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Early Human Expansion and Innovation in the Pacific

Thematic Study
Ian Lilley (co-ordinator)

December 2010



United Nations
Educational, Scientific and
Cultural Organization

In cooperation with



World Heritage
Centre

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Cover: West coast of Tiga Island, Loyalties Province, New Caledonia. Photo Ian Lilley.
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States Parties covered by this study

Chile, Cook Islands, Federated States of Micronesia, Fiji, France, Indonesia, New Zealand, Papua New Guinea, Solomon Islands, Kingdom of Tonga, Kiribati, Niue, Palau, Republic of Marshall Islands, Samoa, United Kingdom, United States of America, and Vanuatu.

The authors

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Figure 1

Map of the Pacific showing places and features mentioned throughout this study.

5

Context for this Thematic Study

Ian Lilley

ICOMOS thematic studies do not entail new research. Rather, they present a synthesis of existing research on a specific theme at a given time. In the present case, the theme is early human expansion and innovation in the Pacific, with an exclusive focus on archaeological sites. Thematic studies support potential Tentative listings and World Heritage nominations by summarising available evidence concerning a specific theme and highlighting the prospective contribution to the World Heritage List of a region or site type. They do not aim to identify Outstanding Universal Value in individual sites – as this could compromise the subsequent assessment process – but provide material that could help States Parties identify potential sites and undertake comparative assessments to show how the value of the sites might be justified and the World Heritage criteria met. World Heritage properties are inscribed if they can demonstrate Outstanding Universal Value, authenticity and integrity. Such properties must also meet certain management and conservation conditions and have in some way been, and still are, influential in a wider than local or national arena. Thus the sites included for discussion in the chapters of this study are indicative examples to illustrate elements of the theme only. Their inclusion is not an indication of their significance or potential as World Heritage properties.

Purpose of this study

The region in focus here covers a quarter of the planet. West to East, it stretches 13,000 km from Western Micronesia, off the East Asian mainland, to Rapanui/Easter Island off South America. North to South it reaches from the subtropics of Hawai'i to the subantarctic extremities of Aotearoa/New Zealand, a distance of some 8500 km. The area contains over 2000 islands varying in size from the huge and ecologically diverse continental islands of New Guinea and New Zealand to the minute and ecologically impoverished atolls of Micronesia and central and eastern Polynesia. The deep human history of this vast region is a dynamic story of movement and transformation, a story in which astonishing feats of voyaging and navigation led to remarkable discoveries and fascinating cultural innovation and elaboration.

To ensure consistency, this context chapter very closely follows the corresponding chapter in Smith and Jones's (2007) thematic study *Cultural Landscapes of the Pacific Islands*. As they noted (2007: 5), the Pacific "is currently one of the most underrepresented regions on the World Heritage List. The reasons for this are many, but central is that few of the Pacific Island countries or territories have documented their cultural heritage places or have legislation to protect them. The character and diversity of cultural heritage places in the region is therefore not well known".

The present Thematic Study of Early Human Expansion and Innovation is the second regional study of the Pacific aiming to provide comparative data to facilitate the selection of cultural properties for nomination to the World Heritage List. It is an important step in the identification and long-term protection of significant cultural heritage sites and landscapes in the Pacific.

The study is an overview of the initial human colonisation of the Pacific, and the various defining characteristics that account for their commonalities as well as their diversity. The study is thus a broad introduction to the issues and places rather than a detailed assessment of potential individual nominations to the World Heritage List. The study was compiled by experts in the field but is based on the information available at the time of writing, not new original field or documentary research. As noted earlier, the study focuses exclusively on archaeological sites.

The principal objectives of the study are to:

- 1 Provide a general understanding of early human expansion and innovation in the Pacific, the diversity of places involved, the cultural, social and economic processes that produced such places, their origins and their associations;
- 2 Identify gaps in current knowledge of particular kinds of places and/or archaeological information to signal priorities for further detailed research.

Using this study

Sites included in States Parties Tentative Lists and nominated for inscription on the World Heritage List must be able to demonstrate that they are of Outstanding Universal Value. That is, they are of:

cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity.

In addition to this, the *Operational Guidelines for the Implementation of the World Heritage Convention* state that

States Parties whose heritage of Outstanding Universal Value is under-represented on the World Heritage List are requested to:

- a give priority to the preparation of their Tentative Lists and nominations;
- b initiate and consolidate partnerships at the regional level based on the exchange of technical expertise;
- c encourage bilateral and multilateral co-operation so as to increase their expertise and the technical capacities of institutions in charge of the protection, safeguarding and management of their heritage; and,
- d participate, as much as possible, in the sessions of the World Heritage Committee.

In this context, the present study will contribute to the identification and recognition of cultural properties concerning early human expansion and innovation in the Pacific by:

- 1 Describing and explaining the geocultural dimensions of early human expansion and innovation in the Pacific;
- 2 illustrating through examples how crucial questions concerning human colonisation and cultural transformation – including matters of voyaging and navigation – are expressed in known archaeological sites in the region;
- 3 recommending strategies that will assist States Parties to fulfil the foregoing requirements of the *Operational Guidelines for the Implementation of the World Heritage Convention*.

On that basis, this study has four key aims:

- 1 To support the identification of the Pacific Islands as a distinct geocultural region for the purposes of World Heritage nominations;
- 2 to characterise the shared and unique elements of Pacific sites concerning human expansion and innovation within this geocultural region;
- 3 to provide a framework to help identify and document such sites;
- 4 to provide comparative data concerning these sites to assist in the selection of properties for Tentative Lists.

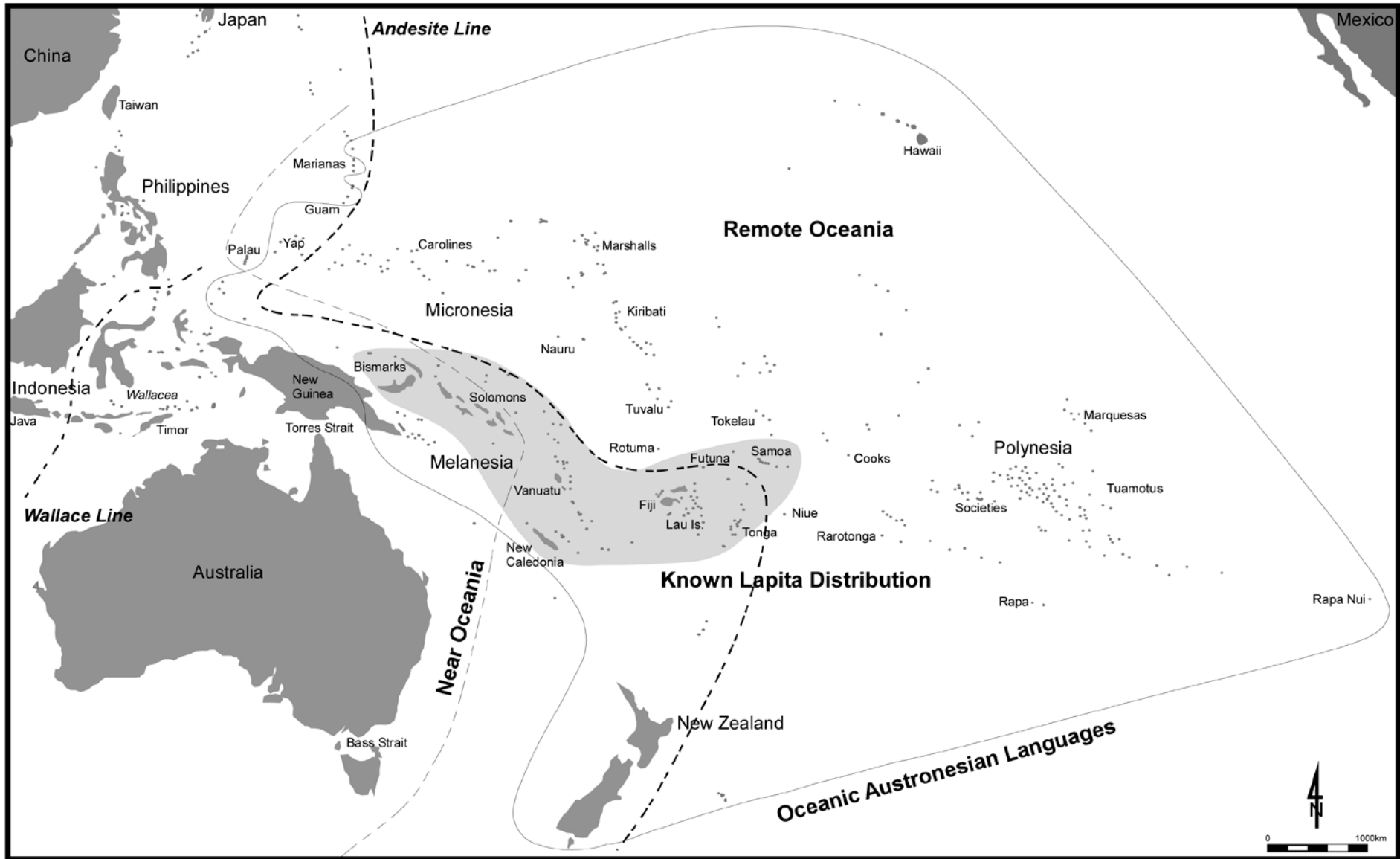


Figure 1. Map of the Pacific showing places and features mentioned throughout this study.

The study is only introductory. It is not a detailed specialist analysis based on new original research. It comprises a general description of key archaeological sites based on published information. The study does not identify or recommend any specific sites for Tentative listing or nomination to the World Heritage List. It discusses particular sites only as examples to help characterise those features of a class of cultural heritage place that ought to be considered in any future of investigation of Outstanding Universal Value in these sorts of sites.

Definition of terms

The study area encompasses all the islands of the Pacific conventionally included in 'Oceania' (Figure 1). Some scholars include Australia in Oceania (e.g. Lilley 2000), a definition long used by the region's premier professional journal *Archaeology in Oceania*. As the journal's editor has noted, Ice Age low sea-levels joined Australia and New Guinea (and Tasmania) as dry land for at least 80% of the region's human history (White with O'Connell 1982). Moreover, while the post-glacial histories of Australia and the Pacific differed significantly, they were not unconnected. New evidence from Torres Strait is beginning to tie Australia to developments in Island Melanesia and the wider Pacific as well as mainland New Guinea in ways unimagined by most Australian and Pacific archaeologists until the last few years. Strictly-speaking, one thus cannot consider the deep human history of Oceania without Australia, or vice versa. For present purposes, however, this technicality is overlooked so attention can be focussed on the Pacific proper without the distraction that would be introduced by the inclusion of Australia, where World Heritage issues are quite different from those in question here.

Other terms, which need to be defined, are 'Melanesia' (the 'black islands'), 'Micronesia' (the 'small islands') and 'Polynesia' (the 'many islands') (Figure 1). Like 'Oceania', these terms were devised by the French explorer Dumont d'Urville in the early 1800s (Clark this volume). Melanesia includes mainland New Guinea and, excluding Micronesian Nauru, all of the islands south of the equator out to and including Fiji in the east and New Caledonia in the south. 'Island Melanesia' refers to Melanesia without mainland New Guinea. The Indonesian province of Papua covers the western half of New Guinea. The eastern half comprises the mainland provinces of Papua New Guinea, a State Party that also includes the islands of the Bismarck Archipelago and northern Solomons. Micronesia includes all the islands north of or straddling the equator between Palau and the Marianas in the west and the Marshalls and Kiribati in the east. 'Triangle Polynesia' encompasses the area between Hawai'i, Aotearoa/New Zealand and Rapa Nui/Easter Island, including Tuvalu. It subsumes 'West Polynesia', formed by Tuvalu, Tonga and Samoa, and 'East Polynesia', which covers all of the remainder. New Zealand and nearby islands are separated by some researchers as 'South Polynesia', but not in this volume. The 'Polynesian Outliers' are Polynesian communities in Melanesia and Micronesia resulting from recent westerly back-migration, while the 'Mystery Islands' are those with signs of prehistoric use which were unpopulated when first found by Europeans. Neither the Outliers nor the Mystery Islands are discussed in detail in this study.

Archaeologists often replace the Melanesia-Micronesia-Polynesia schema with the terms 'Near Oceania' and 'Remote Oceania' (Figure 1). Near Oceania encompasses the area first settled in the last Ice Age (the late Pleistocene): Greater Australia and Melanesia to the end of the main Solomons Islands chain (i.e. excluding the remote south-easterly islands encompassed by the modern States Party of Solomon Islands). Remote Oceania takes in all of Triangle Polynesia and all of Micronesia. Neither set of terms is entirely satisfactory, as witnessed for instance by the distribution of the Polynesian Outliers across both Near and Remote Oceania as well as both Melanesia and Micronesia. All the terms have their uses nonetheless, and so all will be used in this volume as appropriate.

Note that archipelagos and island groups are often referred to by the plural of their name (e.g. 'the Bismarcks' and 'the Loyalties' for the Bismarck Archipelago and the Loyalty Islands respectively), but not when the name designates a modern state (e.g. Fiji, Samoa, Tonga).

Dates

Archaeology in Oceania is heavily reliant on absolute dating, primarily by radiocarbon. In addition, and 'chronometric hygiene' – the careful assessment of the technical soundness of dates themselves and of the integrity of their stratigraphic associations with archaeological material – is a constant concern. Here the abbreviation 'BP' ('before present', technically 1950) is used interchangeably with 'years ago' to indicate generalized chronologies. Some contributors also use BCE or AD/BC dates, according to local practice. The term 'cal BP' is used to signify that a radiocarbon or other absolute determination has been calibrated to calendar years and is used to indicate exact chronologies, however dates over about 20,000 BP cannot yet be reliably calibrated. The abbreviation 'AMS' refers to accelerator mass-spectrometer radiocarbon dating, which allows highly accurate determinations on minute samples.

Background to this study

In line with the World Heritage Committee's action to create a credible, balanced and representative World Heritage List, the Third UNESCO World Heritage Global Strategy meeting was held in Suva, Fiji, in 1997. The gathering identified four main themes for the Pacific:

- 1 Places of origin or mythological origin, navigation routes and places related to navigation;
- 2 Archaeological and historical sites of human settlements;
- 3 Places of traditional economic and ceremonial exchange;
- 4 From the past to the present, continuity and change in the Pacific.

At that time, Aotearoa/New Zealand, Fiji, the Solomon Islands and Papua New Guinea were the only regional States Parties that were signatories to the World Heritage Convention and Aotearoa/New Zealand was the only Pacific nation represented on the World Heritage List. Tongariro National Park was listed as a natural property in 1990 then re-inscribed in 1993 as the world's first World Heritage cultural landscape. Several other properties in the Pacific were on the List at the time, but all belonged to geographically non-local States Parties. These were the Hawaiian Island Volcanoes National Park inscribed as part of the United States of America (1987); the Henderson Island property of the United Kingdom (1988); the Lorenz National Park in the Indonesian province of Papua (1999) and the Rapa Nui National Park, inscribed as a Chilean property in 1995. All, but the last, are natural properties.

In 1998, the Fourth World Heritage Global Strategy meeting was held in Amsterdam in the Netherlands. Participants generated the following definition of *Outstanding Universal Value* that underlines the need to identify themes as well as to recognise regional and historical particularities of cultural properties:

The requirement of Outstanding Universal Value characterising cultural and natural heritage should be interpreted as an outstanding response to issues of universal nature common to or addressed by all human cultures. In relation to natural heritage, such issues are seen in bio-geographical diversity; in relation to culture in human creativity and resulting cultural diversity.

In the same year, East Rennell Island in the Solomon Islands, the largest raised-coral island in the world, became the first property in the small island nations of the Pacific to be inscribed on the World Heritage list. Its listing set a precedent because the island was the first World Heritage site to entail customary ownership and management by the local indigenous community.

In 1999, a second regional World Heritage Global Strategy meeting took place in Port Vila, Vanuatu. The objective was to help raise the profile of the *World Heritage Convention* in the Pacific. Participants stressed the importance of governments pursuing close grass-roots engagement with

future World Heritage nominations in the Pacific to ensure the full agreement of communities in all matters relating to their land, customs and traditions. The meeting also emphasised that Western philosophical and methodological divisions between 'culture' and 'nature' were foreign to the Pacific approaches to the generation and management of knowledge about the world, and thus that mixed nominations would usually be more appropriate in the region.

In 2003, the World Heritage Committee launched the program *World Heritage Pacific 2009*. By that time, the number of regional Pacific signatories to the World Heritage Convention had grown substantially to 11 States Parties. Yet implementation rates languished. No nominations had been submitted and few Pacific states had developed or submitted Tentative Lists of properties with potential for World Heritage listing. On that basis, specialists from throughout the Pacific met in 2004 at the World Heritage Pacific 2009 Workshop at Tongariro, Aotearoa/New Zealand, to develop an Action Plan to assist Pacific Island states and territories with the implementation of the World Heritage Convention over the following five years to 2009.

The Pacific 2009 Action Plan faced up to the fact that Pacific Island nations confront a variety of challenges in implementing the World Heritage Convention. Pacific Island states and territories are mostly very small both in terms of land and population and their heritage agencies are small and have severely limited resources. Many Pacific communities are isolated and have little communications infrastructure. High levels of customary land tenure throughout the region means that thorough consultation is necessary before a site can be entered on a country's Tentative List. While this process enhances the protection of heritage places in the long run, it almost always greatly increases the time taken for Tentative Lists and nominations to be developed.

The 2009 Action Plan sought to redress some of these matters through capacity building. In 2005, there was a regional meeting in Vanuatu to develop a Thematic Framework for World Cultural Heritage in the Pacific, which will be discussed further below. In 2006, the Vanuatu meeting was followed up by a training session in Apia, Samoa, where representatives of the West Polynesian states of Samoa, Tonga and Niue were given technical assistance for the identification of Outstanding Universal Value and for the formulation of World Heritage nominations and management plans.

When Smith and Jones wrote the first Thematic Study for the Pacific in 2007, East Rennell was the only World Heritage property in the small Pacific Island nations. More positively, nine Pacific Island States Parties (including Aotearoa/New Zealand) had submitted Tentative Lists of properties with potential for World Heritage listing. These properties reflected the regional character as well as the local diversity of Pacific Island communities. This positive trend has continued since then, with the pace and scope of listing increasing significantly. East Rennell was joined in 2008 by Kuk Early Agricultural Site (PNG), Chief Roy Mata's Domain (Vanuatu) and the Lagoons of New Caledonia (France). 2010 saw Bikini Atoll and Papahānaumokuākea (USA) and the Phoenix Island Protected Area (Kiribati) listed. The US listings are important, because although that nation is obviously not a small Pacific Island state, it has not submitted any nominations for more than a decade and the Papahānaumokuākea mixed property was nominated as an associative landscape of great importance to Native Hawai'ians as well as for its natural heritage qualities. The region's Tentative Lists have also grown substantially and, as discussed below, many of the proposed sites are directly relevant to the present Thematic Study.

Under Activity 2.5 – "Undertake thematic and comparative studies for cultural heritage values" – the *Pacific 2009 Action Plan* also identified Sub-activity 2.5.1, to hold a workshop to:

- Gain a consensus from Pacific Island Countries (PICs) on appropriate regional themes for nomination of sites of cultural value;
- Agree on the methodologies to be used to undertake these studies;

- Identify those who will take responsibility for the studies;
- Undertake the studies.

As mentioned earlier, a workshop specifically addressing this Sub-activity took place in Port Vila, Vanuatu, in 2005. The meeting saw experts from Pacific Island states and territories meet to identify regional themes for which Thematic Studies were required to help identify properties of potential Outstanding Universal Value in the region as well as possible transnational serial site nominations. Contributors to the Port Vila workshop agreed that the following three Thematic Studies were regional priorities:

- 1 Associative Cultural Landscapes of stories that explain the origin and development of social structures in the Pacific.
- 2 Cultural Landscapes related to cultivation in the Pacific, and
- 3 Lapita expansion.

Smith and Jones's 2007 Thematic Study considered the first two issues. The present study examines the third matter but has broadened the topic to include initial colonisation throughout the Pacific and not just the Lapita phenomenon. The latter is undoubtedly important, but is by no means the whole story of early human expansion and innovation in the Pacific. As described in Irwin's chapter, the settlement of the Pacific required the ancestors of modern Pacific peoples to invent and progressively reshape and refine remarkable ocean voyaging and navigation skills. From about 50,000 years ago, these skills allowed the very first inhabitants of Oceania to cross the permanent water barriers between Island Southeast Asia (now Indonesia) and New Guinea and then move out through the Bismarck Archipelago and the Solomon Islands. This New Guinea-Bismarcks-Solomons region is called 'Near Oceania' by archaeologists and is as far as people expanded at that time. Lilley's chapter in this volume discusses this region. Thousands of generations later, around 3,300 years ago, people speaking Austronesian languages of Asian origin moved into the already-occupied Bismarck Archipelago as well as into uninhabited Western Micronesia to the north. Until much later in history, the story of those who went to Western Micronesia then proceeded largely separately from what happened further south and also, much later, in Central and Eastern Micronesia. These matters are discussed in Clark's chapter of this study. In the Bismarcks, the Austronesian-speakers integrated with local peoples and began producing Lapita, a highly-distinctive form of pottery notable for its intricate decoration made with a dentate (toothed) stamp. From about 3,000 years ago, the Lapita-making descendents of these mixed populations began to spread very rapidly beyond the inhabited world into the unknown expanse of remote Oceania, beyond the Solomons. This expansion is the focus of Sand's chapter. Their expansion paused in West Polynesia for some considerable time before the descendents of the 'Lapita people' – by now recognisable as ancestral Polynesians – pressed on into East Polynesia. In doing so, they moved well beyond the Andesite Line (Fig. 1), which separates the complex continental geologies of the southwest Pacific from the much simpler basaltic geologies of East Polynesia. The implication of this and other aspects of the Polynesian dispersal are discussed in detail in Allen's contribution to this study. As she describes, the Polynesians ultimately reached the western shores of the Americas after establishing themselves on all the inhabitable islands they encountered in the vast triangle between Hawai'i, Rapanui/Easter Island and Aotearoa/New Zealand. Perhaps no more than 2000 years ago, descendents of Lapita colonists living in what is now Vanuatu spread north into Eastern and Central Micronesia, eventually joining back up through trade and exchange networks with the descendents of the Austronesian speakers who first settled Western Micronesia more than a millennium earlier.

Few small Pacific Island nations have inventories of their cultural heritage places. Where these have been, or are being developed, they are often limited in scope and often reflect the interests of foreign researchers rather than being a systematic survey of places and their heritage values. This situation was a significant factor behind Smith and Jones's (2007) Thematic Study on cultural landscapes. In

contrast, the Lapita phenomenon and other aspects of the early colonisation of the Pacific have long been a focus of foreign scientific research interest, and thus of extensive and in places extremely intensive identification and documentation. Archaeological sites associated with early colonisation can thus form a significant if not dominant proportion of those site inventories that have been developed to date in Pacific states and territories. Indeed, such sites are prominent on at least some nations' Tentative Lists. Thus, for example, the Sigatoka Sand Dunes, one of Fiji's four Tentative listings, is a famed Lapita site. The Huon Terraces, a site that is crucial to our knowledge of the earliest human occupation of Oceania, is one of Papua New Guinea's seven properties on the Tentative list. All of Tonga's Lapita sites are tentatively proposed as a serial nomination. It remains true, however, that relevant sites in these countries remain unidentified and unlisted, as do many similar sites throughout the region. Hence the need for a study such as this one, which will help all States Parties in the Pacific identify the sort of attributes that might sustain Outstanding Universal Value and which might be exhibited by early colonisation sites so as to draw attention to factors that ought to be highlighted in World Heritage nominations and management plans concerning such properties.

ICOMOS 2005 "Filling the Gaps - An Action Plan for the Future"

In 2005, ICOMOS published "*The World Heritage List: Filling the Gaps – An Action Plan for the Future*". The objective of this review was to analyse cultural sites inscribed on the World Heritage List and Tentative Lists using regional, chronological, geographical and thematic frameworks. The intention was to offer States Parties a definitive assessment of the current representation of sites in these categories and of likely short- to medium-term listing trends, so that the categories that are under-represented on the List could be identified. The review has a number of ramifications for the present study of Early Human Expansion and Innovation in the Pacific.

The review recognized that cultural regions do not always correspond to the modern political map and thus that it is impossible to achieve a true 'balance' in the World Heritage List at States Party or national level. Nonetheless, the wide cultural regions used by UNESCO – Africa, the Arab States, Asia Pacific, Europe/North America and Latin America/Caribbean – were used in the review to frame the typological analysis. This approach diminishes the usefulness of the review's typological findings with regard to the Pacific. The use of the vast cultural region 'Asia Pacific' as the unit of analysis hides the real extent to which the Pacific Islands are under-represented on the World Heritage List and erases the significant differences between the unique small-scale cultures of the Pacific and those in the much larger and more populous Asia.

