred macrobotanical remains from archaeological contexts. Apart from the plant remains recovered at Bui Ceri Uato Mane (BCUM), smaller assemblages from five other sites excavated by Sue O'Connor, Matthew

Spriggs and Peter Veth in the eastern part of the country were also analysed. As outlined above, this was done with the purpose of obtaining direct evidence from which to investigate the history of plants managed as food resources in East Timor. Some more specific aims within this research are:

- Determining the range of plant types used as food sources during the period of occupation of sites investigated;
- Investigating whether there were significant changes in food plant types used during the Holocene, and specially across the pottery-introduction boundary, approximately 3800-3600 years ago;
- Investigating the antiquity of cereal-based agriculture in East Timor, with particular interest in those species which originated in East Asia (*Oryza sativa*, *Setaria italica*, and possibly *Panicum miliaceum*);
- Developing the practice of systematic recovery and analysis of charred plant remains from tropical archaeological contexts;
- Obtaining a local palaeoenvironmental record from around BCUM, through the analyses of phytolith samples recovered from excavations at the site (research carried out by Carol Lentfer).

1.3 Research limits

This project was faced with particular problems that can be grouped into three distinct categories: those related to insufficient and unsystematic archaeobotanical practice; the biological diversity of the tropics and therefore the impossibility of obtaining a comprehensive botanical coverage; and problems of taphonomy and selective preservation of some plant remains.

The first set of problems is related to the project's originality, and the fact that the archaeological community has not yet embraced systematic archaeobotanical investigation in this part of the world. The most direct consequence of this is a lack of published material for comparative purposes. Archaeologists are familiar with the importance of archaeobotanical research and its multiple uses, but probably less so with the time it takes to obtain meaningful results. Plant remains are thus often retrieved from excavations and left for future analysis by

a “specialist”. That future analysis rarely happens. And even when plant remains are analysed and identifications attempted, publication generally lacks detailed information, such as explicit morphological and anatomical identification criteria, supported by SEM images, etc.

Tropical biological diversity, on the other hand, renders the building of comprehensive collections of modern reference specimens a very difficult task. In the absence of systematic botanical descriptions or ethnobotanical accounts, one is often faced with the challenge of completing the puzzle by building a reference collection of most likely “suspects”, i.e., species existing in the area of study or whose use by humans (in this case as food plants) has been documented elsewhere. The suggestion by Paz (2001:57) that building a collection of modern specimens should start from the investigated archaeobotanical assemblage instead of a comprehensive ethnobotany has to some extent been followed here. Nonetheless, we should be aware that certain taxa, such as those with specific and localised uses, may not be accounted for through this method, and may ultimately be classified as “unidentified”.

The last group of difficulties has to do with taphonomy, as different plants and different parts of plants preserve differentially. This selective preservation at both family and/or species level and within the parts of a plant affects the resultant archaeobotanical assemblages, such that they do not often represent the spectrum of species used by human communities through time. Some soft tissues, such as leaves, flowers, soft stems, and edible gums, rarely preserve; others, such as the storage cells of some vegetative edible tubers, are very fragile and may be destroyed by the very methods used in order to recover them. Thus, fragmentation and poor preservation are not just accountable for difficulties encountered during the identification process; they may ultimately lead to biases in the final interpretation.

Two final qualifications are needed here: the first is that wood charcoal has not been analysed within this study. Despite its overall significance in terms of the quantity of plant material preserved (when compared to other plant parts, such as seeds, fruit and nut fragments, and parenchyma), and its relevance for both palaeodietary and palaeoenvironmental reconstructions, analysis of wood charcoal involves a different methodological approach and specifically the need for an extended collection of reference material. As a result, it was decided not to attempt any species identification, and only total weights (by archaeological layer and excavation unit) will be given.

The second point worthy of notice refers to the remaining archaeological materials recovered from BCUM. Despite adding relevant information to the current study, analysis of pottery, stone tools, and other artifact assemblages, as well as shellfish, fish, and bone assemblages,

was not undertaken. The archaeobotanical line of investigation chosen was complex and time-consuming, rendering any detailed analysis of other lines of evidence an unrealistic task. Thus, only general counts and/or weights (per excavated unit and archaeological layer) of pottery, stone tools and shellfish will be given. Bone has not been analysed at all. These will all be dealt with in future planned studies.

1.4 Thesis structure

Chapters 2, 3 and 4 include the background information relevant to the present study. **Chapter 2** gives an outline of all previous archaeological work undertaken in both East and West Timor. **Chapter 3** presents a summary of archaeobotanical research carried out in Southeast Asia, East Asia and Near Oceania, with special attention given to the Wallacea region. And **Chapter 4** describes all relevant botanical and ethnobotanical research in East Timor, focusing on plants used as food resources.

Chapter 5 outlines materials and methods employed in the study, both in the field and the lab. It begins by explaining the process by which the sites investigated were chosen. A detailed account of the 2004 and 2005 field seasons follows, including the methods used to excavate the sites, to recover macrobotanical remains, and to build a collection of modern materials. It also explains how the sampling and analysis of charred plant remains in the lab were developed, how the reference collection was completed, and which microscopy techniques were used to attempt binomial identifications between archaeological and modern plant specimens.

Chapter 6 lists all plant specimens used as modern reference materials. This is organised by plant family and species. Descriptions of their native range and distribution, evidence for their presence in the archaeological record, and their uses as edible plants are also given.

In Chapters 7 and 8 the archaeological and archaeobotanical results obtained are presented. **Chapter 7** presents the stratigraphic and chronometric sequences at BCUM and results from analysis of the archaeological materials retrieved from excavation. **Chapter 8** describes the archaeobotanical results from the BCUM assemblage and the other assemblages analysed.

Chapter 9 discusses in detail results of the macrobotanical analysis obtained in the course of this research project, explaining the degrees of confidence to which plant specimens were

identified. A reassessment of the identifications provided by Douglas Yen for plant suites recovered from Glover's excavated sites in East Timor is also given.

Chapter 10 revisits the archaeobotanical data previously discussed, interprets the prehistoric human occupation of BCUM as a whole and suggests its importance in understanding subsistence systems practiced in East Timor during the Holocene and the late Pleistocene. Finally, the results obtained are summarised, and directions for future research suggested.

1.5 A note on dating conventions

Some radiocarbon dates given in the text are uncalibrated and referred to as BP, or uncal BP. This has mainly to do with the fact that reliable calibration methods were unavailable in the 1960s, and that many publications cited either use uncalibrated ages or make no mention whether radiocarbon determinations have been calibrated. Whenever possible, dates were calibrated using both online versions of Calib. 5.2 (determinations up to 21,380 uncal BP; Stuiver & Reimer 1993, Version 5.0.2), and CalPal 2007 (older than 21,380 uncal BP determinations; Danzelglocke et al. 2007; Weninger & Joris 2007). When calibrated, dates are presented with 95% probability at 2 σ (sigma). As to calibration of dates obtained on marine shell, the global ocean reservoir correction of about 400 years (incorporated within calibration) has been used. As there are no specific data for East Timor, no differences in Delta R (ΔR) for the local region have been calculated. The dates provided by Selimiotis (2006) are the only exception to this, as she used a putative local correction factor.

Three different dating laboratories provided the radiocarbon dates obtained for sites under analysis. The references for dates used in the text refer to the ANU Radiocarbon Dating Laboratory, (ANU), the Waikato Radiocarbon Dating Laboratory (Wk), and ANSTO (OZJ and OZK). All dates obtained through Accelerator Mass Spectrometry are simply referred to as AMS.