The review's analysis of the World Heritage List on a chronological-regional basis used 'Australasia and Oceania' as the unit of analysis, with Asia dealt with separately. Splitting Oceania from Asia in this way showed much more clearly, how the former was poorly represented on the World Heritage and Tentative Lists of sites in Oceania when compared to the other major cultural regions. The analysis found that:

the region of Oceania and Australia has relatively few cultural Properties[...] In New Zealand, the mountain of Tongariro has been recognized as an associated cultural landscape... However, in Melanesia and Micronesia no cultural properties have been inscribed so far...There are large parts of Asia and the Pacific, especially the Pacific Islands that are hardly represented on the List.

The chronological-regional analysis aimed to identify important cultural phenomena that have appeared in the different parts of the world. The study determined that various "cultures", "empires" or "civilisations" have existed throughout history in Asia, Africa, Europe and the Americas. However, the same sort of chronological framework was not used in the analysis of sites in Australasia and the Pacific. This failure overlooks the substantial cultural change through time in the Indigenous cultures of Oceania and Australasia, in their social and political systems as well as in their patterns of land use

and other economic activity. It is clear that the diversity and transformation through time of Pacific Island societies and their landscapes must be recognized for the World Heritage List to be more balanced and representative.

The thematic analyses in the 2005 review considered the representation of sites in relation to seven main themes:

- Expressions of Society
- Creative Responses and Continuity
- Spiritual responses
- Utilising natural resources
- Movement of peoples
- Developing technologies

The most common theme was found to be “creative response and continuity”, which refers to the categories of monuments, groups of buildings and sites, as defined by the *World Heritage Convention*.

The ICOMOS review also identified several basic issues that undermine the fair representation of regions such as the Pacific Islands on the World Heritage List. These matters must be addressed to achieve a globally representative, balanced and credible List. In countries such as the Pacific Island States and Territories, the range and extent of cultural heritage is largely unknown and at best only partially recorded. At present, there are still no comprehensive scientific studies or inventories of cultural heritage places that can be used to identify cultural properties of Outstanding Universal Value in small Pacific Island States Parties. Many Pacific Island States also lack adequate legislation and policy for the protection of cultural heritage.

The incomplete register of cultural heritage in many parts of the world and the lack of effective mechanisms for protection as required by the *Operational Guidelines for the Implementation of the World Heritage Convention* when a property is nominated for inscription, are two of the main reasons for the continuing imbalance in the World Heritage List.

Finally, the 2005 review found that the gaps identified in the World Heritage List in many regions around the world reflect the need for better international understanding of the local cultural values of potential World Heritage properties. These local values derive from the very particular cultural systems that have emerged in the environments of the under-represented areas.

This matter is of particular relevance to the Pacific Islands, where organically-evolved cultural landscapes – relic and continuing – are a response to the shifting challenges and opportunities of the Oceanic world from the time of initial human expansion into the Pacific up to the present day.

There has been some progress in Pacific Island representation since 2005. Then, 18% or 104 cultural sites on the World Heritage List were said to be in the ‘Asia Pacific’ region. In reality, only one of these is on a Pacific island: Rapa Nui National Park on Easter Island. However, Rapa Nui National Park is not recognised in the regional breakdown of Asia Pacific sites because Easter Island, as an External Territory of Chile, is considered in the region of Latin America/Caribbean. Three cultural sites have now been successfully nominated by small Pacific Island States Parties: Bikini Atoll Nuclear Test Site in the Marshall Islands, Chief Roy Mata’s Domain in Vanuatu and the Kuk Early Agricultural Site in Papua New Guinea. None of these properties is directly relevant to the present study. As mentioned above, the United States successfully nominated the mixed property of Papahānaumokuākea in 2010. This vast area extends over 2000km from the main Hawai’ian group northwest to Kuré Atoll a little beyond Midway. Although the whole property is sacred to modern

Native Hawai'ians, only the two islands closest to the main Hawai'ian group show signs of occupation in precolonial times. However, neither was inhabited in the historical period. They are thus numbered amongst Polynesia's 'Mystery Islands', which are not considered in detail in this study.

Much the same situation applies to Tentative listings. The "*Filling the Gaps*" review was finished in 2004. At that time, very few Pacific Island States Parties had submitted Tentative Lists. Of those that had, only Fiji's Tentative list included cultural properties (Fiji's colonial capital Levuka as well as the Sigatoka Sand Dunes mentioned above). As implied earlier, however, Tentative Lists have now been prepared by other Pacific Islands States Parties and many more cultural properties have been submitted, including a few early archaeological sites relevant here (notably in Tonga and Palau but also in Papua New Guinea). When metropolitan States Parties with Pacific possessions are considered, namely France, the United Kingdom and the United States, the number of tentatively-listed Pacific cultural sites expands by only one (the Marqueses Islands, France), but that single case is relevant to the present study. Indonesia has no Tentative sites in the western half of New Guinea.

Near Oceania

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Misisil Cave, New Britain, the first site in island Melanesia demonstrated to be of Pleistocene age (Specht, Lilley and Normu 1981).

Figure 1

Map of Near Oceania showing indicative pre-glacial sites and the two current World Heritage sites in the region. 31

Figure 2

Bobongara (view of Huon terraces in the vicinity of Bobongara). Photo by author. 32

Figure 3

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Introduction

East Rennell, the first site in the independent Pacific to be inscribed on the World Heritage List, is in Remote Oceania (Fig. 1). Listed in 1998, it comprises part of Rennell Island, the southernmost island in the main Solomons chain and the largest raised coral atoll in the world. The only other listed sites in the region are both on the island of New Guinea: the Lorenz National Park in Indonesian Papua, inscribed in 1999, and the Kuk Early Agricultural Site in Papua New Guinea (PNG), inscribed in 2008. Only Kuk is a cultural property; both Lorenz and East Rennell are natural sites.

At the time of writing, the Solomon Islands had two sites on its Tentative List, Tropical Rainforest Heritage of Solomon Islands, a natural property, and the Marovo-Tetpare Complex, a mixed property. Cultural factors comprise only a minor component of the Marovo-Tetpare submission and focus on recent traditional culture rather than early human expansion or innovation. Papua New Guinea had seven Tentative properties, all mixed. As in the case of the Marovo-Tetpare submission from the Solomons, cultural considerations are only secondary considerations in PNG's Tentative listings and apply to living cultures in all instances except the Huon Terraces. The Huon property is listed under Criteria iii and v as well as "natural" criteria, but the Tentative listing does not reflect the fact that the Huon Terraces have yielded some of the oldest evidence for early modern human expansion and innovation anywhere in Oceania and indeed the world. Cultural attributes such as this need to be thoroughly documented and integrated into the listing to substantiate its potential Outstanding Universal Value. Further details of this site are discussed below. One of PNG's Tentative properties, the Trans-Fly Complex, straddles the border with Indonesia, but at the time of writing, none of Indonesia's 27 properties on the Tentative List was in New Guinea (and thus Near Oceania).

Near Oceania as an analytical unit

As described elsewhere in this study (Clark), the Enlightenment encounter with biological and cultural differences across Oceania saw fundamental divisions drawn between Polynesians, Melanesians and Micronesians, and between those three groups and peoples in Southeast Asia. The supposed distinctions underlay various models regarding relationships among these populations and the settlement history of the Pacific. Such early scenarios in turn gave rise to more recent proposals attempting to account for often not entirely-coincident patterns of biological, cultural and linguistic variation across this vast area. In 1991, the late archaeologist Roger Green wrote a landmark paper entitled "Near and Remote Oceania – Disestablishing 'Melanesia' in Culture History". The paper elaborated a distinction first drawn by Green and linguist Andrew Pawley in 1973 to account for the fact that while Polynesia continues to be "a productive category for historical analysis...the...concepts of Melanesia and Micronesia have proven, particularly for archaeologists, to be fatally flawed" (Green 1991:491). In their place – and also in place of other geographically-based terms – Green proposed terms relevant to human history as revealed by archaeological research. He first discussed (1991:493-4) how Oceania is best identified as the region lying east of the pivotal biogeographic divide denoted by the Wallace Line, which separates the placental mammal faunas of the Old World from the marsupial fauna of the Australian region. The Wallace Line runs roughly north–south immediately east of Bali and Borneo and west of the main Philippines chain. Green then explained (1991:494-5) that some distance further east again, beyond the main Solomon Islands chain, islands are generally much smaller, distances between them greatly increase, usually to the point where major island groups are not intervisible, and the flora and fauna available for human survival are dramatically reduced in abundance and diversity. On that basis, he drew a line at that point, separating Near Oceania – stretching from New Guinea to the end of the Solomons – from Remote Oceania to the south and east. This line, he wrote (1991:494-5), is

likely to have had an important role in the early settlement of the Pacific by humans given that entry was dependent on the voyaging capability of watercraft as well as the facility with which one could direct a vessel to a given destination. It is here that the concept of

intervisibility, as applied to humans, intersects with the previous dispersal mechanisms and colonising abilities of Pacific plants and animals to provide a...boundary that may for a time have served as an important barrier to the movement of humans eastward.

Green knew at the time that he wrote that passage that the scholarly caution evident in his wording "may for a time" was almost certainly unnecessary, and that the boundary between Near and Remote Oceania was clearly a major barrier to early human expansion despite the innovations that allowed people to spread to that point as early as they did. As explained elsewhere in this study (Allen, Irwin, and Sand), it would require significant further innovation over some 40,000 years to allow people to successfully colonise Remote Oceania, the last part of the globe to be settled by humans.

Contemporary cultural and political setting

New Guinea is presently governed by two countries. The western half is part of Indonesia, having previously been encompassed by the Dutch East Indies. The Indonesian provinces in New Guinea are supposed to have a special degree of autonomy from the central authorities in Jakarta, but the arrangements remain in a state of flux. There is an independence movement that periodically makes the international headlines, including at the time of writing, but it has never had a significant impact on Indonesian control. The eastern half of New Guinea forms the mainland territory of Papua New Guinea, which also includes the Bismarck Archipelago as well as Bougainville and Buka, the northernmost islands of the Solomon Islands archipelago. Following prolonged civil unrest, the North Solomons Province of Papua New Guinea was granted a significant degree of autonomy from the central government in Port Moresby and is now known as the Bougainville Autonomous Region. The modern nation of the Solomon Islands includes the rest of the archipelago south of Bougainville plus the remote and geologically-separate Santa Cruz islands to the southeast, beyond the boundary between Near and Remote Oceania. Government authority in the Solomons all but collapsed following civil unrest in the early 2000s. A semblance of order was returned after the Regional Assistance Mission to Solomon Islands (RAMSI), an international effort led by Australia and New Zealand. At the time of writing, RAMSI military and police forces remained in the country but were maintaining a very low profile while civilian governance was gaining strength.

Present environmental setting

In archaeological terms, Near Oceania encompasses that part of Oceania first settled in the Pleistocene (the last "Ice Age"). For the purposes of this study, the area includes from west to east the island of New Guinea, the Bismarck Archipelago (including the Admiralty Islands) and the main Solomon Islands chain (i.e. excluding the remote southeasterly islands encompassed by the modern state of Solomon Islands). Until only about 7000 years ago, New Guinea was joined to Australia by dry land which had lain exposed for almost 130,000 years during the last Ice Age, when sea water was taken up to form the vast ice sheets of the northern hemisphere and sea levels dropped to a maximum of 130m below present. Australia was in turn joined to Tasmania by the same process at the same time, though Tasmania was isolated by rising postglacial seas around 14,000 years ago. The vastly enlarged continent is known to specialists as Sahul. Despite this long-term physical attachment to New Guinea, Australia (including Tasmania) will be excluded from further discussion because its prehistory and its current place in the domain of World Heritage differ dramatically from those of New Guinea, the Bismarcks and Solomons. Also excluded here are the islands of Wallacea, which lie between the Wallace Line and New Guinea's Bird's Head. Although crucial to the history of early human dispersal and innovation in the Pacific, today they are politically part of Indonesia and are generally not considered part of the Pacific region.

New Guinea is the world's second largest island, covering almost 800,000 km². It lies on major tectonic plate boundaries and is thus volcanically highly active. Its most northerly point, on the Bird's

Head in the west, is just south of the equator, while the most southerly point, on the island's southeast tip, is almost 10° South. It is dominated by a central mountain range running roughly east-west for some 1600km across almost the entire landmass and in places rising up to nearly 5000m above sea level. The highest peak, Puncak Jaya, is the tallest point in Oceania, and the high mountain ranges feature permanent glaciers. The treeline is currently around 4000m, above which there are substantial areas of alpine tundra and subalpine grasslands. Below the treeline, montane rainforests dominate. To the north and south of the central range there are vast tropical lowlands drained by major rivers such as the famous Sepik. The lowlands feature rainforests, savannahs, extensive wetlands and some of the largest mangrove forests on the planet. The pre-human terrestrial fauna of New Guinea is largely Australian in origin (as most obviously illustrated by the presence of marsupial mammals), but the natural flora is more Southeast Asian than Australian.

The Bismarck and Solomon Islands Archipelagos are in many ways just scaled-down versions of New Guinea. Both are tropical, mountainous and volcanically active, but neither has any glacial, alpine, or even true montane environments. Both largely share New Guinea's flora and fauna, but unlike New Guinea, which has exceptional biodiversity, the Bismarcks and Solomons exhibit much-reduced species diversity. For instance, Green (1991:494) notes that New Guinea has over 500 species of birds, but New Britain in the Bismarcks has only 80 and the Solomons about 130. The situation with mammals is even more dramatic: New Britain has only four types of marsupial and four genera of native rats, while the Solomons has only one species of marsupial and three genera of rats. One of the major early innovations discussed below entails a fascinating adaptation to these circumstances. It should be noted that the large island of Bougainville and the adjacent much smaller island of Buka are environmentally and culturally part of the Solomons but politically part of Papua New Guinea.

Past environments

The very first events and processes entailed in the early human dispersal and innovation in the Pacific took place in the very distant past. Moreover, they played out over a long period of time during which the climate and thus terrestrial and marine environments varied considerably owing to glacial cycles. The different phases of these cycles are called Marine Isotope Stages or MIS because they form part of a long sequence of shifts in ancient ratios of oxygen isotopes O18 and O16 recorded in polar ice-cores and in calcite in seabed cores. The changes signal shifts in water temperature, which in turn map variations in climate and especially glacial cycles. Glacial periods – Ice Ages – are even-numbered in the MIS scheme, and interglacials odd-numbered. The stages of most relevance here are the glacial MIS4, which lasted from 74,000-59,000 years ago, and especially the first half of the MIS3 interglacial, which lasted from 59,000-24,000 years ago. The following summarizes a recent comprehensive review of the evidence drawn together by Pope and Terrell (2008).

From the start of MIS4 about 74,000 years ago, global climate began to deteriorate significantly. Conditions became extremely cold and dry, in association with an upswing in El Niño Southern Oscillation (ENSO)-related droughts and a much-reduced Asian summer monsoon. Pope and Terrell (2008:6) believe this may have been the driest period in the region since the emergence of biologically-modern humans in Africa some 150,000 years ago. The beginning of MIS3 about 59,000 years ago saw temperatures rise alongside a resurgence of the summer monsoon and a reduction in ENSO droughts. Indeed, one of the wettest periods in the area in the last 100,000 years occurred around 45,000 years ago, roughly when people are likely to have first entered Near Oceania. After that, things began to deteriorate rapidly as the global climate began trending towards the extreme glacial cold and aridity of MIS2, the last Ice Age before now. Dry-adapted and especially cold-tolerant plants and animals would once more have expanded their ranges. Although the effects of such changes were much more muted in the tropics of Near Oceania than in Australia to the south, where the continent's desert core grew to immense size, in New Guinea the tropical glaciers grew, the

treeline and alpine environments moved down to around 2200m and the area of lowland savannah, especially in the southeast, expanded considerably.

While the climate was shifting like this – indeed, primarily *because* the climate was shifting – sea levels around the world also varied up and down relative to present conditions. The formation of glacial ice removes huge amounts of water from the oceans, lowering sea levels by often very considerable amounts. This in turn exposes large areas of previously submerged land and in the process can join lands that are now separated by water, as in the case of Australia, Tasmania and New Guinea mentioned earlier, or say India and Sri Lanka or Britain and Europe. Indeed, for most of the time since biologically-modern humans evolved, global sea levels have been very much lower than they are now. This means coastal lands now underwater were available for movement and settlement and any water crossings that were not replaced by land-bridges would often have been significantly shorter than they are now.

For this reason, archaeologists commonly link the first human colonisation of Near Oceania to times of glacial low sea levels, as population movement would have been easier. This same reasoning is being extended to the original dispersal of the earliest anatomically-modern humans out of Africa. Oppenheimer (2009:7-8), for instance, contends that one or another of two episodes of very low sea level (and accompanying increases in salinity and degradation of marine resources) 85,000 and 73,000 years ago respectively may have facilitated a move across the Red Sea by early modern people searching for more productive waters. Unfortunately for archaeologists, and crucially for the present thematic study, post-glacial rises in sea level mean that any sites located in previously-exposed places are now submerged and inaccessible. This is a particular problem for those researching initial colonisation patterns, because except in rare instances the very earliest sites are now likely to be under water. Thus we may never know exactly when people first arrived in Near Oceania. This question will be further addressed.

Like changes in climate, fluctuating sea levels affect the distribution of plants and animals, especially on coastal margins. The main issue is that the coastal environments through which early colonists had to have moved would not have been stable. Before MIS3 there is little evidence for large-scale formation of coastal swamps, lagoons or estuaries that would have been rich sources of food for early human colonists in Near Oceania, and those that did form during this time did not last beyond about 30,000 years ago, when the climatic downturn towards the Last Glacial Maximum (LGM) really began to take hold. The LGM proper lasted from 25,000-12,000 years ago. Average sea-surface temperatures at the time were up to 4° C lower than now in the tropics and up to 9° C lower further south, while sea levels were up to 130 meters lower than present. Although these lowered sea levels exposed large areas of land in Southeast Asia and around Australia, they did not greatly increase the land areas of northern New Guinea or the islands of the Bismarck Archipelago. In the Solomons, the islands from Buka and Bougainville in the north to Santa Ysabel in the south joined to create a landmass bigger than New Britain is now. However, the Solomons remained separated from the Bismarcks and none of the major islands was ever linked to the New Guinea mainland.

The beginning of the end of the last glacial period was marked by a slight rise in temperature and sea level around 15,000 years ago, though it remained very cold and dry until perhaps 12,000 years ago. The New Guinea treeline began rising, but unlike sea level, which stabilized at present levels around 6,000 years ago, vegetational shifts continued until about 4,000 year ago. Sea level rise finally separated Tasmania from Australia about 14,000 years ago and New Guinea about 7,000 years ago. Until this time, Terrell argues (2010:213), the shoreline of northern New Guinea would have been steep, rocky and not very productive of human food resources. The nature of postglacial (or 'Holocene') environmental change in the Southern Hemisphere remains hard to pin down. There is a well-defined series of terminal Pleistocene/early Holocene arid periods in the Northern Hemisphere

(e.g. the Younger Dryas 12,800-11,500 cal BP), but no clear indication that any of them occurred in the southern hemisphere (Haberle and David 2004:166-167).

In addition to coping with the foregoing patterns of environmental change, the first colonists of Near Oceania had to cope with not just a shift from an Old World placental mammal fauna to a marsupial fauna when they crossed the Wallace Line, but to a marsupial fauna which filled only about one third of the ecological niches occupied by placental mammals in other parts of the world despite a remarkable process of convergent evolution that produced such things as marsupial “cats”, “lions”, “moles” and “wolves”. Moreover, some of these marsupials were now-extinct species very much larger than those alive now: the “megafauna”. These beasts included huge kangaroos (including tree-kangaroos very much larger than modern species), koalas and wombats, but also rhino-sized browsers and the like. There was also a 6m-long monitor lizard and a 2m+-tall flightless bird like an emu or ostrich. In short, the fauna would have been very different from that which Near Oceania’s earliest colonists would have known in Southeast Asia.

The first colonists of Near Oceania

The first people to wend their way from Sunda to Sahul through the Wallacean islands were genetically, anatomically and behaviourally fully-modern *Homo sapiens*. Genetically- and anatomically-modern humans (AMH) appeared first in eastern Africa, evolving from *Homo heidelbergensis* around 160,000 years ago, in the middle of MIS6 when conditions would have been very cold and dry. Whether these first AMH were fully modern behaviourally, in the sense that they acted in ways unambiguously the same as more recent people, is a controversial matter that is beyond the scope of this study. It is important to know here, though, that there were already various sorts of pre-modern humans living well beyond Africa at the time AMH appeared. These older peoples included Neanderthals in Europe, *Homo erectus* in Asia (once called ‘Java Man’ and ‘Peking Man’), and the tiny *Homo floresiensis* ‘hobbits’ in western Wallacea, all of which had evolved from ancestral populations that had left Africa much earlier.

Just who the ‘hobbits’ were is a matter of great contention. Research in train at the time of writing was seeking to clarify the issue, and especially the question of direct links between the ‘hobbits’ and the very earliest members of our genus *Homo* or perhaps even immediately pre-human *Austropithecus* in Africa. Their presence in Southeast Asia is not a complete surprise, but their presence on the eastern side of the Wallace Line is, even if Wallacea is a zone of faunal mixing and transition from the Asian zone to the Australian sphere. How the ‘hobbits’ reached Flores is unknown, though other placental mammals such as elephants (*Stegadon*) did so as well. Like the elephants, the ‘hobbits’ do not appear to have made it to any other island in Wallacea, or into Near Oceania.

We continue to refine our understanding of what happened when AMH began to disperse among these *in situ* populations. There is no hard archaeological evidence from the right places in the relevant periods, but current thinking based on genetic mutation rates is that anatomically-modern people began moving out of Africa through Egypt and into the Sinai around 100,000 years ago. They seem to have pulled back, however, after reaching the Middle East, perhaps owing to the difficulty of long-term survival in the expanses of desert that would still have been present despite the relatively benign interglacial conditions that obtained in MIS5.

Genetic patterns suggest people began pushing outwards again perhaps 70,000-75,000 years ago, roughly at the start of the MIS4 glacial. This second time round, people expanded via a ‘southern dispersal route’ across the Red Sea to the Arabian Peninsula. Such movements have periodically been linked to large-scale multi-species dispersals (people following game or just being pushed or pulled along by the same factors as other animals), but the spread of AMH to the Arabian Peninsula does not seem to be part of a such a phenomenon (O’Regan *et al.* 2009). As noted earlier,

Oppenheimer suggests the movement may have had something to do with falling sea levels depressing marine productivity as well as shortening water crossings.

To get across the Red Sea, people could have either gone directly from one side to the other or hopped through the islands that lie to the south near the Arabian Sea. Sea level at that time was about 100m lower than present, so the distances would have been shorter than now, but some form of watercraft – perhaps just a simple raft – would still have been needed. People then headed east towards India, only much later moving northwest up into western Eurasia and then Europe proper. They appear to have replaced all the pre-modern humans they met, with little if any biological mixing. It is not yet known when AMH reached India. The earliest reasonably-definite modern human sites, as indicated by the nature of the artefacts they contain, date to no more than 45,000 years old, while the oldest anatomically-modern skeletons found so far in South Asia date to no more than about 35,000 years old. However, “genetic clocks” based on estimated mutation rates – and for that reason not very precise (Pulquério, M. and R. Nichols 2006) – indicate that early moderns may have arrived in the region some time before a well-dated eruption of Mt Toba in Sulawesi around 74,000 years ago.

The Toba super-eruption was one of the greatest natural cataclysms in Earth’s history. Its scale boggles the mind. Nearly 3000 *cubic kilometres* of magma was produced and about one million tonnes of ash blown into the stratosphere. Although much of the ash settled into the Indian Ocean and South China Sea, some of it drifted right across Southeast Asia and India as far as the Arabian Sea. Anything close to the eruption would have been vaporized. Heavy falls of ash beyond the immediate vicinity would have destroyed most if not all life as well but may not have reached much more than 350 km from the volcano, and appear to have missed much of mainland Southeast Asia. Thus while obvious Toba ash layers can be found in India, where they serve as a valuable chronological marker in archaeological excavations, there is little very likelihood that any people – modern or pre-modern – were entombed Pompeii-style for archaeologists to find. Interestingly though, recent excavations in India specifically targeting sites containing the Toba ash have found that artefacts immediately above the ash are very like those found just below it. Although in the absence of skeletal remains the Indian finds cannot be definitively associated with modern people, they exhibit tantalising similarities to artefacts thought to be produced by early AMH in Africa. The finds include a piece of ochre from below the ash that was conceivably used as pigment and is thus suggestive of modern forms of artistic behaviour (Haslam et al. in press, Petraglia *et al.* 2007 *Science*; also Oppenheimer 2009:9). In this last connection, the similarities of the material on both sides of the ash have been said to indicate survival of the local population through the Toba cataclysm and thus reveal a level of behavioural adaptability thought most likely to be characteristic of cognitively-modern people.

Early in 2010, however, the project’s dating specialist stunned his colleagues by revising the dates for the material immediately above the ash (Balter 2010). His new pre-Toba dates were the same as his previous ones, which were dated with a very high-precision version of Roberts’ specialty, Optically-Stimulated Luminescence (OSL). Instead of his new post-Toba dates being around 74,000 years old, though, as he had previously determined on less-than-ideal samples, he indicated the post-Toba material might only be about 55,000 years old, or even younger. On the face of it, this means the site may have been abandoned for 20,000 years after the eruption, a possibility that does not sit well with existing hypotheses regarding continuity of occupation, regardless of what kind of human made the stone tools. It certainly undermines the continuity = behavioural adaptability = behavioural modernity equation that is being used in major support of the idea that modern people were present in India before Toba.

Another thing about the Toba eruption is that it has been argued by some researchers to have caused a six-year ‘volcanic winter’ which in turn forced a noticeable cooling in global climate for about 1000 years. It has been proposed that this climatic shift had a dramatic effect on modern human biological

evolution, creating a genetic 'bottleneck', or marked restriction of genetic variability, by killing off nearly everybody on the planet. There is no question that some sort of bottleneck occurred early in the dispersal of modern humans, but it seems unlikely that Toba played any role in it. Toba does appear to have resulted in a local bottleneck in India where the ash fall was heaviest (Oppenheimer 2009: 9), but the marked genetic restriction in the wider early human population was in fact most probably caused by the expansion of a very small original source population that first left Africa. Despite such 'small beginnings', the bottleneck had a major impact. It means that nearly every person who has lived since, at least outside Africa, is descended from a single group of perhaps 1000 individuals. They are thus genetically almost identical to everyone else who has also lived outside Africa since the bottleneck occurred. This implies that the first anatomically-modern people to make it to India and then to Near Oceania would all have been biologically very similar, rather than from biologically highly-diverse populations.

In the language of genetics, these first non-African moderns belonged to the 'M' and 'N' mitochondrial DNA lineages, the two 'basal' or earliest 'daughter' lineages that according to genetic 'clocks' diverged from the African 'L3' source lineage about 70,000-75,000 years ago. This is what provides the date for the successful exit from Africa across the Red Sea. The same "clocks" indicate that L3 itself appeared only around 85,000 years ago. This makes Oppenheimer's earlier date for the initial Red Sea crossing less likely than his later one, even though broadly similar environmental conditions obtained in both periods. An 'R' lineage, which evolved from 'N' very early, is also present in India. While 'M' remained restricted to Asia, and now dominates in India, 'N' (with 'R') is ancestral to western Eurasian lineages, indicating that modern human settlement of the latter region came not only well after but also almost certainly derived from the colonization of South Asia. Mitochondrial DNA (mtDNA) is inherited only through the female line, but new Y-chromosome evidence, which is exclusively male, supports this picture. It indicates that the ancestors of all non-African males first became genetically-distinct from their African forebears approximately 70,000 years ago. The Y-chromosome data have until now been substantially younger than the mtDNA evidence, but – bearing in mind the drawbacks of genetic chronology – the convergence of the latest time-estimates for the two quite distinct indicators goes some way to firming up the chronology of the initial push out from Africa.

Some of the descendants of the genetically closely-related anatomically-modern people who first moved into India kept going all the way through Asia to Wallacea. The water gaps did not stop them, or even slow them appreciably, as they island-hopped into Near Oceania. This affinity with the sea seems to be a characteristic of early AMH, dating right back to the time people first crossed the Red Sea. This indicates that modern humans have always been seafarers, even if they had only modest capabilities so early in the piece. Importantly in this regard, marine shellfish remains are found in some of the earliest AMH sites in Africa, and there is evidence that regular access to certain lipids (fats) available only in marine and aquatic foods was critical to the evolution of modern humans in the first place owing to their impact on brain development (Broadhurst *et al.* 2002).

The modern consensus is that a single, relatively homogenous population in Asia was the source of a single initial colonizing episode into Near Oceania. Crucially for this study, although the first people to move all the way through Wallacea were very much alike, the genetics suggest that from the start, the group(s) that colonised the northernmost part of the region – now New Guinea, the Bismarcks and Solomons – were genetically distinguishable from those who moved into the continent more to the south, into what is now the Kimberley in northwestern Australia. The evidence is still scant, but there was probably only slight biological overlap between these northern and southern groups. This suggests two main routes into Near Oceania – though northern and southern Wallacea respectively – may have been used at roughly the same time by closely-related but distinguishable subgroups of the population of Southeast Asia (e.g. Van Holst Pellekaan 2008).

The culture of the first colonists

While we have an increasingly good idea of who Near Oceania's first colonists were physically, we have less of an idea who they were culturally and especially linguistically. The languages of Oceania are split into two principal classes: Austronesian and non-Austronesian (or "Papuan"). Austronesian languages are associated with Lapita and thus not directly relevant in this chapter. The 700+ languages in the Papuan group includes most of the languages of mainland New Guinea and some of those on nearby islands to the west in Wallacea as well as to the east through the Bismarcks and as far as New Georgia in the Solomons. They were the only sort of language in Near Oceania until the Lapita dispersal some 3000-3500 years ago. They are related at the highest level only by the fact that they are not Austronesian, though a number of groupings can be discerned at lower levels of abstraction. There have been various efforts to distil historical patterns from these relationships, but great uncertainty remains about very early periods, except to suggest that some languages and groupings may have significant time depth, and that some in the mountainous interior of New Guinea may be distantly related to Australian languages (Foley 1986:269-283).

Despite the technical issues that linguists have in dealing with the language(s) of the earliest colonists, the relationship between the need for complex language (rather than just simple vocalization) and the other cognitive abilities required to colonize Near Oceania excites other researchers because of what it implies about the emergence of modern human behaviour. A compellingly case has been made in this connection, propelling Near Oceania to centre-stage in the intense international debates surrounding the emergence of our species. The idea is this. Whatever behavioural flexibility the people who first pushed out of Africa may have needed to cope with the environmental variability of the southern dispersal route to India, their crossing all the way through Wallacea to Near Oceania unquestionably required boats. The construction, provisioning and handling of watercraft capable of carrying a culturally and biologically-viable group of people across up to 100km of open sea to a new land would have necessitated 'propositional meaning, information flow, planning depth, and conceptualisation', all signs of what the researchers call the 'fully reflexive cognition' characteristic of fully modern humans (Balme *et al.* 2009). Cognition of this sort can only be expressed by fully modern language. Thus even though we cannot reconstruct the language(s) of the very first settlers of Near Oceania, there is every reason to believe that their speech was of a complex modern sort rather than some simple forms of vocalisation.

Davidson and Noble (1992:135) take this matter a good deal further. They contend not only that "the first passage of people from...Sunda...to Sahul represents the earliest documentation of the evolutionary emergence of language", but also that this comprises "the oldest [unambiguous] evidence for the expression of behaviour that is distinctively human". A large claim indeed, especially in view of the fact that people probably used boats to leave Africa in the first place, and the distinctly pre-modern *Homo floresiensis* managed to cross a water gap from Sunda into the western edge of Wallacea! As we shall see below, though, Near Oceania's first settlers managed some truly extraordinary feats of voyaging which put the efforts of the 'hobbits' firmly into perspective. Generally-speaking, though, other researchers agree with the overall proposition, even if they put their own twist on the situation. Hapgood Franklin (2008; also Brumm and Moore 2005; Franklin and Hapgood 2007; also Mellars 2006), for instance, are firmly of the opinion that the evidence for early (much less the earliest) behavioural modernity is very sparse in Near Oceania compared with Europe and southern Africa. They use a standard trait-list developed by McBrearty and Brooks (2000) to suggest that a 'package' of archaeologically-detectable modern behaviours that ostensibly heralds the arrival of modern people in other parts of the world is not found in Near Oceania, but was built up over the long term following colonization. Mellars (2006:798) agrees that supposedly crucial archaeological indicators of modernity are missing here, and calls the situation in Near Oceania the "greatest enigma in the current archaeological record" concerning the initial dispersal of modern humans.

This sort of position clearly implies that the very first people in Near Oceania were behaviourally pre-modern, or at the very least somewhat devolved, if, as Mellars argues, they lost the package of modern behavioural markers en route from Africa. All the researchers in question acknowledge this implication, but still stress that they agree the initial colonists of Sahul were cognitively as well as anatomically modern. How can these authors have it both ways? The short answer is that they are not seeking to do so, despite appearances. With the exception of Mellars, they are in fact questioning the use of trait-lists on the grounds that they suffer from a basic logical circularity: people presumed or demonstrated to have been cognitively modern produced traits x, y and z, so whenever one find such traits one has evidence for the presence of modern people (or, conversely, no such traits, no cognitively-modern humans). Are we really to believe that all early modern people, whatever conditions they confronted as they dispersed around the fringes of the Indian Ocean, necessarily behaved in exactly the same way? Surely if one of the hallmarks of cognitive modernity is behavioural complexity, we would expect something more complicated than “cookie-cutter” patterning in the archaeological record. Mellars (2006:799) largely takes this line, but adds the possibility that modern people’s technological repertoire gradually became simplified through a process of ‘technological drift’ as they moved further and further from Africa.

What is wrong with the alternative view, though? What exactly is the problem with Near Oceania perhaps being colonized by pre-modern people, if that’s what trait-list comparisons with Africa and Europe indicate? Why should Near Oceania be different? The biological anthropologist Webb (2006), has suggested on other grounds that Near Oceania – or at least Sahul – was in fact colonised by *Homo erectus*. No-one has taken his proposal further. This is because the extraordinary strides in genetic and other biological research capabilities over the last generation or so have completely altered the way we look at human evolution. In a nutshell, there is now little doubt that there was no linear *in situ* development of modern human characteristics out of local pre-modern populations, with, for example, ‘Peking Man’ eventually becoming modern Chinese, while European *erectus* turned into Neanderthals then ‘Cro Magnon Man’, and ‘Java Man’ *erectus* gave rise to the first people in Near Oceania, with everyone somehow staying in sufficient biological contact to remain the same species rather than diverge like Darwin’s finches. Instead, the genetic evidence in particular but also various aspects of human skeletal biology very strongly underpin an “Out of Africa” or “African Eve” model of modern human origins. Analysis of Neanderthal DNA, for instance (Noonan et al 2006 Science: 1113, also Briggs *et al.* 2009 Science), shows that Neanderthals and humans ‘share a most recent common ancestor ~706,000 years ago, and that the human and Neanderthal ancestral populations split ~370,000 years ago, before the emergence of anatomically modern humans’.

Thus it is that those who argue that Australia’s first colonists lacked the classic trait-package associated with modern cognition elsewhere can nonetheless agree that the earliest Australians were behaviourally fully modern. They are highlighting and offering explanations for discrepancies in the arguments that position early Aboriginal people as somehow deficient – more primitive, or premodern – because they lacked the ‘package’. It is the idea of a ‘package tour’ that these scholars want to critique or refine, not the proposal that Aboriginal people were cognitively as well as anatomically modern from the time they arrived in Sahul.

Interestingly in this context, Langley (2009) very thoroughly ‘crunched the numbers’ recently to show that the seeming absence of the ‘package’ of modern human behaviours in early Near Oceania may just be an artefact of natural processes of site destruction and patterns of archaeological work rather than the sorts of processes considered by Mellars or Hapgood and Franklin. Confusing? A little, certainly, but it is important to get to the bottom of this matter given its centrality in debates about the origins of our species. Rather than call the whole ‘package tour’ model into question on the grounds that the Australian situation ostensibly does not fit, Langley et al. (in press) hold that her research supports the notion that the complete ‘package’ of behavioural modernity traits was exported from Africa to other regions of the Old World and ultimately into Near Oceania. They contend that when

issues of taphonomy (site destruction) and archaeological sampling are taken into account, there “are no significant differences between the archaeological records of [early modern behaviour in Near Oceania]...Africa and...Europe if the specific traits are given less priority than the types of behaviours and thought processes that likely produced them”.

A large part of our problem in determining who was doing what, where and when, is that the archaeology of the relevant periods is not well developed in the Middle East and in South and Southeast Asia. There are only a handful of sites in Southeast Asia even approaching the right age, but only one that actually dates to the exact period of concern to those studying the initial movement of AMH through Wallacea to Sahul. This site, Kota Tampan in Peninsula Malaysia, has yielded rough stone tools that are encased in the Toba ash and are argued to have been made by modern people (Majid 2003). There are no modern human bones that would make this contention certain. Instead, the link is made because essentially the same sorts of artefacts are found in very much more recent and unquestionably modern human context in the site. Apart from that, there is genetic evidence that places AMH in that general region 60,000-65,000 years ago (Macaulay *et al.* 2005, Thangaraj *et al.* 2005). The paucity of hard data means it is not possible simply to trace the movement of culturally-related people along the southern dispersal route via India into Near Oceania by tracking particular sets of distinctive ‘marker artefacts’ across the landscape in the way that can sometimes be done in other contexts, such as the very much later initial colonization of Remote Oceania, discussed elsewhere in this study, or the first movement of agriculturalists into Europe. Research underway or being proposed at the time of writing should go a long way to solving this problem, but until it does debates of the sort we have just discussed will continue to bounce back and forth without much prospect of resolution.

What was done, where and when?

So, where does that leave things? We can be reasonably confident that some time less than 70,000 years ago we had two main groups of closely-related but distinguishable people:

- moving across the water gaps between the islands of Wallacea,
- to a place no human, modern or otherwise, had ever seen before,
- an unfamiliar landscape inhabited by animals of a sort no human modern or premodern, would ever have encountered anywhere else,
- including various ‘giant’ species,
- but not including mammals in perhaps two-thirds of the ecological niches occupied by placental mammals elsewhere in the world.

What an astonishing thing to have accomplished! How might it have been done? Which way(s) might people have come?

One important thing to consider in thinking about how the colonization might have been effected is the size of the first group of settlers. As mentioned earlier, this issue is yet to be settled. We will never know for certain, but there have been various estimates over the years, ranging from a single pregnant woman – a colourful but undoubtedly tongue-in-cheek suggestion – to much larger numbers of people. The crucial thing would have been that the group was biologically viable, that is, for there to have been enough people to ensure that the group survived over the long term rather than died out. This requirement immediately rules out the ‘single pregnant woman’ idea even if it had been serious, but just how many people would have been needed? As already indicated, there are two quite dissimilar answers to this question. The differences between them have significant implications for the ways in which the process of colonization may have played out.

The first possibility is that the group was really large. Some geneticists suggest 500-1000 women would be needed to account for patterns they observe in the islands of Near Oceania (Merriwether et al PNAS 2005), so perhaps one group or a number of closely-interacting groups totalling at least 2000 people could have been involved. This is the number that biologists calculate would be necessary on the basis of their understanding successful breeding behaviour in an isolated population. This number can be very much reduced, though, if the colonizing group remains in contact with just one other group back home or in some other locality (Moore 2001; also Allen and O'Connell 2008). Plainly there is a major difference between organizing the movement of 2000 people and then successfully managing their permanent isolation, even if they are closely-related, and organizing the movement of much smaller numbers of people who will be maintaining, initiating or re-establishing relationships with people elsewhere. What we know today about population movement on the one hand and small-scale hunter-gatherer societies on the other – based on recent historical examples which may have little or no applicability to the remote past – strongly suggests that the latter scenario is the right one. It is safe to say that people – hunter-gatherers or otherwise – almost never set off with the intention of permanently severing all ties to their homeland and in fact generally go to some lengths to maintain such ties for long periods. What may have happened and why is taken up in more detail below.

Was initial colonization deliberate?

Why did people do it? Why set off into the unknown, across the open sea to who-knows-where to meet who-knows-what, if they made it safely to land at all? Most scholars think it highly unlikely that there was a conscious decision to migrate of the sort people make today when moving within or between countries. It certainly seems implausible that a “Pleistocene Columbus” (Spriggs 1997:29) set off (or was dispatched by community leaders) to see what riches lay over the horizon. The speed of colonization appears rapid, archaeologically-speaking, owing to the statistical vagaries of our dating techniques. Yet those skeptical of deliberate migration argue that in real human terms – that is, measured in people's (then usually short) individual lifetimes – the process is likely to have been imperceptibly slow. Even with hopping to previously uninhabited islands, they suggest that movement probably passed largely unnoticed within and even between single human generations. Expansion rates of no more than one kilometre a year are all that would be required to get people across the distances entailed in even the shortest timeframes that researchers envisage.

As Denham et al. (2009) pointedly remind us, we have a tendency today to think of migration and colonization in terms of historical examples. What springs to many people's minds are the vast and often very rapid population movements that have occurred since the rise of the ‘Atlantic economies’ over the last 500 years or so. Yet even if we put such things to one side, it remains true that there are numbers of well-documented earlier examples as well. One can point to the expansion of the so-called “Western Greeks” through the Mediterranean, for instance, as well as the great *völkerwanderung* that attended the fall of Rome, or the early-Medieval expansions of the Vikings, Mongols and others. Can we really dismiss deliberate migration very much earlier, in the colonisation of Sahul?

The first people to move into Near Oceania had watercraft of some sort, and thus not only had the cognitive capacities discussed earlier but also could presumably move groups of people reasonably quickly over significant distances. It needs to be kept in mind, though, that the people at that time were organized in very small-scale hunter-gatherer societies. Despite some crucial caveats about pushing modern ethnography back into the remote past, everything that we know about hunter-gatherers in historic and prehistoric times indicates that they were profoundly egalitarian. This means that they were not geared to controlling or directing the behaviour of either large groups of people or individuals in a sustained manner. In other words, it seems unlikely a leader in such a society could have either mobilised a large group of colonists which then purposely set off in search of a new world or commissioned an individual to raise a crew and go off exploring like Vasco da Gama. This means

that the sorts of images that may be conjured up by the term 'migration' are almost certainly incorrect in this instance. Successive 'waves' of mass migration are extremely unlikely.

So where does that leave us in getting people through the islands of Wallacea? It leaves us with purposeful small-scale movement on the one hand and accidental drift on the other. Accidental drift was the model of choice in explaining the settlement of the Pacific until simulations demonstrated it was effectively impossible, owing to the patterns of winds and ocean currents in the region. Much the same was found in the sole simulation to consider Sahul (Irwin 1992:28). People could drift to Sahul from Timor in the right season, but getting back – as was very probably needed to survive biologically – was not easy. Interestingly, that simulation is little-cited, and it has generally been assumed, when the question is actually raised, that movement into Sahul was purposeful even though it may have been exceedingly slow. By this it is meant that people were moving with purpose through the islands, not that they were knowingly heading to Sahul or any other ultimate destination. What purpose may they have had, then? It was almost certainly a very focussed, short-term one: access to food and other resources necessary for making a living as small-scale hunter-gatherers.

Various theoretical models have been advanced to characterise and explain population movements of this sort. A common one is the 'wave of advance' model often used to explicate the expansion of agriculturalists into Europe or, in modified form, the human colonisation of the remote Pacific (Irwin this volume). It proposes that people spread across the landscape relatively evenly and continuously, in the way spilled liquid flows across a flat surface. An alternative can be found in 'Levy flight' models (Lilley 2008). Deriving from 'chaos theory', Levy flight migration involves people concentrating their attention and movement on a small area then jump often quite long distances to new areas, leaving intervening regions to be 'backfilled' at a later stage. In the Pacific, this model has so far only been applied to the Lapita dispersal, but a similar mechanism has been suggested for the initial colonisation of Sahul tens of millennia earlier. Allen and O'Connell (2008:38-41) have an explanation they believe can "provide us with a way to understand how Wallacea might have been crossed as part of a conscious foraging strategy that involved neither accidental castaways or deliberate colonisations". Combining "optimal foraging theory" with an "ideal free distribution model" which lets people live where they choose, they see early colonists moving through Wallacea (and probably all the way from Africa) by deliberately seeking successive resource "sweet spots" as previous localities become less productive and/or social fission occurred for one reason or another. This is the way they put it:

the first successful human colonisation of Sahul was the consequence of many small but deliberate decisions that involved conscious and continuing risk assessment of behaviours intended to maximise reproductive fitness. People crossed from Sunda to Sahul as a consequence of these behaviours, rather than with conscious intent, like the chicken, to get to the other side. Even so, the colonisation of Sahul was not accidental.

This means any island hopping through Wallacea may not have followed the shortest possible route. People could have skipped some or even many islands, and may not have landed on the parts of Sahul that are closest to Asia. We come back to this question shortly.

In recent years, many archaeologists concerned with population movement have turned to a paper by David Anthony (1990). This article sought to refocus theoretical attention on migration after a period of neglect sparked by an uncritical tendency to use 'migration' as a *deus ex machina* explanation for just about everything (which of course meant in the end that it explained nothing much at all). Anthony makes a number of important points, including the inclination of purposeful migrants to have 'scouts' going ahead of but reporting back to the main migratory group. He also draws attention to the likelihood that there are 'push' as well as 'pull' factors prompting people to relocate and that people a.

move to where their relatives have already moved (on the basis of information from 'scouts' and earlier settlers) and b. tend to maintain ties back to their homeland and indeed commonly move back and forth between destination and source areas for what can become quite a prolonged period.

Anthony's (2009) main interest is in Bronze Age horsemen sweeping into Europe from the Asian steppes, but his theoretical ideas are based on migration behaviours in the very recent past. Even if they apply in at least general terms to ancient phenomena such as the movement of people off the steppes or up the Danube or out into *Remote* Oceania, they are still being applied to societies with one absolutely critical difference from those which first colonized *Near* Oceania: they were all agriculturalists. Categories such as 'hunter-gatherer' and 'agriculturalist' unquestionably blur at their shared margins, with the lives of 'complex' hunters often looking much like those of 'simple' farmers. However, there is little doubt that the transition to farming entails a profound shift in attitudes to land and resources and the way they are used. Agriculture – even of relatively unsophisticated sorts – also generally leads to significant and rapid population growth. This last is a pivotal matter, as it creates a need for one or both of two things: expansion into new lands, or intensification of the use of existing resources to reap more output per unit of land and/or effort. In certain circumstances, hunter-gatherers can live at population densities comparable to and even exceeding those of simple agriculturalists. Typically, though, their technology and social systems are just not organised to produce the quantities of food and other resources needed to support population growth of the sort commonly associated with farming. They are thus much less 'land hungry' and therefore much less driven to expand in the manner of some agricultural societies (Bellwood 2005).

If we accept the Allen and O'Connell idea, maintaining ties back to source areas or homelands would for the most part not have been an issue, as the 'homeland' was in fact never very far away, even after several generations. The final jump to Sahul may have been different in this regard, depending on the route in question, though regular return voyaging cannot be excluded even for the widest water gap at the time. Yet it seems more plausible given the likely technological as well as environmental constraints that several small groups of people made the 'jump' to neighbouring parts of Sahul at roughly the same time, providing the extra 'breeding pool' for however many groups first landed to survive despite the likely very small size of each individual group.

Routes in

Whether or not "Levy flights" or "sweet spots" were involved in a technical sense, it is conceivable that the founding colonists of Sahul came directly by boat from somewhere further away than the closest islands in Wallacea. It is also possible that they first landed on Sahul somewhere other than those parts of the continent closest to their immediate point of origin. Even if some made it this way, directly from mainland Asia to mainland Sahul for instance, it seems unlikely that enough of them completed such a long-distance move sufficiently close together in time and space to ensure biological viability. If only a small number came, they would then have had to routinely return to home or at least regularly reach some other inhabited place to mix biologically with other people if the colony were to remain viable. This is all possible but needlessly complicated. On that basis it seems more likely that Sahul's initial colonists would have followed the path of least resistance in terms of distance and environmental difference or difficulty.

Birdsell (1977) is one of very few scholars until recently to have examined the question of routes through Wallacea in detail. He identified five routes, two landing in New Guinea at the Bird's Head, two through the middle to reach land in what are now the Aru Islands and the Arafura Sea and a southerly route through Timor to the Kimberley. He determined these alternatives on straightforward criteria of inter-island distance and visibility and the "hit-ability" of potential target islands based on their apparent width. In his scheme, a highly visible and hit-able island would be preferred over a closer but smaller and harder to hit target. He also factored in glacial sea-level variation, arguing that

different water levels could dramatically shift the suitability of this or that route by shortening or lengthening inter-island distances. All of Birdsell's routes necessitated one crossing of more than 70 km and at least three great than 30 km (Allen and O'Connell 2010). All modern scholars accept that Birdsell's routes are the most likely paths of entry into Near Oceania.

The timing of initial colonization

When did the initial movement into Sahul take place? There have been some extraordinarily old dates proposed over the years, but the genetics suggests perhaps 50,000 years maximum. This fits well with a conservative archaeological figure of around 45,000-47,000 years (Allen and O'Connell 2010), but as is often the case with such questions of timing, there is a long chronology as well as this short one. The long chronology for the initial occupation of Near Oceania is based on luminescence dating and the short one on radiocarbon. The latter proposes that people first arrived in Greater Australia and nearby archipelagoes no more than 50,000 years ago. Long-chronology supporters argue that this is because radiocarbon is technically unable to date anything older. They use luminescence techniques to circumvent the problem and presently date colonization at up to 60,000 years ago. They suggest that dates much older than 60,000 are unlikely because there is no evidence of anything like that antiquity from Tasmania, where the land bridge across Bass Strait was open between 62,000 and 70,000 BP.

Allen and O'Connell (2010, Allen 2003) champion the short chronology. They reject dates older than 45,000-47,000 BP on three main grounds. First, they argue that no dates of this antiquity are secure in their stratigraphic association with unambiguous remains of human activity. Second, they show that the long chronology does not fit with knowledge of the dispersal of modern humans elsewhere in the world. There are for instance no modern human remains in Island Southeast Asia – through which the first migrants to Australia must have passed – older than 45,000 years. Finally, they raise issues of calibration, arguing that luminescence dates are not sufficiently well-understood in terms of their relationship to calendar and radiocarbon dates.

O'Connor and Chappell (2003) defend the long chronology. They believe calibration issues are well-resolved in favor of accepting luminescence dates and that new discoveries in East Asia are continually pushing back the date for human occupation on this side of the world. They do not, however, address the issues of taphonomic integrity upon which Allen and O'Connell stake much of their case. Instead they go on to argue that Australia and New Guinea, though joined at the time, saw initial colonization at different times and by different ways. This is because there are no dates – luminescence or radiocarbon – much older than about 45,000 from New Guinea or the Bismarcks or Solomons (see below). In the short-chronologists' view this means that the whole of Near Oceania was effectively settled all at once, although the New Guinea highlands, the Solomons and the Admiralty Islands in the north of the Bismarcks may not have been settled until around 10,000 years later the rest. The highlands are remote and inaccessible, while reaching the Solomons and Admiralties requires formidable sea-crossings

Discussion

The foregoing raises a number of crucial issues in relation to early human expansion and innovation in the Pacific. Any sites contemplated for inclusion on Tentative Lists or World Heritage nomination would have to contribute and enhance global understanding of these issues.

Key questions centre on 'who, what, where and when':

- Who were the first colonists biologically and culturally – were they all unquestionably behaviourally and anatomically modern humans?

- What did these settlers do and where,
 - first to cross the Wallace Line and get through Wallacea into Near Oceania and then
 - to spread into the depauperate environments of the Bismarcks and Solomons?
- When did the major events and processes occur?

The following section briefly describes a selection of key early sites to illustrate the sorts of archaeological evidence currently available to answer these questions and that would need to be represented in any sites considered for Tentative listing or World Heritage nomination on the basis of their contribution to global understanding and appreciation of the earliest phases of human settlement of Near Oceania.

Indicative Sites

There are ten sites dating to before the last glacial maximum that can help identify the sorts of qualities that might be expected of sites that could be nominated for World Heritage listing because of their importance to global understanding of early human expansion and innovation in the Pacific.

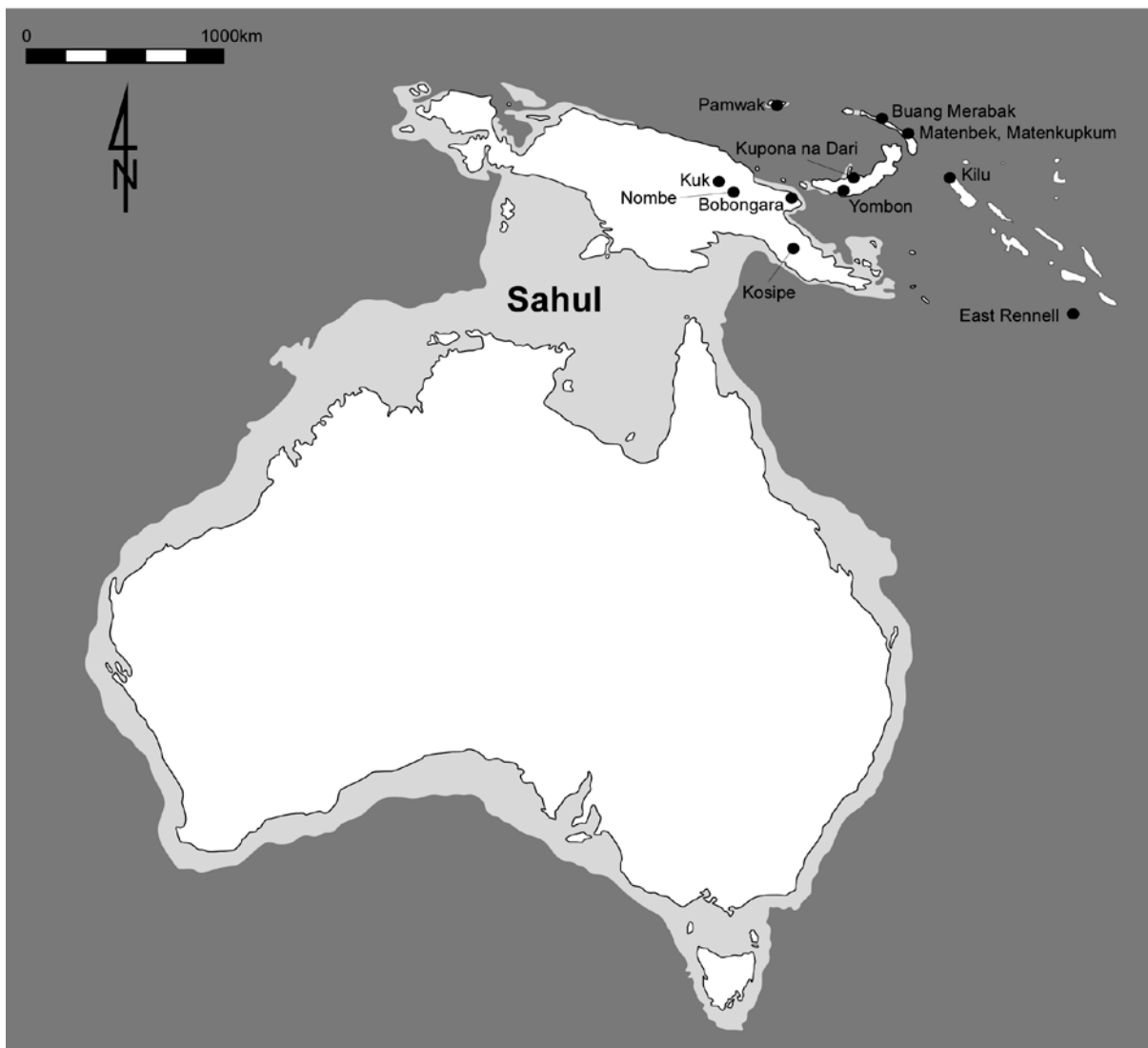


Figure 1. Map of Near Oceania showing indicative pre-glacial sites and the two current World Heritage sites in the region.

The following sketches are drawn from the major scientific publications concerning the sites in question. There are other pre-LGM sites, such as Lachitu in Papua New Guinea (Gorecki et al. 1991 and O'Connor pers. comm. 2010) and Toé Cave on the Bird's Head in Indonesian New Guinea (Pasveer et al. 2002; Pasveer 2003). The dating of the basal levels of Lachitu remains poorly-resolved and while Toé registers a human presence deep in the interior of New Guinea during the last glacial, its investigation was exploratory and has not yet revealed other archaeological implications of note.

The following discussion DOES NOT mean that any of the particular sites in question or any others mentioned anywhere in this thematic study are being recommended by the authors for World Heritage nomination or tentative listing.

New Guinea

Bobongara

At the time it was first reported by Groube and colleagues in 1986, the 40,000-year-old open-air site of Bobongara on the Huon Peninsula was the oldest site by far in Near Oceania. Indeed, it was one of the oldest sites anywhere in the wider Australasian region. Bobongara is sometimes also known by its original name of Jo's Creek. As noted at the start of this study, the Huon Peninsula is already on PNG's Tentative List, ostensibly as a mixed property, but despite its global archaeological and wider cultural importance, the cultural component of the tentative listing is very weakly developed. The site was first described in print by Papua New Guinean archaeologist John Muke in his unpublished 1984 undergraduate research thesis. The following offers some more detail about the site, drawn from Groube et al.'s 1986 paper in *Nature* and other accessible published sources.



Figure 2. Bobongara (view of Huon terraces in the vicinity of Bobongara). Photo by author (Prof Ian Lilley).

The site as currently known from very limited investigations is at the southeast extremity of the Huon Peninsula, in the vicinity of the town of Finschhafen. As described in the Tentative Listing, this part of the Huon Peninsula exhibits a dramatic series of coral terraces previously submerged beneath the sea but now uplifted by geological forces which continue to operate today. The terraces have been

comprehensively dated by geologists. The site described in 1986 was found in a small gully on a terrace dated to 45,000-53,000 years old. Three layers of ancient volcanic ash (tephra) lie over this terrace. The ashes have been dated to older than 40,000 years on the basis of their distribution (or lack of it) on terraces of known age as well as thermoluminescence dates on the tephra themselves. A number of stone artefacts were found during controlled archaeological excavation of these ashes, including several large and highly-distinctive “waisted axes”, so named because of the narrowing or “waist” they exhibit to allow the attachment (lash-hafting) of a handle. In addition to the excavated specimens, more than 100 similar tools were found in surface contexts in the general vicinity, though none with “waists”.

These artefacts are similar to others excavated or surface-collected from other localities in New Guinea, New Britain, the Solomons and Australia, but little more is known about them. Groube (1989) has speculated that they were used for forest clearance – “taming the rainforests”, as he put it – but there is no unambiguous evidence that this is the case. It has also been suggested that at least some of these broadly similar artefacts reflect the introduction of a shared technological tradition of Asian origin by Sahul’s first inhabitants (e.g. Golson 2001). However, there is no clear evidence that any of the various specimens from around Near Oceania and Australia are connected in time or function and good evidence that at least some of the material is definitely not related in time (Specht 2005; also Denham *et al.* 2009). Despite this, archaeological finds of the age of the Bobongara site are rare in Near Oceania and indeed around the world, and the cultural evidence such sites contain shed invaluable light on the behaviour of early modern humans as they explored the limits of their world.

Kosipe

Situated in the Ivane valley, north of Port Moresby at about 2000m above sea level, the open-air site complex at Kosipe centres on a large swamp. The following details are drawn primarily from a 2010 article in *Science* by Summerhayes and colleagues.



Figure 3. Kosipe (view across Ivane Valley and Kosipe sites). Photo courtesy of Dr Andrew Fairbairn, School of Social Science, University of Queensland, Australia.

Kosipe was first scientifically excavated by White in the 1960s (White 1970). Amongst other material, White found waisted tools dated to around 26,000 years old (now calibrated to over 30,000 BP). The recalibration of White's dates fits with dates around 30,000 BP obtained by Hope's (1982) geomorphological studies in the Kosipe Swamp, which recovered evidence for land disturbance including burning dating to around that time. Since 2005, excavations and analysis at and near Kosipe Mission led by Summerhayes (2010; also Fairbairn *et al.* 2006) have extended the time of first occupation back to 44,000-49,000 BP. This date is now the oldest anywhere in Near Oceania and amongst the most ancient dates anywhere the wider Australasian region. Like other New Guinea Highland sites, Kosipe lacks evidence for human use during the height of the last glaciation (LGM), when mean temperatures in the coldest month would have been up to 9°C lower than now. A variety of artefacts was found, including several waisted examples from the oldest dated levels of the site. A range of food plant and animal remains was also identified, some from the oldest layers. Finding food plant remains is rare in most archaeological sites in Near Oceania, often owing to the nature of the archaeological recovery techniques used (or not used), rather than a true absence of plant remains.

As Gosden (2010) points out, finds like those from the Ivane Valley remind us that "the world of Sahul's early hunter-foragers was very different from anything found in the region today". Such discoveries tell of "small and highly mobile populations moving up and down the interior mountain chains of what is now PNG, engaged in small-scale clearance and some movement of plants", rather than the intensive agriculture in place now. Gosden rightly observes that such activities "set the stage for what came next", namely the exploration of the rest of Near Oceania and, much later, the independent local development of such innovations as plant domestication, as revealed at the World Heritage-listed Kuk Early Agricultural Site in the New Guinea highlands some distance northwest of Kosipe.

Nombe

"Prehistory ended at Nombe rockshelter at 10.15 a.m. on Tuesday 22 March 1933, when the Leahy reconnaissance flight flew over the site on its way to Mt Hagen" (Gillieson and Mountain 1983:53). Nombe was first excavated by White in 1964, when it was called Niobe (White 1972). The site was then subsequently studied in great detail by Mountain in the 1970s and 80s (e.g. Mountain 1993), often with assistance from specialists such as Gillieson and Evans (e.g. Evans and Mountain 2005). Nombe is in a limestone ridge in the New Guinea Highlands, located at about 1700m above present sea level near the town of Chuave to the west of Goroka. The site is about 31,600 year old (calibrated radiocarbon). There are two major findings from the site. The first complements the evidence for very ancient plant use in the highlands from Kosipe by demonstrating hunting in the high altitude ecotone between montane forest and subalpine grassland, a significant distance above the rockshelter, as well as in the rainforest surrounding the site. Uniquely in Near Oceania and extremely unusually in Sahul, Nombe also demonstrates the hunting of four very large and now extinct "megafaunal" marsupials: *Diprotodon*, two large species of *Protemnodon* kangaroo and a large *Dendrolagus* tree-kangaroo. Smaller extinct fauna such as the thylacine (marsupial "wolf") are also present, as are various extant species of various sizes (though nothing as large as the extinct megafauna). Extraordinarily, these species seem to have co-existed from the time the site was first occupied until as recently as 17,000 years ago, well after the last glacial maximum. This evidence stands in stark contrast to proposals that colonising humans wiped out the megafauna of Sahul around 46,000 years ago, essentially as the enlarged continent was being peopled (e.g. Roberts *et al.* 2001; cf. Wroe and Field 2006).

New Britain

Kupona na Dari

Torrence and colleagues (2004) have produced the only publication dealing in detail with the open-air site of Kupona na Dari at the base of the Willaumez Peninsula in central-north New Britain. The researchers found the site in 1998. They describe it as being situated located on a coastal plain about

600 m from the present beach. The site comprises interbedded layers of ancient soil and volcanic ash (tephra) forming a low, oval-shaped hillock roughly 10m high and 30m across.



Figure 4. Kupona na Dari (view of site mound in middle distance). Photo courtesy of Dr Robin Torrence, Anthropology Department, Australian Museum, Sydney, Australia.

Archaeological and geological study of the site and its cultural contents, combined with C14 and thermoluminescence determinations and fission-track dating of obsidian artefacts, shows that Kupona na Dari was established at some time between 35,000-45,000 years ago. The site is in a highly-active volcanic locality and for the entire time people lived there they were subject to eruptions of varying active severity. A sourcing study of obsidian artefacts from the site indicates that from the beginning of settlement people were accessing tool-making stone resources over a significant part of the regional volcanic zone. In addition, study of manufacturing methods shows that the most ancient stone artefact technology at the site does not differ much from that evident in neighbouring much later sites. On this basis, Torrence and colleagues propose that human communities were mobile from the time of first settlement until at least 5000 years ago or so, but that the site's Ice Age inhabitants ranged further afield in search of stone for artefact manufacture. The researchers also argue that the finds from Kupona na Dari indicate that early human expansion and innovation in this part of the Bismarck Archipelago involved an extended process of adaptation to a tectonically-volatile landscape. They also caution that the pattern of colonisation evident at the site may not have been the same as in other parts of the Bismarck Archipelago (or, one might add, the rest of Near Oceania) owing to variability in the environments into which early colonists would have moved. Much of the rest of New Britain, for instance, as well as New Ireland, is limestone rather than volcanic, which dramatically alters the nature and distribution of the resources available to human communities.

Yombon

Yombon, in the limestone belt of central-south New Britain almost due south of Kupona na Dari, is an open-air site complex of great antiquity. Located about 500m above sea level and some 35 km from the coast, the landscape around Yombon features flat ridge tops, lower rises, and valleys of different sorts. I worked there assisting Specht in the early 1980s but we only found relatively recent material before moving to Misisil Cave in the jungle some distance north. There we found evidence dating to the end of the last Ice Age, demonstrating for the first time that people had colonised Near Oceania beyond the New Guinea mainland in the Pleistocene (Specht et al. 1981). It was not until Pavlides's work a decade later that the Yombon area was shown to have Pleistocene occupation, and she

showed that initial settlement in the area dated back over 40,000 years (calibrated radiocarbon), very much earlier than indicated at Misisil (Pavrides and Gosden 1994).



Figure 5. Yombon (view across Yombon site area, airstrip in foreground, mission buildings to rear). Photo courtesy Dr Christina Pavrides, Archaeology Program, La Trobe University, Melbourne, Australia.

Pavrides's findings are of great international interest because they demonstrate that the organised human use of inland rainforests is an activity that occurred very early in Near Oceania. The Yombon site complex indicates that the region's early settlers were flexible enough to move beyond well beyond the coastal fringes of island Melanesia to make use of important economic resources deep in the jungles of the interior. There is good evidence that these rainforest-dwellers were quite structured in their approach to the acquisition of stone for tool manufacture as well as in the actual process of artefact production. Specifically, dispersed high-quality stone sources were sought out and quarried to provide the raw material for formal tools that could be maintained for extended periods, indicating that Yombon's very early occupants had significant organisational and technological capacities. At the other early sites discussed in this chapter as well as others not described here, people obtained their stone for artefact manufacture from river and creek gravels, which are widely distributed, not from *in situ* quarries in specific locations. That these quarries were probably located in deep sinkholes in the limestone adds to the picture of highly-organised procurement strategies. In addition, the other early sites in the Bismarcks and Solomons discussed below did not yield long-lived formally-shaped flaked stone tools. Rather, the material from those sites comprises expedient informal tools. Thus, like Kupona na Dari, finds from the Yombon site complex indicate that the earliest colonists of the islands of Near Oceania were highly adaptable and able to cope with a wide variety of environmental challenges.

New Ireland

Buang Merabak, Matenbek and Matenkupkum

These three sites are located in the uplifted limestone of New Ireland's north coast. Buang Merabak is about halfway along the island, and is situated about 1 km inland and perhaps 200m above sea level. Matenkupkum and Matenbek are in the south of New Ireland. They are less than 100m apart, about 50m from the present shoreline and about 15m above sea level. Unlike the sites discussed above, all three are caves, not open-air sites. All would have remained close to the sea during Ice Age sea level

fluctuations owing to the extreme steepness of the offshore seabed in the region. The sites were found during the ground-breaking Lapita Homeland Project in 1985, and the dates for their first use tripled the known age of human occupation of Near Oceania. Matenkupkum was first reported in *Nature* (Allen et al. 1988) but neither it nor the other two sites have been published in detail. They are however referred to in many other publications by the excavators and others (e.g. Allen 2003, Allen and Gosden 1996, Allen and O'Connell 2010).



Figure 6. Matenkupkum (cave mouth). Photo courtesy of Professor Jim Allen, Archaeology Program, La Trobe University, Melbourne, Australia.

At Buang Merabak, marine-shell midden material dates to 43,500 years ago (calibrated radiocarbon). This is the oldest precisely-dated site in the island Pacific. With the most ancient estimates for Kupona na Dari, Buang Merabak indicates that people moved out well beyond Sahul almost as soon as they arrived there. A drilled tiger-shark tooth from the site dates between 32,000 and 43,500 years old, making it the oldest human ornament known in Near Oceania. Other finds in these sites reflect gathering of marine shellfish and fishing that includes deep-water species in addition to the tiger shark. While it is possible these latter species were caught by accident close to shore, their presence in these sites may also indicate that people were capable of building watercraft suitable for deep sea angling. If so, the finds from New Ireland constitute the earliest evidence in the world for ocean fishing. The use of drills to detach circular disks from marine shells is evidenced in the earliest layers at Matenkupkum and Matenbek. This is important, because it shows that the shell artefact technology of the Pacific has very ancient roots. Other material in the earliest levels of these sites shows that people's diet also included bats, reptiles and birds, all probably captured nearby.

Major cultural innovations started some 24,000 years ago. New Britain obsidian (from the general neighbourhood of Kupona na Dari) appears in Matenbek and Buang Merabak, demonstrating movement over straight line distances of more than 300 km and entailing sea crossings. In addition, the non-local marsupial *Phalanger orientalis* appears in both sites and in Buang Merabak replaces a local bat as the main food species. After the LGM, the phalanger became common across New Ireland. As Specht (2005:271) observes, the appearance of *P. orientalis* in these sites in the same period that New Britain obsidian begins to be deposited demonstrates "a broadening of social

horizons as well as accidental or deliberate modification of the resource base of the islands". This development is a critical innovation in the early human settlement of Near Oceania, and thus one factor which would have to be taken into account in any future Tentative listings or World Heritage nominations.

Manus

Pamwak

Spriggs (1997:49) describes Pamwak as the "richest of the Pleistocene sites [in island Melanesia] in terms of number and variety of stone artefacts and also the deepest, with approximately 4m of cultural deposit sitting on limestone bedrock". The site was found in 1989 and was described in detail by the excavators shortly afterwards (Frederickson, Spriggs and Ambrose 1993). It is a large overhang in ancient limestone, about 4km inland and 30m above current sea level. Unlike the New Ireland sites, which have never been far from the coast, Pamwak would have been much further inland during periods of lowered glacial sea levels, perhaps up to 10km.



Figure 7. Pamwak. Photo courtesy Mr Wal Ambrose, School of Culture, History & Language, Australian National University.

Although the site is deep, the lowest metre or so of the deposit is a dense clay that contains quantities of stone artefacts but no organic material that can be dated. The oldest date presently available for Pamwak is only about 14,600 years (calibrated radiocarbon), from a depth of 1.7m. The depth of deposit below this determination suggests that an age of more than 25,000 years for first occupation is not unreasonable, but this must await confirmation. Even so, the astounding thing about Pamwak is that a site of Pleistocene and possibly pre-Ice Age antiquity is present in Manus. As Spriggs (1997:29) puts it

The settlement of Manus may represent a real threshold in [human] voyaging ability as it is the only island [anywhere on the planet] settled in the Pleistocene beyond the range of

one-way intervisibility. Voyaging to Manus involved a blind crossing of some 60-90 km in a 200-230 km voyage, when no land would have been visible...These would have been tense hours or days on board that first voyage...

The 14,600 date marks an important shift in the human behaviour recorded at the site. First, local chert is replaced by obsidian as the favoured raw material for stone artefact manufacture. The obsidian comes from small-island sources adjacent to Manus. At about the same time, there is evidence for more postglacial faunal introductions in the form of the bandicoot, *Echimipera kalubu*, and perhaps a second species of phalanger. The bandicoot must have been brought from mainland New Guinea because it is not present in New Ireland. The phalanger could in fact be native to Manus but appears suddenly in the middle of the Pamwak deposit. In addition, remains of the galip nut (*Canarium* spp.) are present in some quantity in these same layers. Today, galip is an important dietary item and in some parts of Near Oceania it has been domesticated. There is a suggestion that like the bandicoot and possibly the phalanger, the galip nut was introduced to Manus by people.

“Solomon Islands” (Buka)

Kilu

The site of Kilu is located on Buka, a small island adjacent to Bougainville in the Bougainville Autonomous Region of Papua New Guinea. Geologically and in traditional cultural terms, Buka and Bougainville form part of the Solomon Islands archipelago for the archaeological purposes of this report. Assigning PNG's Bougainville Autonomous Region to the Solomons Archipelago in this way is not intended to infringe the sovereignty of either Papua New Guinea or the Solomon Islands, nor imply anything at all about current political circumstances in the region or their bearing on past, current or future arrangements for heritage management.



Figure 8. Kilu. Photo courtesy Dr Stephen Wickler, Department of Archaeology, Tromso University Museum, Norway.

Kilu is a cave site at the base of a limestone cliff, and only about 65m from the sea and 8m above present sea level. Buka had been studied by Specht in the late 1960s, but Kilu was found by Wickler in 1987 when he began research on Buka to expand on the findings elsewhere in the region of the Lapita Homeland Project (Wickler 2001). The site is 30,000 years old (calibrated radiocarbon). Like Pamwak, the human presence in Kilu demonstrates that the earliest colonists of Near Oceania had substantial voyaging skills. Although never completely out of site of land, the crossing was between 140-175 km, depending on the route, and the crew would have had to travel 40-55 km out to sea before the northern tip of the Solomons would have been visible.

In addition to being critical evidence for early human expansion in Near Oceania, Kilu is remarkable because it is the only site yet known to demonstrate what plants the first people in island Melanesia ate. Pre-glacial evidence for plant use is still almost non-existent in this region (Denham et al. 2008), but specialist analysis of residues on stone artefacts from Kilu found traces of *Alocasia* and *Colocasia taro* on stone tools from Kilu Cave on Buka (Wickler 2001). Spriggs (1997:38) believes that these findings indicate that people were selecting and manipulating their resources at this time. Allen and O'Connell (2010) hypothesise that "Such a pathway might have diminished coastal dependence and whether this reflects people arriving on Buka with the knowledge of root vegetable exploitation or developing it there (*Colocasia* probably being endemic) these data indicate manipulations of the environment before c. 25 kya". In addition, as at Pamwak there is evidence for Pleistocene galip nut use (Wickler 2001: 234, Table 8.11), though at Kilu dating very much earlier, to around 27,000 years ago (calibrated radiocarbon). The coconut *Cocos nucifera* has also been tentatively in the same layers.

Discussion

The ten indicative sites briefly described above largely define what we know about the key questions raised earlier about the 'who, what, where and when' of the first stages of early human expansion and innovation in the Pacific. In particular, they indicate that any site(s) considered for Tentative listing or nomination for World heritage Listing on the basis of their contribution to global comprehension and appreciation of the earliest colonisation of the Pacific should illuminate questions concerning the following matters:

- crossing Wallace Line into the marsupial realm
- exploration and exploitation of the deep interior of New Guinea including extreme high-altitude zones
- the encounter with and extinction of the megafauna of Sahul
- the origins of deliberate forest modification
- adapting to the increasingly depauperate environments of the Bismarck and Solomon Islands archipelagos, including plant and animal introductions
- exploration of deep interior rainforests of the Bismarcks, including sinkholes for stone quarries
- the origins of long-distance movement of goods (e.g. obsidian)
- the origins of ocean voyaging and navigation
- the origins of deep-sea fishing
- the origins of shell artefact manufacture

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Navigation and seafaring

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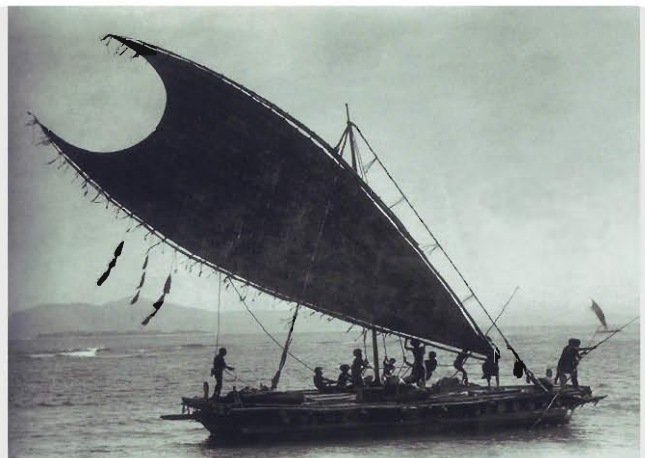


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Ouro double canoe under sail at Mailu, Papua New Guinea, 1932.
Photograph by H. Bernatzik, 1932.

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Introduction

The Pacific is the world's largest ocean, was the first to be explored, and its remarkable prehistory involved countless voyages to discover and settle thousands of previously unknown islands. The other chapters in this thematic study have outlined the evidence of archaeology, linguistics and biological anthropology and this chapter considers the current diverse theories about the nature of the navigation and voyaging that is implied.

There were three major episodes of migration widely separated in time - each characterised by developments in technology, expanding geographical range and accelerating tempo, and the seascapes that were traversed became navigationally more demanding. Some of the first known water crossings in the world occurred during the late Pleistocene Ice Age, when modern humans gradually spread through the region of large close-set islands shown as Near Oceania in Figure 1 in the period between 50,000 and 30,000 years ago. Seafaring remained rudimentary and coastal for many millennia.

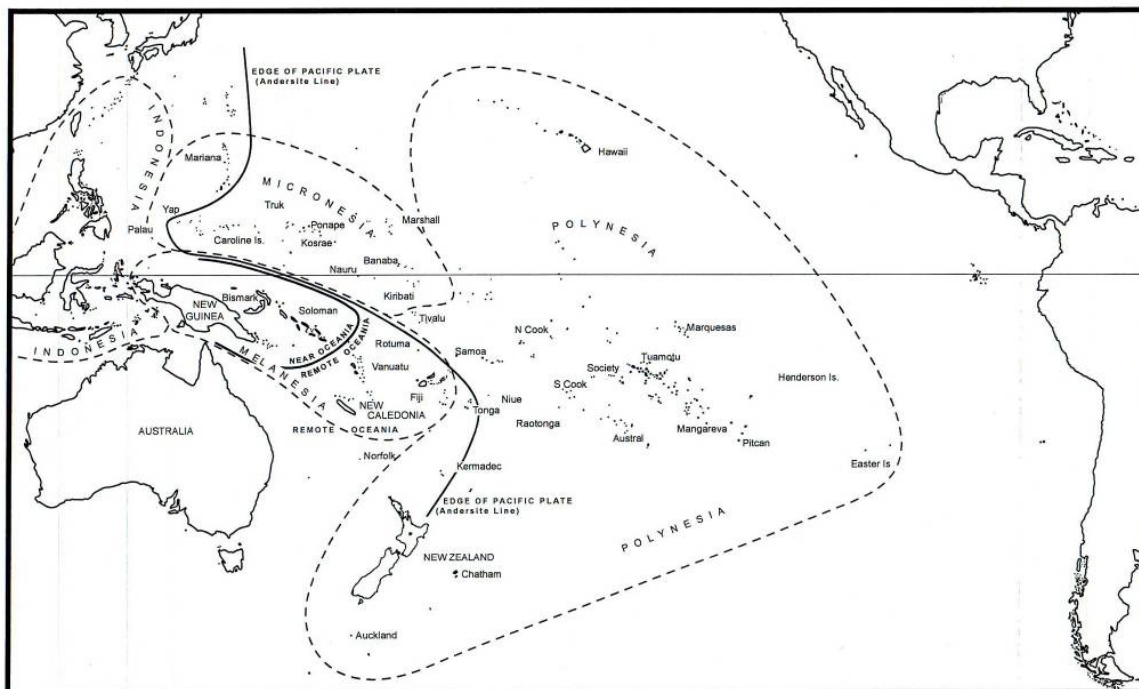


Figure 1. Regions and islands of the Pacific Ocean

A second major pulse of maritime expansion beginning around 1500 BC had its origins in Near Oceania and in what is now Island Southeast Asia and extended into open ocean in the region known as Remote Oceania (Figure 1). This involved a new order of technology with sailing canoes and crews able to survive at sea as they searched for new land. Between 1200 BC and 900 BC, archaeological sites of the Lapita cultural complex spread rapidly eastward beyond the Solomons to Fiji and West Polynesia, including Tonga and Samoa. A comparable dispersal from Island Southeast Asia to the Marianas of West Micronesia occurred shortly beforehand (Clark *et al.* 2010).

There was a pause in further colonisation until around AD 0 in Micronesia and for some centuries longer in Polynesia. A number of explanations have been suggested for the pause but it is striking that it occurs close to a major geological feature which marks the western, downfaulting, edge of the Pacific Plate. The

Andesite Line (Figure 1) separates large continental island groups to the west from the generally smaller volcanic oceanic islands to the east.

A final major pulse of expansion settled all of tropical East Polynesia by AD 700 to AD 1000. This brought a sophisticated ocean-crossing technology within range of South America and evidence and claims for Polynesian contacts with America have increased in recent decades (Jones *et al.* in press); however, the evidence for Polynesians in Australia at the other side of the ocean has remained virtually nil. America was harder to reach than Australia but easier to return from given normal weather patterns and it has been suggested that the direction of advance was influenced by a safer direction of return. The extent of an East Polynesian sojourn in America remains to be shown.

New Zealand, far to the southwest of tropical East Polynesia, was difficult to reach and return from and was, correspondingly, the last major temperate land mass in the world to be settled by humans. Initially, the flight paths of migrating birds would have invited investigation. New Zealand then became a secondary centre of settlement to the Chatham Islands and south to the sub-Antarctic Auckland Islands which were among the most marginal landfalls of the Pacific. Norfolk Island and the Kermadec group lay mid-way between the tropics and New Zealand and were implicated in its settlement, possibly as stepping-stone islands. At the same latitude, but closer to Australia, Lord Howe Island is one of the few Pacific islands with no evidence for a human presence, which may indicate the disinclination of Polynesians to venture into regions from which it would have been difficult to return against the prevailing winds.

The influence of changing land and sea areas on maritime migration

Pacific islands vary enormously in terms of accessibility and isolation from their neighbours, and these variations affected initial settlement and subsequent interisland voyaging. Figure 2 shows the ratios of land area to the area of surrounding ocean, by longitude, for tropical islands from the Bismarcks eastwards to Rapanui/Easter Island using values estimated by Irwin (2000). A small number of islands have high ratios of land to sea while most have very low ones. There is a clear distinction between the seascapes of Near and Remote Oceania, and also between the Lapita (1000 BC) and East Polynesian (AD 1000) seascapes which were separated geographically by the Andesite Line (Figure 1). These three seascapes broadly coincide with the three major episodes of colonisation.

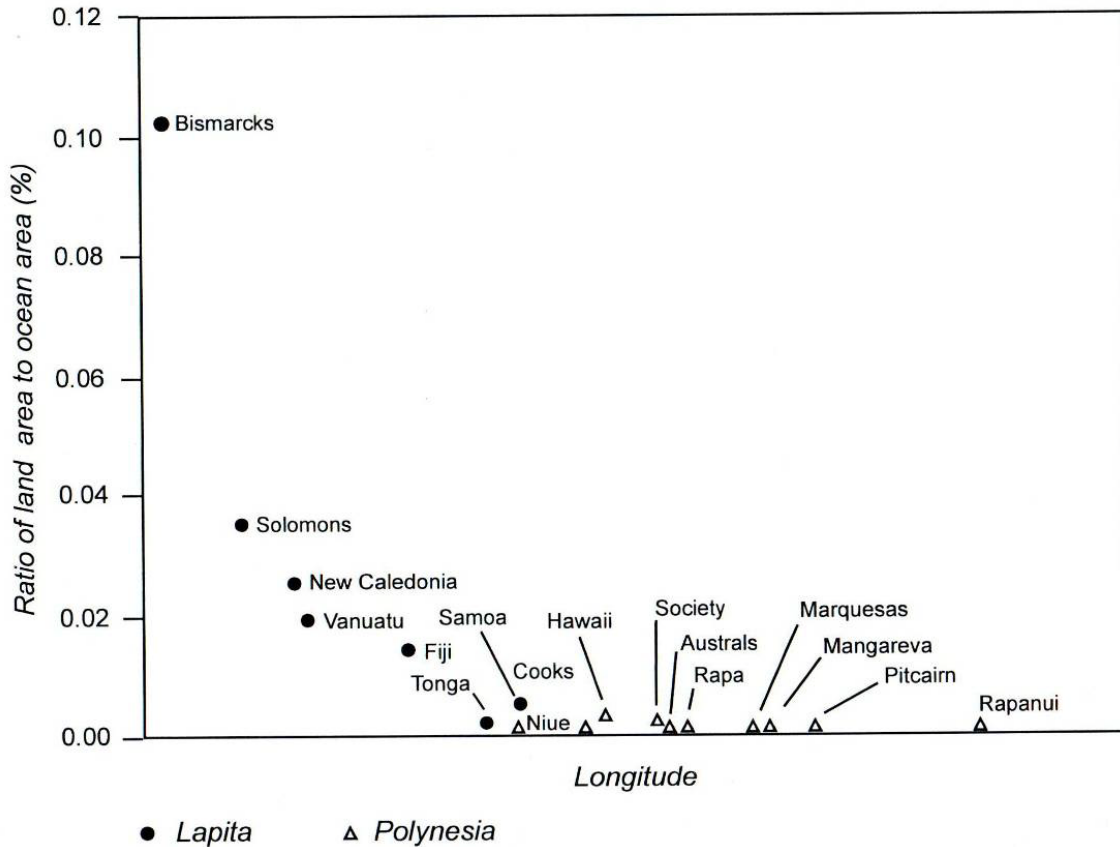


Figure 2. Ratios of land area to ocean area plotted by longitude for the tropical islands of Remote Oceania.

Most Melanesian islands settled by Lapita are large - Vanuatu at 14,750 km² and New Caledonia at 19,000 km² - but West Polynesia may have been more marginal with Samoa at 3100 km² and Tonga only 750 km², and this is where the spread of Lapita evidently stopped. Computer simulation suggests that Tonga in West Polynesia and Rarotonga in East Polynesia were only about 20 days apart by canoe (Irwin 1992), but they are currently about 2000 years apart in radiocarbon dates. To give an example of the scale of the change we find that within an 800 km radius of Ha'apai in Tonga, settled in Lapita times, there are approximately 24,000 km² of land in the Fijian, and West Polynesian archipelagoes, whereas within the same radius of Rarotonga in the Southern Cook Islands in East Polynesia there are no more than 10 habitable islands with a total land area of 240 km², which gives a ratio of 100:1. It may be the case that learning to live in East Polynesia and East Micronesia involved adapting to different environments and also to greater social isolation, which was mediated during the colonisation period by continued long-distance voyaging.

Wind and weather

The essence of sailing in small boats is to manage the weather, which may change more in a few days than average climate may change in a millennium. Winds and weather change with the passage of highs, lows and fronts, with the seasons and with longer-term perturbations. The weather, as it was experienced by system or season, was well understood by island people and this was as fundamental for coastal

fishing as for crossing ocean. The wind systems for the Pacific are shown in Figure 3. Ocean currents generally follow the winds.

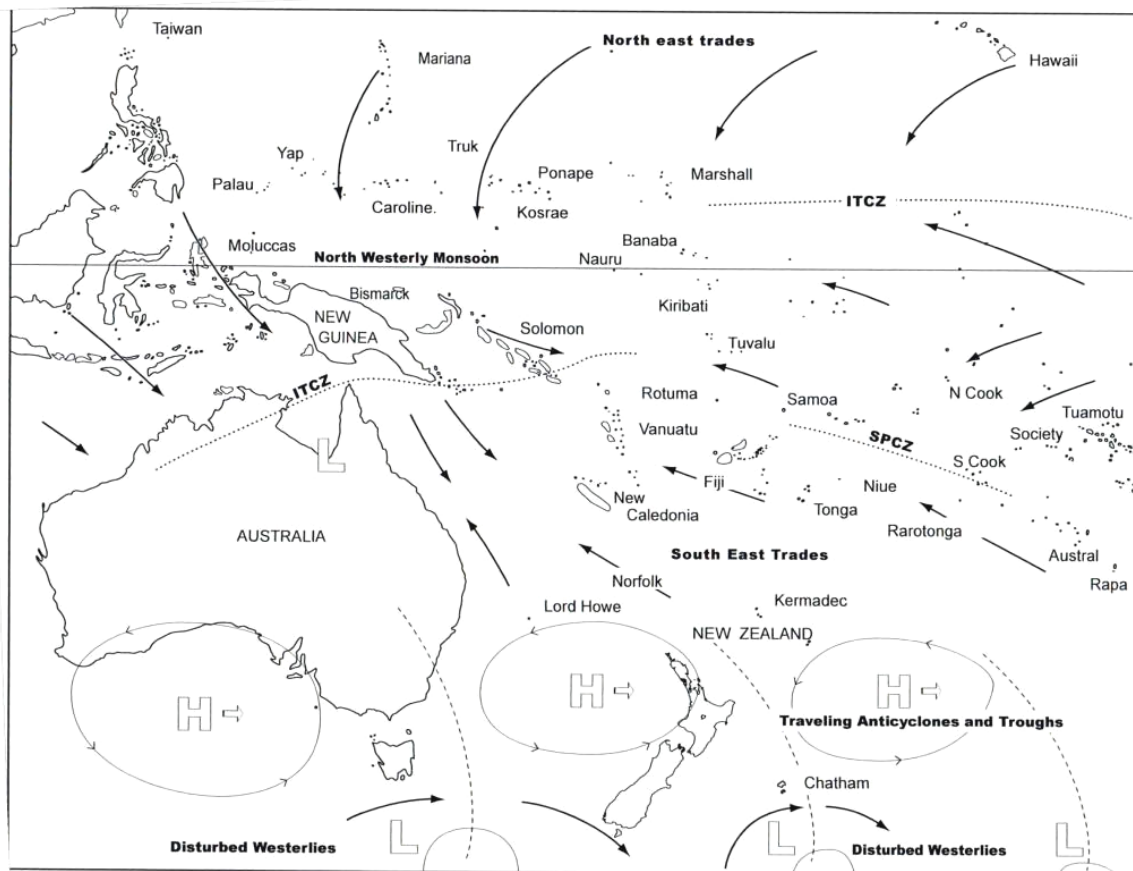


Figure 3. Wind systems negotiated by Pacific voyagers in the southern hemisphere summer.

The Northwest monsoon

In the southern summer the northeast trades of the western North Pacific cross the Equator towards a low pressure system over northern Australia, and are then deflected left by the earth's rotation, producing northwest winds through Island Melanesia and intermittently as far as east as Tahiti in East Polynesia. The monsoon provided good winds for sailing east between November and April.

The doldrums

The Intertropical Convergence Zone (ITCZ) moves north and south with the seasons in the western Pacific, but in the east lies permanently north of the Equator. It is often about 150 sea miles wide and the winds are variable, with calms and thunderstorms. The doldrums can be hard to cross.

Southeast trade winds

These blow on the equatorial (northern) sides of rotational high pressure systems (anticyclones) that travel east from Australia, and to the north of a stationary high in the eastern Pacific. The northern limit is the ITCZ and the southern limit is around 25° S in summer and 20° S in winter. Winds are steady and usually moderate.

Variables

South of the tropics is a belt of mainly moderate but sometimes stronger winds that extends to about 40° S in summer and 30° S in winter. The weather here is affected by eastward-moving high pressure systems separated by troughs of low pressure which bring alternating good and bad weather and associated changes in wind strength and direction.

Westerlies

These predominate in a belt of low pressure lying south of the variables in the latitudes of the “roaring forties” and beyond, and there is a continuous passage of depressions. Gales are common and conditions for sailing canoes hazardous.

Westerly winds in and near the tropics

In spite of the prevailing easterly trades, other winds make it possible to sail east in both hemispheres. One source of these is the succession of rotational high and low pressure systems whose centres lie outside the tropics. In the Southern Hemisphere westerly winds blow in the equatorial quarter of low-pressure systems and on the southern sides of anticyclones. In the southern winter these systems shift north with the sun and bring predictable westerly winds to a band of the southern tropics that stretches from New Caledonia in the west to Easter Island in the east, and beyond (Ferdon 1963, Finney *et al.* 1989, Irwin 1992). Captain Cook talked to Tahitians about westerly winds during his first voyage (Beaglehole 1968), and Joseph Banks and others on the ship *Endeavour* found them to be excellent weather forecasters (Beaglehole 1962).

ENSO

The anomalous westerlies of El Niño were another means to sail east. Finney *et al.* (1989) drew attention to episodes of El Niño when westerly winds increase in frequency and duration and, since then, environmental scientists have filled in the record of El Niño history over the past several thousand years. These winds were available to all seafarers, although they would have been hard to distinguish from other kinds of westerlies, but for any canoes unable to sail into the wind, El Niño could have provided the only means to settle East Polynesia (Anderson *et al.* 2006).

Pleistocene voyaging in Wallacea and Near Oceania

While antique forms of *Homo erectus* existed on the Asian mainland and a relict population of *Homo floresiensis*, commonly called “hobbits”, may have persisted in isolation on the island of Flores, no leap of technology or imagination took them any further. It was only with the advent of fully modern *Homo sapiens sapiens* in the area, approximately 50,000 years ago, that there is evidence of boats and other elements of modern human behaviour such as art, and advanced language (Lilley, this volume).

Geographic circumstances favoured the spread of maritime coastal foragers among these large, close and often-intervisible islands (O’Connell *et al.* 2010). In fact, it was possible to see by stages along one route from the Asian mainland to the end of the main chain of the Solomons, so it is no surprise that this is where the first water crossings took place (Irwin 1992). There was continuity of plant and marine environments across the tropics and archaeological sites show that fish and shellfish were taken with simple technology (Allen 2003). In the coastal forests there were many edible wild plants including sago, bananas, yams and taro, and the innovative practice of modifying the plant environment to promote their growth was ancient in the area (Groube 1987).

From 20,000 BP evidence for the long-distance transport of stone and the translocation of species of animals subsequently hunted for food indicates increasing maritime activity through time, and voyages were made out of sight of land to settle Manus in the northern Bismarck Archipelago. The translocation of species into new environments implies a long-term intention with a planned outcome rather than a series of accidents (White 2004), and such intentionality would apply equally to human migration.

The consensus view is that early watercraft in the region were rafts, probably made of bamboo, and while they may have been technologically simple they were substantial enough to carry founder populations of viable size. There is a range of opinion about seafaring skills at this time. Some early writers such as Birdsell (1977) thought there were just a few water crossings in very simple craft. At the other extreme Horridge (1987) thought it possible that 20-30,000 year-old Indonesian rafts had early forms of sail and travelled back and forth with the monsoon and trade winds. Irwin (1992) suggested that the area from mainland Southeast Asia to the Solomons was a voyaging corridor in an equatorial belt sheltered from cyclones with seasonal winds and currents that facilitated coastal movements back and forth and contacts between different groups.

Anderson (2000) agrees that bamboo rafts were responsible for some very early landfalls but he is not persuaded that other kinds of maritime technology developed here or did so particularly early. He suggests that Pleistocene voyaging merely became more frequent through time but not more efficient or extensive (Anderson 2003). However, Allen (2003) points out that the settlement of Manus probably required a number of voyages - first to carry a viable founder population and later to translocate animals and *canarium* nut trees. He also suggests that the transport of obsidian from Lou Island located about 30 km offshore from Manus to the mainland site of Pamwak from 11,000 BC, indicates more developed maritime technology in the late Pleistocene.

Rafts and dugout canoes

Rafts are well suited to drifting and steering with the wind and current, but rafts large enough to carry a founder population would have too much drag to paddle effectively or easily. Nevertheless, rudimentary drifting, poling and paddling are sufficient to account for the early penetration of Wallacea and Near Oceania. Simple rafts with sails blow readily with the wind. They have enough stability to carry small sails but can only sail in the same direction as the wind. While it may be a minority opinion, I think that simple improvised sails could have been used for downwind sailing in the voyaging corridor before the advent of the dugout canoe. In fact, any simple structure built for shade or shelter on top of a raft would create enough windage to function in the same way, and this would be plain to see. The point is not crucial because the longest distances to be covered were only about 100 km and favourable currents and winds could carry a raft over such a gap at 2 km per hour in just 50 hours even without a sail.

The dugout canoe was undoubtedly a major technological advance and its ancient origins are unknown; however, it could hardly have appeared before the invention of suitable tools to hollow-out logs. In the northern Moluccas and in the Bismarck Archipelago hafted and ground adzes made of *Tridacna* and *Hippopus* shell first made an appearance in coastal sites in the early Holocene after 10,000 BC. They became more widespread during the first half of the Holocene and a few edge-ground stone tools occurred among them (Bellwood 1997, Spriggs 1997, Swadling *et al.* 1989). Fully-ground stone adzes do not appear in coastal sites until after 2000 BC where they are associated with the appearance of maritime Neolithic settlement (see below).

Dugouts canoes offer considerable advantages over rafts because they have more buoyancy and less drag, but they have low resistance to capsizing. But the principle of roll stability already existed in the raft and one plausible scenario is that dugout canoes stabilized by outriggers - or double-canoes - developed

in the first half of the Holocene. There is no evidence for when the sail appeared in the Pacific either as an innovation or a borrowing, but both simple rafts and dugouts with outriggers have enough stability to carry small sails and go with the wind.

Voyaging and colonisation in the Lapita seascape

The origins of the Lapita cultural complex in Island Southeast Asia and the Bismarck Archipelago and the general association with the Austronesian language family and canoe complex have been described elsewhere (Pawley and Pawley 1994, Sand this volume).

Sailing canoes were fundamental to Lapita culture. Their construction and performance will be discussed below and suffice it to say that they were sufficiently large, fast and safe to sustain an extensive and rapid maritime migration. Canoes would have been esteemed as items of great value, possibly with painted and carved hulls and with decorative designs on their woven sails.

Lapita sites were widespread in the Bismarck Archipelago by 1300 BC, but there was a pause of a century or more before they spread beyond the Solomons to the Reef/Santa Cruz Islands by 1100 BC (Green 2003). This delay was short but significant because while sailing canoe technology would have remained much the same there was a major change in navigation from coastal sailing among large intervisible islands to wayfinding in open ocean. A period of El Niño westerlies began around 1300 BC (Anderson *et al.* 2006) and monsoonal winds of summer were available also, but Lapita navigators evidently did not use these to sail east immediately. With experience in the intervening time Lapita sailors learnt how to search at sea and survive, and the island chains they left behind provided wide safety nets for canoes returning with the southeasterly trade winds. This explanation would fit a model of stratified diffusion in which relatively slow expansion was followed by a phase of long-distance movement (Clark *et al.* 2010).

Navigation in the western part of Remote Oceania was much more demanding than previously in Near Oceania, but not as demanding as it would become further east. While some offshore voyages were out of sight of land, several island chains could be negotiated by shorter coastal voyages as shown in Figure 4. Commentators, including myself, have emphasized the speed of Lapita dispersal in archaeological time, but there was actually time for some generations of sailors to experience local conditions and learn to recognize landmarks and seamarks along the way, and add this to navigational lore.

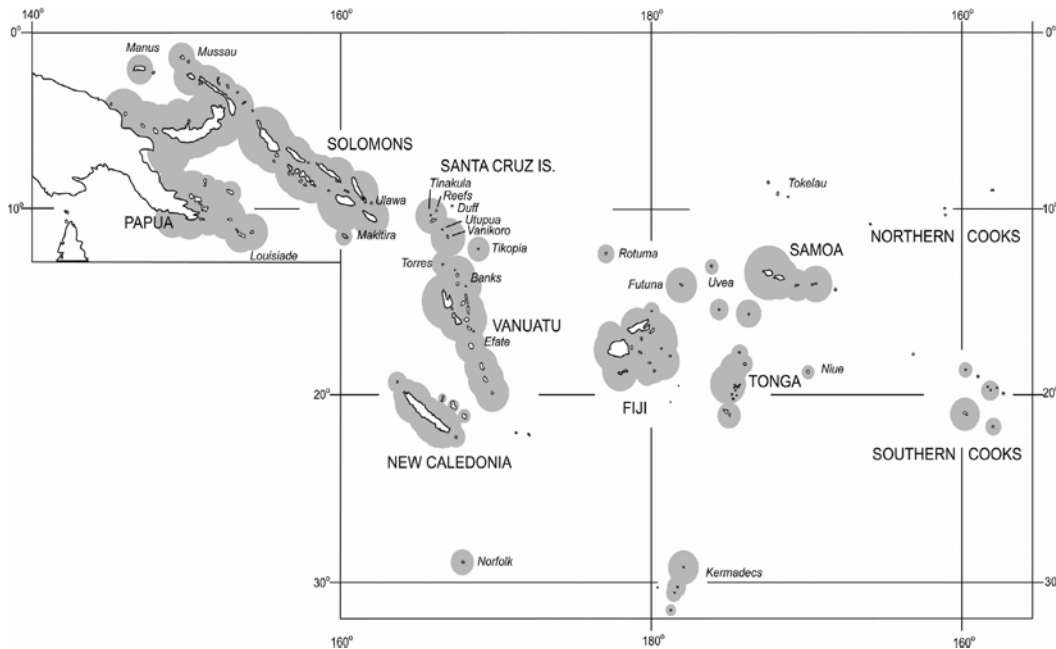


Figure 4. Islands in the Lapita seascape. Shaded areas indicate the maximum distances from which high land can be seen from sea level, in optimal conditions.

There are conflicting views as to whether Lapita settlers leap-frogged past the Solomons chain or whether their sites remain undiscovered there (Sheppard and Walter 2006). In either case a location at the southern end of the Solomons chain would have been a natural departure point for the first ocean voyage of around 300 km out to the Santa Cruz Islands, where high land would have assisted the landfall. This ocean passage provides the best archaeological evidence for two-way Lapita voyaging in Remote Oceania, in the form of Bismarcks obsidian and Solomons chert which continued to arrive in the Santa Cruz group (Green 2003). Voyages further south through Vanuatu to New Caledonia traversed fairly well-connected islands, but the passage across to Fiji was a long one, and additional voyages were required to carry domestic animals not in the first canoes (Davidson and Leach 2001).

Lapita navigation

We will never know how Lapita sailors navigated but, given that they had ocean-going canoe technology, it is clear that they had command of levels of skill adequate to produce known archaeological outcomes. For steering a course at sea they had the sun at the start and end of the day, the direction of rising and setting stars through the night, and swells during the day. They sailed among groups of large, high islands and to help make landfalls they had clouds over land and birds that feed at sea and return to roost on land at night. Navigators would have been aware of zenith stars which passed directly overhead, and it is interesting that the same stars passed over the south of the main Solomons as over Santa Cruz. To travel between them was as simple as following a zenith star path, east or west, with the seasonal winds, and this crossing was made repeatedly. The relatively short distances and large island targets within the Lapita seascape provided more forgiving conditions for wayfinding than in East Polynesia, where there was less latitude for error if people were to survive.

The trajectory of Lapita settlement

Lapita crossed a navigational threshold into open ocean. Voyages were longer and there was more time for adverse weather to develop. The risks of exploration became greater, and even if explorers had an idea of where they were, they no longer knew where they might find new land. The question arises as to

whether they concerned about safety and survival. The archaeological evidence implies Lapita spread rapidly into Remote Oceania, in small groups. They established initially small villages where some people remained as settlers while others migrated on within quite a short time - perhaps a generation. It has been argued that Lapita did not have the time or the numbers to sustain heavy losses at sea (Irwin 1992). This would appear to be no accident and some strategy of expansion is implied.

If Lapita colonists dispersed in random directions we would expect to see evidence for it, but most successful Lapita migrants went in a general southeasterly direction, and could use the northwesterly monsoon and El Niño westerlies to do so. This was the direction from which canoes could most easily return, perhaps implying a concern for safety (Irwin 1992). Other options were available. Australia and Papua New Guinea were very accessible from Island Melanesia with the trade winds of winter. Land was available for settlement in the Louisiade Archipelago and coastal Papua, as demonstrated by a later widespread migration of people with Lapita-derived pottery and similar patterns of settlement and economy around AD 0. The sourcing of a piece of obsidian found in the Reef/Santa Cruz to Fergusson Island in coastal Papua (Green 2003) could be a result of Lapita scouting expeditions and we might expect to find further evidence of this elsewhere on the Papua New Guinea coast. However, the dispersal of Lapita appears to have been directional, and compared with what was to follow in East Micronesia and East Polynesia, even cautious and modest; but, for its time, it was remarkable on a world scale.

Seafaring in East Polynesia

Archaeological excavations in Samoa and Tonga since the 1950s have shown that distinctive elements of Polynesian culture developed within Polynesia and had their origins in the Lapita expansion. Innovations in language shared by all descendant Polynesian languages occurred during a period of settlement before they dispersed. West Polynesia was the immediate Polynesian homeland (Kirch 2000), however, the genetic association of Lapita people and modern Polynesians is a more open question and is currently under review (Addison and Matisoo-Smith 2010).

East Micronesia was settled from AD 0 (Clark, this volume), and at around this time West Polynesians found Niue, Rotuma (north of Fiji) and Pukapuka (the closest of the Northern Cooks). Notwithstanding the pauses in settlement, the tradition of ocean navigation continued and was being passed from generation to generation. Current radiocarbon evidence indicates that all of the islands of East Polynesia were settled by AD 700-1000 but does not demonstrate an order of settlement among them (Allen 2004, Anderson and Sinoto 2002, Green and Weisler 2002, Kirch and McCoy 2007). New Zealand and its satellite islands south of the tropics were settled last, from around 1200 AD, probably from the region of the Southern Cooks, Australs and Societies.

The periodicity of pulses and pauses in migration is currently under investigation by scholars. However, one of the variables associated with the pauses was the changing seascapes. The pause of more than a millennium in both Polynesia and Micronesia occurred around the edge of the Pacific Plate where the two seascapes meet. One reason for the delay could have been the need for further developments in marine technology to cover the greater distances involved, but it is unlikely that this alone could explain such a long delay (Dickinson 2003, Irwin 1992). A more likely possibility is that people were discovering that the smaller, more isolated and environmentally-limited islands of the Pacific Plate were becoming more difficult to live on than they were to find.

After the pause colonisation accelerated and almost every island has evidence for human discovery. Much empty ocean must have been traversed in order to discover them all. More excavation in several

island groups will be needed to determine the accurate radiocarbon order of settlement but navigational theory provides a relative order. The developing evidence fits a model based on seasonal wind patterns involving the initial settlement of central East Polynesia followed by a separation in migration with one arm going through the northwestern Tuamotus to the Marquesas and then north to Hawaii, and a southern one passing through the Tuamotus to Mangareva, Pitcairn and Henderson, and thence to Easter Island (Irwin 1992). The impetus for voyaging extended south of the tropics, and New Zealand became a secondary centre for voyages to the Kermadecs, Chathams and the sub-Antarctic Auckland Islands (Anderson and O'Regan 2000).

From Polynesia to America

When the tropical island groups of East Polynesia were settled the maritime technology was in place to continue with seasonal westerly winds to America, which now presented a huge target at a distance that was feasible in consideration of voyages already made. At present, there is no evidence for the comparable development and expansion of seafaring on the American coast at the same time.

In recent years there has been increasing evidence and arguments for prehistoric Polynesian contacts with parts of the American coast stretching from Chile north to California. Certainly the sweet potato and probably the gourd were taken from America to East Polynesia. Various items travelling the other way, from Polynesia to America, could have included the coconut, the domestic fowl, the technique of building boats with stitched planking, and certain distinctive kinds of portable artefacts and sometimes even the Polynesian names for them (Jones *et al.* in press). Although there is continuing debate about the details, we can be satisfied that the general case for contact has been made.

First contacts between Polynesia and America were most probably return voyages made by Polynesians (Finney 1994, Irwin 1992). We cannot rule out occasional contacts by American balsa rafts (Anderson *et al.* 2007) but, in my opinion, if they happened it was after Polynesians had first established contact. And if American rafts did reach Polynesia it is unlikely that they could have sailed back home to America with a sail and rig essentially unsuitable for that voyage. The easiest sea routes to America were in the higher latitudes of the tropics and in the nearby subtropics where rotational weather systems generated periods of westerly winds, which were seasonal and predictable. Reliable returns could have been made using the easterly trade winds.

Once the sea routes to America were discovered, further voyages could have followed. At the present time, the scale of a Polynesian sojourn on the American coast remains unknown, but the possibilities are very interesting - not just in terms of the material items that were exchanged, but for any ideas and concepts that might have influenced subsequent cultural developments in Polynesia.

Boats - their form and performance

A huge literature on the traditional sailing canoes of the Pacific has accumulated since the first written accounts and illustrations made by European eyewitnesses. However, at present, there is more agreement among sailors about their performance than there is among scholars (Anderson 2000, Finney 2006). The debate is an important one because theories of colonisation stand or fall by it. Certainly, the evidence of archaeological outcomes shows that founder populations were established in Remote Oceania during episodes of rapid and extensive migration when the loss of life was low enough to be sustainable. Moreover, there was multiple voyaging to islands as shown by the evidence of multiple lineages of mtDNA of both humans and *Rattus exulans* (Matisoo-Smith 2009; Penny *et al.* 2002).

Recently, the radiocarbon dates accepted for the settlement of East Polynesia have become later in time and compressed into a shorter interval (Anderson 2003). We can reasonably infer that the faster it happened the more effective were the means of migration. This would suggest competent crews, capable canoes and intentional exploration. More random voyaging in less capable craft would have required more time and it is a moot point whether it could have produced the known pattern of archaeological evidence at all (see below).

History, ethnography and linguistics

Early descriptions and illustrations of canoes were made by European sailors who sometimes conversed with Pacific sailors and even sailed with them, as they did with James Cook (Salmond 2005). Some basic features of canoe hulls and rigs were widespread (Haddon and Hornell 1997) and indicate shared inheritance from ancestral forms. Historical linguistics has reconstructed the names of canoe parts in ancestral Austronesian-family languages which spread with colonisation through Island Southeast Asia and across the Pacific Ocean (Blust 1999, Pawley and Pawley 1994). Although there are no archaeological remains of Lapita canoes a likely type was a basic single-outrigger canoe made from a dugout log with its sides raised with lashed-on planks, and steered with a steering oar. The outrigger provided stability which allowed canoes to sail with simple two-spar rigs known as oceanic spritsails (Anderson 2000, Blust 1999, Doran 1981, Finney 2003, Haddon and Hornell 1997, Irwin 2008, Pawley and Pawley 1994). Spritsail canoes sailed by *reaching* with and across the direction of the wind and that level of performance was sufficient to explore an ocean.

Direct archaeological evidence

Wooden components of canoe types associated with the settlement of East Polynesia have been found preserved in wetland sites in the Society Islands and New Zealand showing that broadly comparable, composite canoes existed on islands that fell out of contact with each other some centuries before the end of prehistory. At the Fa'ahia site on Huahine, Society Islands the finds included two seven-metre planks with lashing holes, a steering paddle and a bailer (Sinoto 1979, 1983). The site was initially dated to the period AD 900-1000 (Anderson and Sinoto 2002), but now appears to be later (A. Anderson pers. comm 2009). At Waitore Swamp, New Zealand there was a decking plank, an outrigger float, and parts of paddles, thwarts and other fittings possibly dating to around AD 1500 (Cassels 1979). The 17th century AD Kohika lake village, New Zealand has produced parts of several canoe hulls with dugout hulls with separate lashed-on ends, together with planks, thwarts and other fittings, steering paddles, ordinary paddles, cordage and woven fabric (Irwin 2004).

Canoe performance

Fundamentally, the canoes used by Lapita and in the settlement of East Polynesia had roll stability that enabled them to sail. Their outriggers or double hulls produced a righting moment to resist the heeling moment from the driving force of the sail. Oceanic spritsails sketched by Europeans before AD 1800 in Tahiti, Hawaii and the Marquesas were fore-and-aft sails able to take the wind from either side, and a sail of this form was collected in New Zealand before 1800 (Haddon and Hornell 1997, Irwin 2008). The spar at the leading edge of these sails was stepped on the canoe and transferred aerodynamic forces from rig to hull, and the spar at the trailing edge of the sail was attached to the bottom of the forward spar and used to adjust the trim. These canoes were designed for *reaching* across the wind. They could *broad reach* with the wind coming from aft of the beam and travel downwind, and *beam reach* with the wind from the side and sail across the wind. This was sufficient for the strategic use of weather systems. David Lewis (1972) and Ben Finney (2003) think that early canoes could make passages at sea with the wind from around 75° degrees, but Anderson *et al.* (2006) consider that evidence for prehistoric upwind sailing

ability of this order is lacking. Experiments and computer simulation can throw light on the issue (see below).

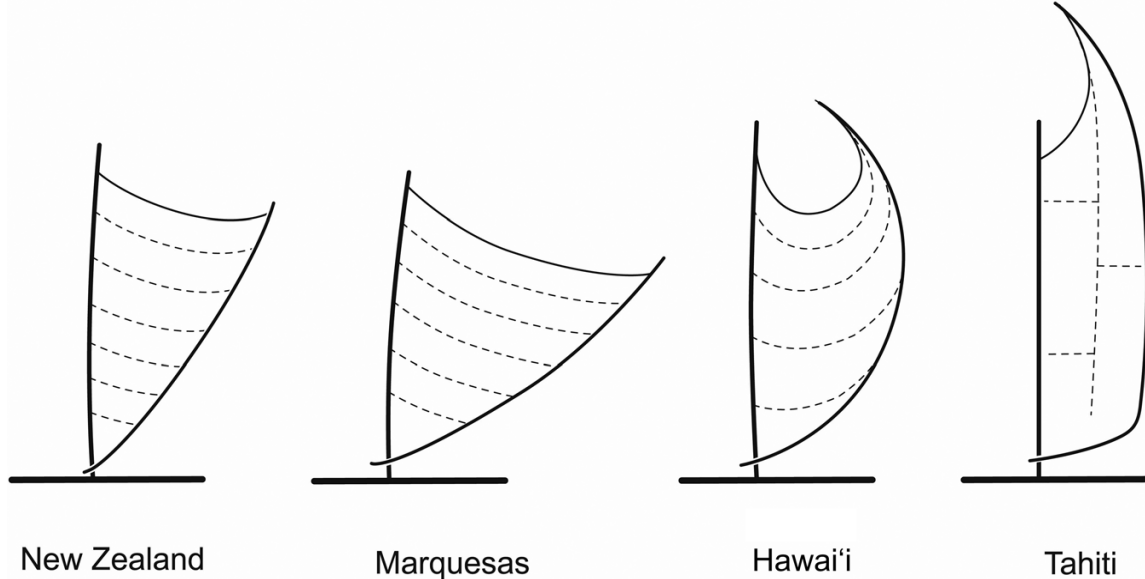


Figure 5. Schematic sketches of Oceanic spritsails illustrated by Europeans in the Marquesas, Hawaii, and Tahiti in the 1770s. The New Zealand sail is based on one held in the British Museum (Haddon and Hornell 1997). The leading edges of the sail are to the left and trailing edges to the right. These various spritsails probably shared a common ancestral form (or forms).

Changes in canoes and navigation during East Polynesian prehistory

The question arises as to whether traditional canoes and navigation described for the historic period are representative of those of the colonisation period (Anderson 2000, 2008). The case can be made more strongly for East Polynesia than for Lapita but there is considerable evidence for cultural and linguistic continuity between them. Certainly, during the last millennium, there was an opportunity for canoes and rigs to diversify in the context of increasing isolation as they adapted to different conditions in different islands. By the time of European contact there were no sea-going canoes on Easter Island and Mangarevans were by then sailing on rafts, not canoes. In New Zealand there were still double canoes but the use of single canoes without a second hull or outrigger had increased and, without roll stability, they could not reach across-wind without capsizing. Joseph Banks reported that ‘... we very seldom see them make use of Sails, and indeed never unless they were to go right before the wind’ (Beaglehole 1962:423). The development of large and elaborately-decorated waka taua (war canoes) was plainly evolutionary, but these were essentially for coastal use (Irwin 2006).

At the end of prehistory seafaring in East Polynesia was within archipelagoes and no longer between them. There was less application of the skills of ocean navigation as compared with coastal - less use of dead-reckoning for extended periods at sea and more concern for landmarks, winds and currents around land. The earlier voyaging spheres of East Polynesia had long-since shrunk. By contrast, further west in West Polynesia/Fiji and Micronesia, interisland voyaging continued and marine technology elaborated into the historic period. The three-spar Oceanic lateen rig was a late arrival or innovation and, in Micronesia, sophisticated deep-V asymmetric hull designs of the recent period were a development not present in the canoes of the early migrations. It appears that around the Pacific there were places where canoe technology advanced and other places where it declined.

Current theories of voyaging in Remote Oceania

Strategic and safe use of weather patterns

This theory envisages a basically systematic process of exploration and settlement in which sailors used their experience of seasonal weather patterns and their expanding knowledge of island geography for mobility and survival (Irwin 1992, 2006). In Lapita times canoes could have travelled through Island Melanesia to Fiji and West Polynesia during the northwesterly monsoon which interrupts the southeasterly trade winds in summer, and also with episodes of El Niño. Later, during the settlement of East Polynesia, canoes could have sailed east with the seasonal westerly winds that extended at times right across the southern tropics. The proposition is simply that was safer to explore first in the direction that was normally upwind to ensure a secure return. Later on, voyages were made across the wind to Hawaii and then downwind to New Zealand. Voyages of exploration in Remote Oceania were into the unknown and more risky than traversing known routes. Seafarers had both the need and the opportunity to become more skilled with experience, as they negotiated increasingly more demanding seascapes during archaeologically documented episodes of migration. This model implies a relative chronology of settlement.

Changing sea levels

Another explanation for the archaeological chronology of human settlement is based on the geological chronology of changing sea levels which reached a metre or more above present levels during a mid-Holocene highstand 5000 to 3000 years ago, and afterwards fell - at different times in different island groups - to present levels (Dickinson 2003). During the highstand low-lying reefs were flooded and atolls were uninhabitable. And although high islands could have been settled, their coastal flats were still submerged and attractive conditions for settlement were lacking (Dickinson 2003). Radiocarbon dates show a general conformity to the model and several island groups conform closely to it. However, Fiji and West Polynesia were settled rather earlier than predicted, and some islands of East Polynesia including the Cooks, Australs, Societies and Mangareva could have been settled earlier according to the sea-level model than they were by C14 dates from archaeological sites.

El Niño - Southern Oscillation (ENSO)

El Niño brings westerly winds which were probably used to sail downwind into the east (Anderson 2003, Caviedes 2001, Finney *et al.* 1989), and dated periods of high frequency overlap with the archaeological chronology of Pacific settlement (Anderson 2003). In addition, an El Niño-forcing hypothesis holds that canoes were only capable of sailing with the wind, and El Niño episodes lifted the normal technical constraints on colonisation (Anderson *et al.* 2006). Different episodes can vary in strength and geographical range and Di Piazza *et al.* (2007) found in a computer simulation that El Niño did not ease the navigational threshold they describe between West and East Polynesia. There is general conformity between archaeological and El Niño-forcing chronologies but not a precise match. There was a short delay after the onset of El Niño around 1300 BC before evidence of Lapita appears in Remote Oceania, and El Niño winds became available to West Polynesian seafarers several centuries before the archaeologically-attested settlement of East Polynesia.

Comparing the theories

All theories agree that colonisation was intentional and episodic. Both the sea-level and El Niño models could allow earlier settlement of East Polynesia than the current C14 dating of archaeological sites, and it has been suggested that chronometric hygiene of the dates could have compressed the colonisation period and created the impression of a wave of settlement rather than a step-by-step advance (Allen and McAlister 2010). There are also very different opinions about the sailing performance of canoes. The sea-

level model does not envisage any delay once favourable geological circumstances prevailed and, similarly, the strategic/safe sailing hypothesis holds that the ocean was searched and settled by simple but capable canoes with competent crews who steered their canoes by the regular wind systems, found their way by the stars and other sea signs, and survived to settle new islands. In support of this view is the speed of initial colonisation and the evidence for transport of industrial stone between island groups for some time after settlement (Collerson and Weisler 2007, Walter and Sheppard 1996, Weisler 2002). In contrast, the El Niño-forcing hypothesis holds that canoes could only sail or drift downwind and to reach many island groups they needed anomalous winds (Anderson 2000, 2003; Anderson *et al.* 2006). Implications of this model are that migrants could not so easily communicate between islands, and that migration trajectories were determined more by winds than minds.

Computer simulation of voyaging

Scholars are in considerable agreement about the archaeological evidence for Pacific colonisation, but because there is no direct evidence for the actual boats used - except in East Polynesia - it is not surprising that there are widely diverging opinions about the nature of the navigation and voyaging involved. Computer simulation has proved useful for investigating different interpretations because it has the known facts of archaeology to compare with simulated outcomes. It can run multiple experiments with varied input data and compare the outcomes of different voyaging theories. It also requires assumptions to be made explicit and it produces measured estimates which are often more useful than opinions. It is interesting that all of the simulations to date have had useful results, even where their results do not match the archaeology. Some examples of experiments given below include (1) those which make predictions for archaeology, (2) those that inform us about navigational skills, and (3) those relevant to contact with America.

Prediction

To take one example, at one time it was generally thought that Rapanui/Easter Island was settled directly from the Marquesas. This was based largely on linguistic grounds. However, a simulation by Irwin, Bickler and Quirke (1990, Irwin 1992) showed that such a voyage was extremely improbable and a more likely route was through the southeast Tuamotus, Mangareva, Pitcairn and Henderson to Rapanui. Accumulating archaeological evidence has since shown this to be the case.

Navigational skills

A pioneering computer study by Levison *et al.* (1973) tested a theory by Sharp (1957) that the Pacific was settled by one-way drift voyages and accidental discoveries but the results showed that major voyages of Polynesian settlement could not have occurred by drift. For the parts of the ocean where the number of weather observations was adequate these results can still be regarded as robust, because the British Naval Hydrographic Office pilot books and routing charts using the same weather data have successfully guided sailing vessels at sea since 1885.

A later simulation by Irwin *et al.* (1990, Irwin 1992) using the same wind data investigated levels of navigational competence. It compared five levels of navigational skill from rudimentary to sophisticated and compared outcomes with the archaeological evidence and assessed the loss of life at sea. The results showed (1) that navigation became more difficult as migration spread through more demanding seascapes, and sailors had the need and the opportunity to develop their skills over time. (2) Return voyaging must have been used in Polynesia because the loss of life when canoes failed to find land became too great to sustain. (3) To successfully settle Hawaii and New Zealand at the margins of

Polynesia, and to return safely from America, required strategic sailing through different seasonal weather systems.

Di Piazza *et al.* (2007) used a new generation of continuous wind data collected 1991-1997, including the El Niño year of 1996, at a 1° degree scale of latitude and longitude, which provided a more realistic model of conditions in prehistory. Another improvement was to vary canoe speed with wind direction according to a performance model which affected the distances sailed. The aim of the experiment was to compare Lapita voyages from island Melanesia to Fiji/West Polynesia with subsequent voyages from Samoa to East Polynesia, and the results showed the latter to be more difficult. The authors concluded that there was a navigational threshold sufficient to explain the Polynesian pause which persisted even during a recorded El Niño.

Experiments by Avis *et al.* (2007), investigating the Lapita settlement of western Oceania, and by Montenegro *et al.* (2008) modelling the prehistoric transfer of the sweet potato in Polynesia have also used records of continuous real wind and current data which include both normal seasonal patterns and El Niño years. However, their model of canoe performance allowed only drifting or sailing with the wind. The Avis *et al.* (2007) simulation of Lapita voyaging had low rates of success. It also produced outcomes for which there is no archaeological evidence; for example the rate of success for reaching Vanuatu in Melanesia was about the same as for Australia. These results are a valuable test of the downwind colonisation model by demonstrating that theories which assume limited canoe performance do not match the archaeology.

Contacts between Polynesia and America

A simulation by Montenegro *et al.* (2008) shows that boats drifting or sailing downwind could have brought the sweet potato from America to Polynesia, which conforms to the archaeological evidence, although it does not show whether it was Amerindians or Polynesians who transported it.

The translocation of the chicken (*Gallus gallus*) from Polynesia to the Arauco Peninsular of Chile is examined by Fitzpatrick and Callaghan (2008). They found that Easter Island was the most likely source, but most of the landfalls were north of Chile in Ecuador and Peru, suggesting that earlier evidence for chicken could be found there. In addition, successful return voyages from Chile were rare and returns from the coast of Ecuador to much of Polynesia were more feasible.

The simulated transport of the coconut to Central America by Ward and Brookfield (1992) found that it was unlikely to have crossed the central Pacific by drift while remaining viable, which suggests a human agency (Ward and Brookfield 1992). However, if the transfer was made by Polynesians it is very unlikely they could have sailed east at the latitude of Central America through trade winds and equatorial doldrums. This raises the question of whether El Niño was the agent or whether the coconut could have taken an indirect route having first arrived at some point further south on the American coast.

Fitzpatrick and Callaghan (2009) found that high numbers of vessels from Hawaii reached southern Mexico and Central America in the months of August and September but return voyages over the same track were not feasible.

Traditional navigation at the time of European contact

Having considered the evidence that comes to us from the past, it remains to consider traditional navigation as described for the historic period. Clearly some navigational techniques have deep roots in

the past. Certain general concepts that were widespread across the ocean were shared by the people of islands that were out of contact with one another for centuries in late prehistory. These cases indicate some shared ancestry. Although early seafarers had no metal and no navigational instruments or maps, they did have culturally equivalent navigational methods that were equal to the task. These included mental maps, various forms of star and wind compasses and concepts of how a canoe moved in relation to the position of islands (Gladwin 1970, Lewis 1972).

Captain James Cook was aware from his first voyage to the South Pacific of the wide geographic knowledge of Polynesians, and Sir Joseph Banks wrote about indigenous knowledge of the stars (Beaglehole 1962:368):

Of these they know a very large part by their Names and the clever ones among them will tell in what part of the heavens they are to be seen in any month when they are above their horizon; they know also the time of their annual appearing and disappearing to a great nicety, far greater than would be easily believed by an European astronomer.

Polynesians could forecast the weather for days ahead, and on the question of seasonal winds, Cook noted in his journal account of Tahiti that it was known that the easterly trade winds were not constant and there were winds from a westerly quarter in some months, and he wrote '... they know very well how to take the Advantage of these in their Navigations' (Beaglehole 1968:139).

Three elements of traditional navigation widespread in the Pacific were steering a course at sea, maintaining a running fix of position, and making an island landfall. For steering, navigators used stars low on the horizon as bearings for particular directions as the stars rose one after another in the sky. The Southern Cross could be used for long periods as it changed its attitude in the sky through the night. By day canoes steered by the swells and it is clear from various accounts that steering was as much a matter of feel as of sight.

Dead-reckoning kept a running estimate of position and its elements were course (compensated for current), elapsed time, and estimated speed. Modern canoes have made safe landfalls after long voyages without instruments, and experiments with Global Positioning Satellites (GPS) have found that mistakes made in non-instrument navigation occur at random, and cancel one another out over the course of a voyage.

Land could be detected from as much as 30-50 sea miles offshore by cloud formations over high islands and from the influence of land on ocean swells. The sighting of sea-birds that returned to land at night was a valuable sign, and before humans drastically reduced their numbers there were huge clouds of birds around empty islands.

Pacific people did not know latitude and longitude in a Western sense but experiments at sea have shown it is possible to estimate an equivalent of latitude, to within half a degree of error, from the angle of stars in the sky. In the case of zenith stars (which pass directly overhead), this can be done by sighting up a line with a fishhook or sinker dangling as a plumb-bob and the measurement error is about the same as the distance from which navigators could detect the presence of an island over the horizon. Longitude cannot be told just by looking at the sky but requires a fine control of time. So, instead, the position of a new island was fixed by dead-reckoning from its distance and direction from others.



Figure 6. A canoe from Mailu, Central Province, Papua New Guinea (G. Irwin 1973).

The end of prehistoric ocean voyaging and a new beginning

With the discovery of America the eastward expansion that began ultimately in Asia was complete. With the extension of exploration and settlement beyond the tropics south to New Zealand and its neighbours less than 1000 years ago, the whole the Pacific that lay within technological range had been reached. Archaeological evidence for the interisland transportation of stone shows that voyaging continued in some regions of Polynesia. However, within a few centuries, and evidently by some time around the mid-second millennium AD, this had ended throughout much, although not all, of Remote Oceania. The three points of the Polynesian Triangle - Hawaii, Rapa Nui/Easter Island and Aotearoa/New Zealand - were no longer in contact with the centre. The reasons why ocean voyaging declined remain largely unexplained, but the internal dynamics of island societies had evidently superseded their overseas interests.

The declining frequency of long-distance voyaging exposed the vulnerability of small and isolated islands. Around 20 so-called “Mystery Islands” were found empty by Europeans, but have archaeological evidence for earlier settlement. This has been explained in terms of the pressure of people on limited resources; however, the particular islands abandoned are very predictable in terms of accessibility from their neighbours, which shows the impact of increasing isolation.

Scholars and sailors have debated Pacific voyaging and navigation for 300 years, but the people of many islands have been in no doubt about their origins and retain voyaging traditions which still have the potential to reveal useful information about the past. Since the mid-20th century, as modern anthropological research has brought to light the outlines of the prehistoric exploration and colonisation of the Pacific, there has been a striking “renaissance” in indigenous seafaring in many parts of the Pacific and, once again, its sea-lanes are being crossed successfully by many diverse sailing canoes as modern seafarers approach the future while remaining in touch with their past.

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Ceramic chronologies of the Western Pacific during the Lapita period

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Poterie Lapita entière découverte sur le site éponyme WKO013A de Lapita (Koné, Nouvelle-Calédonie)

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Introduction

As noted in the introductory chapter above, in 2005 there was a regional meeting in Vanuatu to develop a Thematic Framework for World Cultural Heritage in the Pacific. The meeting brought together experts from the Pacific to identify regional themes for which Thematic Studies were required. Participants in Port Vila agreed that the Lapita expansion was a regional priority.

When the present Thematic Study was commissioned, it was recognised that the Lapita phenomenon was a central question but had to be contextualised in the wider picture of initial colonisation throughout the Pacific. Lapita is unquestionably important, but is not the whole story of early human expansion and innovation in the region.

The high profile of the Lapita dispersal has meant that it has long been a focus of scientific research interest. This has seen extensive and in some countries very intensive identification and documentation of Lapita sites. Some such sites in the Reef Santa Cruz Islands (Solomons) and Arawe Islands (PNG) were discussed as primary features of cultural landscapes in Smith and Jones's 2007 Thematic Study. Other sites have since been registered on national Tentative Lists. The Sigatoka Sand Dunes, one of Fiji's four Tentative listings, is a well-known Lapita site, while all of Tonga's Lapita sites are tentatively proposed as a serial nomination. The following describes Lapita and the history of its discovery and analysis in more detail.

Background

Over the hundred years since Father Otto Meyer published the first report of dentate-stamped Lapita sherds, which he had found on Watom Island in the Bismarck Archipelago (Meyer 1909), archaeological research around this item has moved from a ceramic type defined by a "roulette" technique (Gifford and Shutler 1956), to a "community of culture" (Golson 1962), before being defined as part of a "Lapita cultural complex" (Green 1979). Even more than during the first 75 years, Lapita archaeology has changed dramatically over the last 30 years ago. At that time, summaries relying on fieldwork and syntheses proposed by Jim Specht, Roger Green, Daniel Frimigacci, the Birks, Bruce Palmer and Jens Poulsen, to name a few, emphasized how much we didn't know about Lapita. The dates of Lapita settlement were confused, with the south and the east of the region seemingly settled before the west. The length of the Lapita chronology was even worse, with late occupations apparently lasting well into the first millennium AD (Green 1979). The understanding of Lapita pottery itself was not much better, with mostly very fragmented sherds, apart from a few well-preserved collections. There were blanks all over the map. And most of all, a hypothesis about pre-Lapita settlement of southern Island Melanesia was still favoured by a number of people (Shutler and Shutler 1975) and the whole understanding of the Lapita phenomenon was still intricately tied to the question of "Polynesian origins" (Green 1973), relying mainly on the study of sites excavated in what Roger Green would soon call "Remote Oceania" (Green 1991). The Lapita Homeland project (Allen and Gosden 1991) had not started, and the whole topic appeared like a nightmare.

Twenty-five years later, to take a nice image from Stuart Bedford (2003), "the haze has begun to clear". The redating of sites throughout the region with AMS precision and the excavation of new Lapita sites with well-preserved stratigraphies have led to the slow build-up of what appears today to be a fairly robust chronology (see Specht and Gosden 1997; Sand 1997; Burley 1999; Specht 2007). In-depth studies of ceramic collections have started to give a definition that is more accurate to the different pottery types that were produced during the Austronesian expansion into the Western Pacific (e.g. Summerhayes 2000; Bedford et al. 2007; Burley et al. 2002; Chiu 2005; Sand 2010). A series of computer-generated programs (Siorat 1990; Noury 2005; Chiu and Sand 2005) are recording and comparing in detail the multiple variations of dentate-stamped motifs produced in the Bismarcks, Central and Southern Melanesia, and Fiji/West Polynesia during Lapita times. Finally, we are slowly arriving at the stage where variations within and between regions, as well as the social dynamics at

play in each archipelago, can start to be properly integrated into our models. This approach was pioneered by people like Roger Green long ago (e.g. 1978), but has been surprisingly slow to get into the general literature. Present-day syntheses have still mostly remained at a first stage of analysis, focusing mainly on the Lapita “dispersal” and producing A-to-B maps, illustrated by an arrow from west to south and east. Although this is far too simple a model, archaeologists often seem to remain happy with it. This paper presents data that highlight the overall “complexity” of the Lapita cultural complex, introducing different parameters to disentangle the successive stages of diversification of this tradition, in order to get closer to a form of archaeological reality.

There is no possibility in the present format to cover in detail all the points surrounding the Lapita question, the amount of data having increased to a point where entire books can be published on just one region (cf. Sand 2010). In the following pages, the focus will be on the most important topics highlighting the complexity of the Lapita dynamics, integrating geography and chronology in back-and-forth rhetorical movements. After a rapid overview of current knowledge about the different Lapita divisions, the successive steps in the Lapita expansion will be discussed in turn, before analyzing the demise of dentate-stamped decoration.

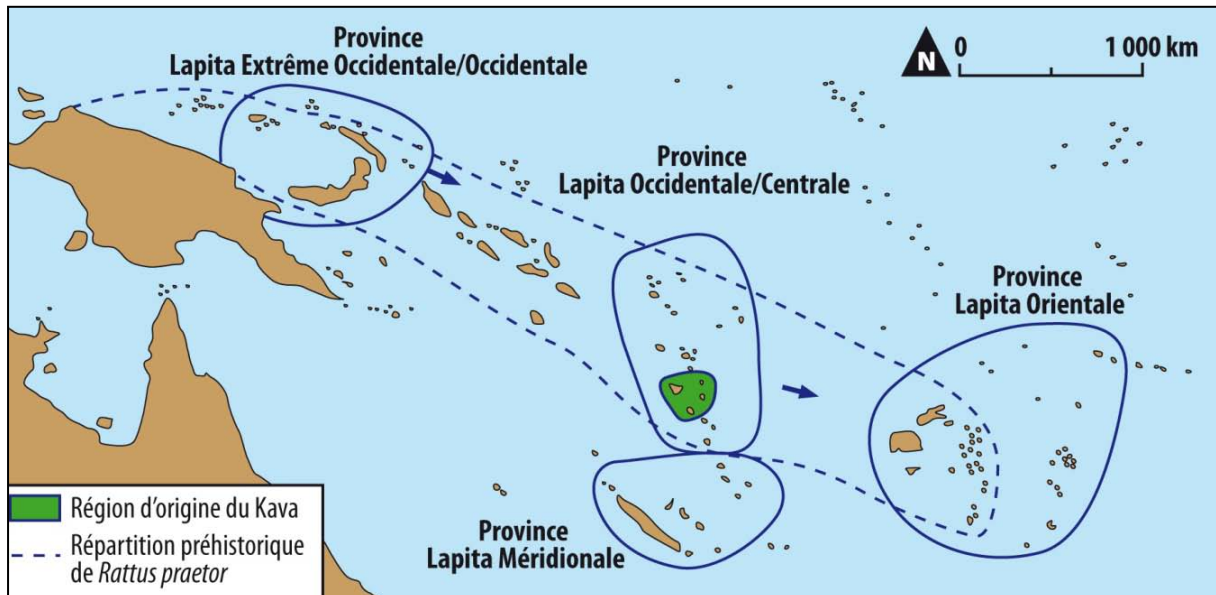


Figure 1. Geographical divisions between the different Lapita Provinces.

I. The ‘Lapita Provinces’

The uniqueness of Lapita ceramics was defined in the 1950s and ‘60s mainly through its dentate-stamped designs. Over the succeeding decades, a series of refinements led to Green’s (1979) definition of Western and Eastern styles, Anson’s (1983) identification of a Far Western Province, Kirch’s (1997) creation of a Southern Province, my (2001) questioning of a putative Central region, and the recent identification of a South Papuan expansion area (David et al. 2010) (fig. 1). In parallel, successively more sophisticated statistical methods of motif recording by Mead (1975), Anson (1983), Siorat (1990), Sharp (1991), Noury (2005) and Chiu and Sand (2005) have started to disentangle the similarities from the differences among related Lapita sites throughout the Western Pacific. The compilation of results has seen continual typological refinement, leading for example to the proposal of a chronological partition of Lapita into Early, Middle and Late periods (Summerhayes 2000).

Over the last decade, detailed excavations have helped to distil regional Lapita chronologies. These new studies have shown that a simple decay model of motif simplification from West to East (Ishimura 2002) could not account entirely for what was observable in the sites. Local dynamics were at work in

each sub-region and between related communities, integrating founder effect, site-specific developments, possible secondary arrivals, isolation, and so on (Green 2003). The mainly unidirectional, down-the-line model of dispersal from the Bismarck Archipelago to Central Melanesia, and from there to Southern Melanesia and Fiji-West-Polynesia, obscures numerous secondary arrows in multiple directions.

Today archaeologists are in a position to start looking at the subtle differences between the remains buried in different sites, to more clearly identify local specificities. Pinpointing the ceramic tradition introduced by the first discoverers in one place and the evolutions witnessed over the succeeding generations, appears today one of the main tasks to fulfil in Lapita studies.

II. Origins of Lapita and the Far Western/early Lapita period

The Bismarck Archipelago, located on the north-eastern fringe of the large island of New Guinea, has for decades been considered the “homeland” of the Lapita diaspora. Recent enhancement of the chronology shows a possible first appearance of dentate-stamped pots in this region around 3350 cal. BP (Specht 2007), although slightly earlier dates have also been proposed (see Kirch 2001). These dates are supposed to mark the start of Lapita. Nonetheless, looking only at the excavated material, archaeologists still appear to be missing the definitive archaeological signature of the origins of the ware. We theorize about it, about links with Southeast Asia and/or local influences (cf. Spriggs 2007, Allen 2000), but the precise starting point of Lapita history in the Bismarck Archipelago remains unknown. Kirch has recently published a series of data from the site of Talepakemalai in Mussau, hypothesizing the presence of early non-decorated “Asian-like” red-slipped pots before the appearance of dentate-stamping (Kirch 2001). Unfortunately, the ceramic data have yet to be published, preventing colleagues from evaluating the material used to support the proposition. The Island Southeast Asian data for this period, on the other hand, on which rests the “red-slipped” link, are too slim to help us solve the question of Lapita origins, as the majority of the sites excavated in the archipelagos surrounding Western New Guinea have been rock-shelters (ex: Bellwood 1992). In the Western Pacific, this category of site has been shown to be a very unrepresentative type of occupation for Oceanic populations during initial settlement (Anderson et al. 2001). The red-slipped pottery is dated in such sites in Asia to post-Early Lapita times and so does not tell us anything about the earlier part of the ceramic sequence in the region. Moreover, simple dentate-stamped sherds have been securely dated to 1800 BC in northern Luzon and to at least 3200-3300 BC in the Marianas, so to start the ceramic sequence of the Bismarck Archipelago with only plain pottery seems incongruous. In conclusion, to be blunt, archaeologists are probably still missing the origin phase of Lapita in the Bismarcks, mainly because they do not really know what was happening further west just before the appearance of the currently earliest ceramic sites in northern Island Melanesia.

What we have, in a few sites scattered from Mussau (Kirch 1988, 2001) to the Arawes (Summerhayes 2000) and from the Duke of Yorks (White 2007) to Ambitle (Ambrose 1997), is a distinct but complex set of Early (Summerhayes 2001) or Far Western (Anson 1986) Lapita ceramics. They exhibit a series of unique features that allow separating them from other Lapita collections. First, the dentate-stamping is mostly very fine, with imprints that are usually only about 0.5 mm in diameter. Secondly, some of the ceramic forms produced during this early phase have a number of characteristics that are not present later in the sequence. There appear to be three main peculiarities. The first is the regular production of pot-stands/pedestals with outcuts and voids, often incorporating a series of unique dentate-stamped motifs such as the seed-like oval motif. The second is the creation of bowls with a unique grooved rim-form and apparently no carenation. Only the upper part of these vessels is decorated, with complex sets of motifs sometimes intermixed with stylized representations of human eyes or faces. Recent data appear to show that some of these ‘bowls’ were in fact attached to pedestals exhibiting outcuts. The third specificity is the development of a series of carenated pots with unique forms, decorated with successive horizontal bands, subdivided into friezes but also featuring a

restricted set of central motifs designs, along with flat-bottom dishes decorated in the same way. This Early/Far Western Lapita tradition spans the entire Bismarck Archipelago up to Ambitle. Specht's (2007) recent reassessment of the C14 dates for the early occupation of some of the sites in this region has allowed him to revise partly the conclusions he published ten years earlier (Specht and Gosden 1997), by pushing back by about one century the starting point of the chronologies for those sites, to around 1400 BC. This aligns well with the detailed analysis of the radiocarbon dates from Mussau published by Kirch (2001), and underpins a fairly robust argument for an Early/Far Western Lapita phase probably spanning at least one to two centuries. This said, however, were all the people making and using these pots from one and the same cultural "pool"? Where they all connected in an expanding network? Does the apparent homogeneity of Early Lapita ceramics, as well as associated remains such as fishhooks, indicate that we are dealing with a unique socio-cultural entity during those four to perhaps six generations? The striking similarities of the complex ceramic remains across the region during this short period would suggest the affirmative. If this conclusion is correct, Early/Far Western Lapita communities might be defined as a small expanding group in the Bismarck Archipelago, with links to pottery communities in Island Southeast Asia, producing pot-forms and decoration techniques mainly canvassed further west.

As nicely summarized by Torrence and Swadling recently (2008), these Early Lapita communities were living in a region which was developing for at least 4000 years a whole series of cultural objects, partly as trade items, such as carved stone pounders and mortars. The overall nature of these objects points to the existence of sailing capabilities, as well as some form of horticulture in the Bismarck Archipelago before Lapita times, though this has not been defined archaeologically to this day. Production of specialized items like stemmed tools and exchange of some of these objects over long distances was part of the overall cultural tradition of northern Melanesia well before any Austronesian arrival from Island Southeast Asia.

The emergence of distinctive Early/Far Western Lapita pottery appears on present data (but see Kirch 2001) to occur just after the catastrophic eruption of the Witori volcano (WK-2) in northern New Britain, that wiped out most of the settlements around the volcanic cone (Torrence and Swadling 2008). The magnitude of the eruption certainly had an impact on the whole northern Melanesian region, in terms of crop destruction, coastal devastation by tsunamis, short-term weather pattern changes and so on. It apparently also disrupted regional exchange networks, some central supply locations, such as the obsidian sources of the Talasea Peninsula, appeared to have been abandoned for some time after the eruption. The eruption also marks the abrupt end of the production of carved stone pounders and stemmed tools, the new obsidian tools produced in Talasea after the WK-2 eruption being of a completely different (and more simple) technological nature.

These data throw new light on the development of Early/Far Western Lapita in the Bismarck archipelago. The appearance of this new item might signal a process of intrusion of a marginal group of Southeast Asian ceramic tradition-bearers in a region under crisis after the WK-2 eruption, taking advantage of this unique opportunity to settle in northern Island Melanesia. During this period, the restricted number of communities allowed to preserve a clear homogeneity in pottery production and decoration.

III. The classic Western Lapita phase

Although the detail of what happened during the Early/Far Western Lapita phase in the Bismarck Archipelago remains still very much a matter of conjecture, data show that the homogeneity that characterized this period did not last. By at least 1250 BC, when the first settlement of the Reef/Santa-Cruz and then northern Vanuatu took place (Green and Jones 2008), the ceramic kit from the Bismarcks had already evolved into something that can be classified as "Western" or "Middle" Lapita (Green 1979; Summerhayes 2000). This Western phase is characterized by an evolution of

ceramic forms, with a dramatic diversification in sizes, a multiplicity of new dentate-stamped decorative motifs and the emergence of new ways to place these motifs on the pots. Out-cuts on pedestals mostly drop out and only occasional grooved decorations on the rim or the base of flat bottom dishes remain, while a more narrow form of pot-stand with tri-dimensional horizontal bands develops (Bedford et al. 2007). Carenated pots of a large variety of sizes and with mostly out-curved rims become predominant, along with a diversification of flat-bottom dishes and the near disappearance of the earlier bowls with grooved rims. An elaboration of new dentate-stamped motifs is evident, with rectangular, labyrinthine and curved designs emerging amongst others (Sand 2005). These are placed on the pots in more strict horizontal sets of friezes, the tradition of developing two rows of central motifs sometimes being maintained (Donovan 1973; Summerhayes 2000). The number of different face-motifs expand, some associated in a pattern incorporating curved designs (Spriggs 1990) (fig. 2). On some pots, two completely different motifs compose the same central band. Finally, we see the development in each site of incised carenated pots bearing a restricted range of motifs, along with the production of non-decorated oval pots with out-curved rims.

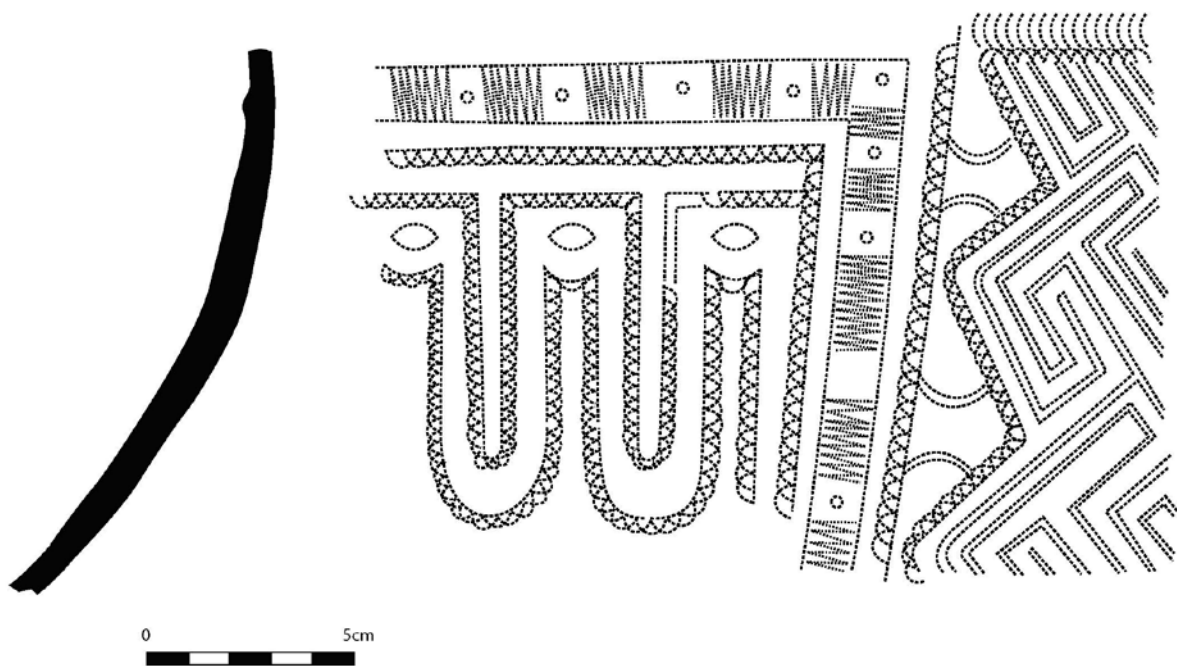


Figure 2. Face motif and labyrinthine motif associated on a Lapita pot from the Watom site (Bale Museum col.).

This change might signal that the Lapita tradition bearers had finally managed to get integrated into the disrupted multi-millennia regional network after the catastrophic WK-2 natural disaster, leading to a progressive social reshaping using the Lapita kit. 'Lapita' symbols and items began to be shared by new groups, not of direct Austronesian descent, probably through marriage links that had started well before the Witori eruption. In this speculative scenario, the rapid multiplication of communities producing 'Lapita' items fostered a diversification of the Lapita ceramic set. What might have distinguished the advent of Western/Middle Lapita was the emergence of a number of discrete socio-cultural groups in the Bismarck Archipelago at that stage of the sequence, not all maintaining the same homogeneous Lapita tradition, because the number of Lapita communities had expanded. Consequently, the Lapita spread out of the Bismarcks might have been much more complex than a coherent one-way movement of one homogeneous cultural group towards the southeast. Not everybody had the same phylogenetic origin, a number of the people involved being of old Near Oceanian descent. Not every group moved at the same time, but the pace of departure probably extended across at least two centuries. There were probably return settlements from Remote Oceania

to Near Oceania, along with secondary departures out of the Bismarcks in a number of directions, including towards the west in Island Southeast Asia (Bellwood and Koon 1989). We are plainly dealing with a complex pattern of expansion over a significant number of generations.

A number of data appear to signal that a process of this kind was underway in northern Island Melanesia by the time people reached the southern limit of Near Oceania. Noury (2005), for example, through statistical analysis of dentate-stamped motifs, has suggested there were distinct 'northern' and 'southern' Lapita 'groups' in the region. He thinks that they spread southeast at different times. In his early site of Makué, near Santo in northern Vanuatu, Galipaud has excavated a series of potsherds that can be classified as Far Western Lapita (Galipaud 2010). This signifies that at the time of first settlement of the site around 1150 BC, some communities further north were still partly "Far Western/Early Lapita", while others had already become purely "Western/Middle Lapita". These "old fashioned pots" do not appear to have been found in either the Reef/Santa Cruz islands (Donovan 1973), or the sites of Malo (Hedricks nd; Galipaud 2000). Nor have they been identified in sites along the east coast of Malekula (Bedford 2007), strengthening the idea that there were various discrete cultural groups entering Remote Oceania from about 1250 BC. Further south in New Caledonia, motif differences between Lapita sites appear to signal the settlement of the archipelago by not one, but a series of different Lapita families or clans, each with its specific traditions (Sand 2010).

Other examples could expand this picture, underlining the fact that what is at play between Near and Remote Oceania around 1250 BC and in the following centuries is an intricate set of movements of people along the Solomon Islands axis, out of a region that had already experienced a first phase of diversification. Sheppard and Walter (2006) have recently outlined for the Solomon archipelago a complex scenario of Lapita settlement that could support the scheme I propose, by hypothesizing the bypassing of the central Solomons by the first Lapita groups settling the Reef/Santa Cruz Islands.

IV. Central and Southern Lapita

The dynamic at work between Near Oceania and the northern margin of Remote Oceania must have impacted on the way Lapita communities dispersed out of the new central region formed by the Reef/Santa Cruz-Northern Vanuatu sphere. At the same time, the first incoming groups to Remote Oceania had to deal with a new parameter: empty islands, without inhabitants with whom to intermarry. This must have fostered immediate adaptation strategies, ranging from long-distance mating in Near Oceania to the reshaping of marriage traditions between related communities exploring Remote Oceania. That regular contacts with further north were retained in this core region of the Reef/Santa Cruz-Northern Vanuatu is highlighted by the continual inflow of obsidian from the Bismarck Archipelago over a long period (Sheppard 1993; Galipaud and Swete Kelly 2007), a pattern that is not replicated in Remote Oceania further to the south and east.

The progression of people out of the Reef/Santa Cruz-Santo region as far as New Caledonia appears to have been sequential and may have taken over a century, if the early dates around 1250-1150 BC for RF-2 (Green and Jones 2008) and Makué (Galipaud and Swete Kelly 2007) are correct. Four to six generations in a landscape of empty islands visited by diverse seafaring families, that the Teouma data suggest were probably quite diverse in terms of their ethnic affinities (Valentin et al. 2010), before reaching a unique landmass of continental origin formed by the Grande Terre of New Caledonia between 1100 and 1050 BC (Sand 1997), left plenty of time to accumulate new cultural behaviors. Permanent settlement in each of the major islands would have increased these specificities through founder-effect processes, The essentials were retained, but around them people could multiply local innovations.

The hypothesis that the Lapita spread towards central Island Melanesia was not just a unidirectional push by one homogeneous group, but a set of movements of different groups on a series of voyaging

routes at different times over one to two centuries, undermines the concept of a large “Western Lapita Province” (Green 1979). We seem to be dealing more in this case with partly or loosely associated interactions spheres, not just one simple homogeneous group. In all probability, in the near future statistical studies will show the emergence of a series of new combinations of motifs and particular developments of pot forms that differentiate the Western Lapita tradition of the Bismarck Archipelago from what happened further south, the differences increasing partly with distance. The hypothesis of the progressive development of a “Central Lapita Province” (Sand 2001) awaits detailed publication of the northern/central Vanuatu material and the conclusion of renewed study of the Reef/Santa Cruz collection. Preliminary data from the sites of northeast Malekula (Bedford 2007) and Teouma (Bedford et al. 200) show a series of unique features that cannot be compared directly with what has been found in Watom or Ambitle-Kamgot for example, in terms of motif components or pottery forms. In Teouma, for example, the successive triangle motif appears to be statistically overrepresented on potsherds. Once again, some earlier features were retained, like the out-cuts on some rims and flat bottom of dishes, but others evolved in a unique direction. This is also the case for New Caledonia, where over time a unambiguous “Southern Lapita Province” emerged (Sand 2010), characterized by a focus on very large carenated pots, a massive increase in stylized elongated face-motifs, the development of new types of rectangular-shaped motifs, the near absence of out-cuts, the emergence of paddle-impressed pots and so on (Sand 2010) (fig. 3). Differences are also apparent in the plain pots developed in the Southern Lapita Province, with the production of globular lightly-carenated pots with short rims, of a different typology from the plain pots produced in the Bismarck Archipelago and possibly central Melanesia during the same time period. All this, associated with indications that small amounts of obsidian were imported from the Kutoa-Bao source in the Talasea region to New Caledonia but none brought from the Admiralties or the Banks Islands (Sand and Sheppard 2000), appears to illustrate a rapid breakdown of regular contacts between the southernmost archipelago of Melanesia and Lapita networks further north. This is not to say that contacts ceased completely, though, as some New Caledonian Lapita pots have been found in sites in Vanuatu (Dickinson 1971; Bedford et al. 2009).

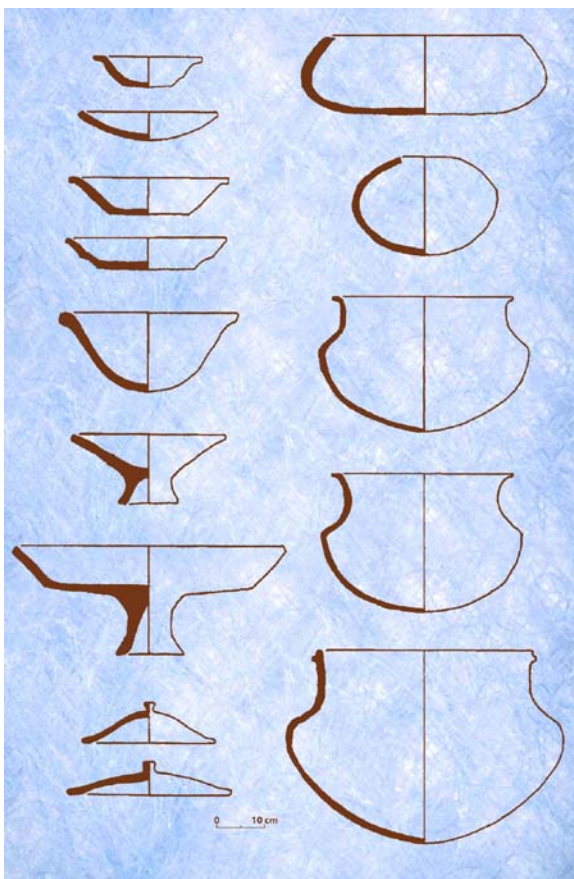


Figure 3. Diversity of Lapita pottery series of New Caledonia.

V. Eastern Lapita

The Fiji/West Polynesian region is certainly the Province where the rapid changes experienced by the founding Lapita groups can best be highlighted. The very start of the chronology in western Fiji is now much better understood than it was just a decade ago, owing to the discovery (Nunn 2007) or re-excavation (Irwin et al. 2002) of a couple of founding sites. Bourewa stands out as one such place, with first occupation dates calibrated to just before 1000 BC in stratigraphic levels typified by a variant of Western/Central Lapita ceramics, encompassing face motifs, complex pottery forms and tri-dimensional appliqué bands. The presence of a few obsidian flakes from Talasea is another direct indication of the early nature of the settlement.

Once again, it is probable that not only one, but a number of different groups sailed to the east, mainly out of the Reef/Santa Cruz-Northern Vanuatu region, after receiving news that rich islands had been found in that direction. Natunuku (Shaw 1967; Davidson et al. 1990), Yanuca (Hunt 1980), Naigani (Best 2002), Moturiki (Nunn 2003), all in Viti Levu or on nearby smaller islands, have a series of complex pottery forms with friezes and what Mead has termed “restricted zone markers” (Mead 1975) that set them apart from the rest of the Lapita ceramic productions in this region. In this case, we can define with fair confidence the chronological limits of these complex, Western-style pots, owing to the very precise dating of the founding settlement of Nukuleka on Tongatapu around 950 BC (Burley and Dickinson 2001). That this site produced the only Western-Central style Lapita sherds for Western Polynesia, some with a possible source in the Southeast Solomons, amongst hundreds of more simple decorated sherds, is an indication of a rapid shift in decoration rules. The Nukuleka dating seems to highlight that the Western-style Lapita pots were probably produced in western Fiji for only a couple of generations at most. During these few decades, potters started to develop less complex dentate-stamped designs with often small, three-dimensional alignments or bands, peculiar to “Early Eastern Lapita” (Green 1979; Sand 2005). Pottery forms shrank markedly, with flat-bottom Lapita dishes for example being progressively abandoned in most sites, while new pot forms were developed region-wide. The two main forms characterizing the Eastern Lapita style were a carenated pot and various bowl types (fig. 4). The carenated pots are mainly of small to medium size (25-40 cm), usually with a flat bottom and three-dimensional bands, showing a clear difference with the types found in the Melanesian crescent (Sand 2007; Clark 2007). The bowl types are also of typological forms that are only remotely comparable to types from further west: incurved rims, short carenations, rounded bottoms and the like. These patterns visible in the ceramic evolutions of Fiji/West Polynesia after 1000 BC, are also observable in other aspects of material culture. Burley (2005), after others (Anderson 2003), has recently highlighted a possible economic facet to Eastern Lapita, with a focus on a more foraging economy in the first generations of settlement in this eastern region. Changes in adze forms and shell ornaments can also be observed.

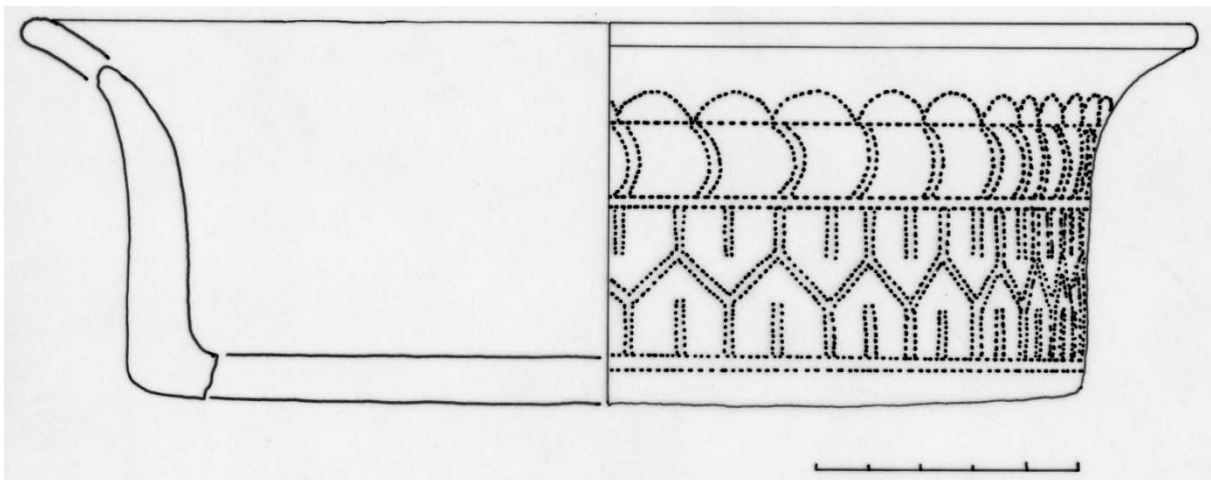


Figure 4. Eastern Lapita bowl form from Fiji.

VI. Divergent patterns in the demise of Lapita

While the exploration of Remote Oceania was taking place between 1200 and 900 BC, things did not remain static in Near Oceania, nor in any region in Remote Oceania, once first settlements had taken place. Once again, what characterizes the whole Melanesian crescent is the rapid diversification of Lapita ceramic traditions. There does not appear to be one unique trajectory (contra Summerhayes 2001), but, on the contrary, multiple localized sets of changes, partly unconnected between sites, even inside each Province. In the Bismarck Archipelago, the northern area including Mussau appears, from published data, to see the progressive demise of dentate-stamped motifs at the expense of incised pots, with the final disappearance of dentate-stamping around 800-700 BC (Kirch 1996). This is what is also proposed for Tanga Island east of New Ireland (Garling 2003), for Buka (Wickler 2001) and for the Roviana Lagoon in the Solomon Islands (Felgate 2003). In southwest New Britain, the last period of dentate-stamping sees the development, in parallel to more simple geometric motifs (Summerhayes 2000), of unique open anthropomorphic motifs (Specht 1991). Although decorative patterns continue to use toothed tools, overall motif composition becomes quite different and distinct from classic Lapita. These open anthropomorphic motifs can be compared with other anthropomorphic motifs found on late Lapita pots by Meyer in Watom. Green and Anson (2000) believe for this last site that dentate-stamping went out of use at the end of the first millennium BC, in alignment with a late Lapita chronology proposed for the Talasea area by Torrence (2007).

For the Reef/Santa Cruz sites, Doherty has recently studied the late Lapita and post-Lapita ceramic chronology, giving a detailed insight into the end of the dentate-stamped sequence. Here there is clearly no development of strange anthropomorphic open motifs like in some of the sites of the Bismarck Archipelago, but rather the slow demise of dentate-stamping over a Lapita period lasting some 400-500 years (2009).

The picture is clearly different for nearby Vanuatu, where the late phase of Lapita appears to see the emergence of new forms of small pots, some unique to the archipelago (Bedford and Galipaud 2010). There seems to be a clinal demise of dentate-stamped pots from south to north, the northern part of the archipelago retaining dentate stamped decoration longer (2007). Nonetheless, after less than about 100-200 years in some cases, dentate-stamping disappears from most sites, with the development of undecorated and then incised pots. Some islands of southern Vanuatu appear to abandon pottery altogether in less than a half millennium (2006).

This is also the case for the Loyalty Islands in eastern New Caledonia, where dentate-stamping was replaced by full stamping after a few generations (Sand et al. 2002), before the advent of incised pots. Ceramic production eventually disappeared altogether around the middle of the first millennium BC in the Loyalty Islands, from that time the eastern New Caledonian archipelago seeing only paddle-impressed pots produced on the Grande Terre (Sand 1998). On the large island of Grande Terre, the Lapita sequence lasted about 250 years (Sand 1997), with a progressive reduction in the size of the pots, the disappearance of complex rim-forms and the addition of new incised, shell-impressed and paddle-impressed motifs, along with the rapid disappearance of the flat-bottom dishes and the pedestals (Sand 2010). Here also, the end of dentate-stamping was progressive, not abrupt, and appears to have varied from site to site over perhaps as long as a century.

The case of Eastern Lapita is again particular. Isolation from the west might have led eastern founding groups to keep a common set of regional traditions and evolve in a more coordinated way (Sand 2005). Although open dentate-stamped motifs of an easily identifiable Eastern tradition were produced in some early sites over a number of generations, in most later-founded sites and smaller islands, the production of a few dentate-stamped vessels probably did not last more than one to two generations at most (Sand 1992). Statistical studies of motifs have also highlighted the dynamism of design multiplication in western Fiji during this period, compared with the conservative replication of a small set of dentate-stamped motifs in eastern Fiji and West Polynesia (Clark and Murray 2007). A

clinal end of dentate stamping from east to west is also apparent from the late dates obtained from level 1 of Sigatoka in western Fiji (Burley 2008), with small simple dentate-stamped pots persisting until 650 BC, nearly two centuries after the production of these sorts of pots ceased in most places of West Polynesia.

Compared with the massive diversification seen in the Melanesian crescent, one of the characteristic innovations of the late part of the Eastern Lapita sequence is the production of a unique type of collar-rimmed, mostly non-carenated pot that replaced Lapita pots (Birks 1973). Significantly, these 'Sigatoka type' pots were produced with the same general typological characteristics from western Fiji as far as Tonga and Wallis in West Polynesia after 800 BC (Sand 2005), emphasizing a regional interaction-sphere still at work in the former Eastern Lapita Province after the end of dentate-stamping. The development through the same region of new shell ornaments defined as "long units" highlights the distinctive path followed in Fiji/West Polynesia (Best 1984), a path paralleled by the conservative nature of language evolution and the slower intra-regional diversification witnessed in the former Eastern Lapita Province.

Analysis and conclusion

This summary paper has tried to highlight a series of major implications drawn from recently-acquired archaeological data that allow us to understand more accurately the real complexity of the Lapita phenomenon. Even if numerous blanks remain in the picture and the Lapita history of a significant number of important islands remains totally unknown, this synopsis shows that there is enough information at hand to push for more complex hypotheses concerning the Lapita diaspora. The trends that can be defined for each geographic region in terms of Lapita settlement chronology and ceramic changes over time highlight the major processes of diversification at play in the Lapita ceramic repertoire, and in other cultural fields, once people definitely settled each island and Province.

What does all this tell us of the lasting links, secondary settlements and final breakdown of relations between Lapita communities during the late- second to early-first millennium BC? Significantly, the connections that can be identified between sites do not lead directly to a mathematical scheme of transformation over distance, variations depending on the type of material under study. For example, the existence of some sort of distance-related effect in terms of access to raw material and connection with ancestral lands in Near Oceania can be emphasized through a simple observation of the amount of Kutao/Bao obsidian in Remote Oceania. The numbers are high in the Reef/Santa Cruz (Sheppard 1993), still significant in the early Makué site just off Santo (Galipaud and Swete Kelly 2007) and in Teouma (Bedford et al. 2009), but amount to just a few flakes in New Caledonia (Sand and Sheppard 2000) and Fiji (Best 1987). On the other hand, New Caledonia's main island appears to have retained "classic Western Lapita" style longer than the intermediate Northern and Central Vanuatu regions, even if the Southern Lapita Province was disconnected from Near Oceania (Sand 2010).

The data presented appear to point to a complex pattern of links that can be summarized by the metaphor of the "strings of pearls", a term proposed by Moore (2001) and used by Green regarding Lapita dispersal (2003). The graphic representation of the Lapita process would probably look like a disorganized necklace without any meaningful structure. It would have a series of starts, different strings that do not all join at the same point but on the contrary get intermixed at different stages along the way, with the pearls not necessarily all connected to each other. To add to the complexity, each major part of the necklace would then have a straight string that would end by itself without reconnecting to the main string, representing the divergent trajectories experienced at the end of the Lapita sequence in each sub-region. At that point, if we add to the model possible return voyages that some of the Lapita families did make 3000 years ago to maybe resettle their former homelands, as can be hypothesized by Talasea obsidian flakes in Borneo (Bellwood and Koon 1989) or New

Caledonian Lapita sherds in Malo off Santo Island as well as Teouma, the “string of pearls” becomes a sort of three-dimensional nightmare. But this is what real human history is all about a series of incredibly complex scenarios and localized rooting of tiny family groups. The unexpected number of different and unique mortuary rituals identified in the early Lapita cemetery of Teouma (Valentin et al. 2010) is just a small reminder of how complex Lapita societies must have been. The picture that archaeologists can try to extract from 3000-year-old potsherds and stone flakes can only be an idealized reconstruction of this former complexity, especially in Island Melanesia, where complexity and diversity are the core of social organization (Thomas 1989). Even though we might never be totally confident about what occurred through the history of the Lapita diaspora, it appears that the data that have been progressively gathered over the decades allow us today to discuss on firmer ground some of the complex processes that were at play during the Austronesian spread across the Western Pacific.

Any further work on the Tentative Listing or World Heritage nomination of Lapita sites must take this extraordinary complexity into account if the outstanding universal value of the Lapita phenomenon are to be captured appropriately. The full spectrum of variation through time and space in the contents and locations of Lapita sites has to be taken into consideration if the values encapsulated in any nominations are to make sense.

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Micronesia

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Introduction

"The Micronesian nations are under-represented in the discussions and in the landscape portfolio" (Smith and Jones 2007).

The World Heritage List currently consists of 911 properties, of which 77% are cultural, 20% natural and 3% mixed. The only site inscribed on the World Heritage list in the Pacific Ocean subregion of Micronesia is the Bikini Atoll nuclear test site, inscribed in 2010, which epitomizes the dawn of the nuclear age. On the Tentative List, Palau has four properties and one transboundary property shared with Yap, and the Marshall Islands has three properties. All of the Palau and Yap properties and two of the Marshall Islands are cultural/mixed properties (Table 1). On the tentative list, early prehistoric sites are already included within the suite of prehistoric sites in the Rock Islands-Southern Lagoon Management Area of Palau (Koror State) and a burial cave in Palau is within the Yapese disk money transboundary property (Arai State).

There are 22 sites in the Pacific cultural landscape portfolio drafted by Smith and Jones (2007) including two from Micronesia (Bikini Atoll nuclear test site/Marshall Islands and fortifications and traditional villages/Palau). The Pacific cultural landscape portfolio was not intended to be exhaustive, but it does privilege the cultural landscapes of Polynesia, which in one form or another comprise 68% of sites on the list at the expense of the cultural landscapes of Melanesia and Micronesia.

The theme of early human expansion and innovation in Micronesia is poorly represented in the World Heritage list as are a range of significant prehistoric sites in the region that could meet one or more of the cultural criteria for Outstanding Universal Value (OUV). The 'early human expansion' theme is useful as it is likely that the oldest sites in Micronesia represent the earliest major sea crossings in the world and mark the first extension of human occupation past the Pleistocene limits of human settlement that had existed for over 30,000 years. The theme of 'innovation' is especially relevant to Micronesia through human adaptation and innovation to hostile environments such as atolls and raised limestone islands, and it could include parts of Micronesia like the Marshall Islands that might not be considered under the 'early human expansion' theme.

This chapter focuses on the oldest sites in Micronesia and those associated with human adaptation to marginal island environments. The chapter also develops specific topics and identifies the attributes that might meet criteria for World Heritage inscription and to substantiate Outstanding Universal Value. The oldest sites are associated with the Neolithic expansion of peoples and cultures from Island Southeast Asia to Western Micronesia. These population movements took place at approximately the same time as the Lapita dispersal spread through the West and Central Pacific, which is also considered to have been influenced by cultural expansion in Island Southeast Asia. The initial colonization of Micronesia, then, is a significant part of a Neolithic migration event that linked Asia to the Pacific 3000 years ago, which is arguably ancestral to many of the more than 250 million people living in the region today. The second theme of 'innovation' is explored in relation to the lifeways and adaptations necessary to live in precarious and marginal atolls and limestone islands. Dates are presented as 'BCE' (Before Common Era) and 'CE' (Common Era) with BCE/CE = BC/AD.

Table 1. Sites in Micronesia on the World Heritage Tentative List
(<http://whc.unesco.org/en/tentativelists>)

Location	Criteria	Summary
Palau		
Imeong Conservation Area 26/08/2004	Mixed	The Imeong conservation area includes sacred cultural sites such as li ra Milad, Ngeruach and Ngerutechei traditional village. Associated oral history depicts the site as where chiefly titles were handed to the people of Imong by the gods. Older sites are earthworks that have been dated to 2200 years ago.
Ouballang ra Ngebedech (Ngebedech Terraces) 26/08/2004	Cultural (ii),(iii), (v)	Prehistoric terrace complexes are sophisticated earthwork systems that were variously used for agriculture, settlement, defense, and ceremonial purposes.
Rock Islands-Southern Lagoon Management Area 06/11/2007	Mixed (iii), (iv), (v)	The Rock Islands include many natural and cultural sites that are intact and managed under Koror State Government and traditional leadership including stone work villages and the oldest archaeological sites found in Palau.
Tet el Bad (Stone Coffin) 26/08/2004	Cultural (i)	Tet el Bad is a rectangular stone coffin or sarcophagus located on top of a cut bank on a stone platform for the chiefs' meeting house in Ollei traditional village in Ngarchelong State. The stone coffin is an example of expert carving of a sarcophagus with both the casket and the lid made of andesite.
Palau-Yap		
Uet el Daob me a Uet el Chutem and Chelechol ra Orrak in Airai State (Palau) and Taraang Island and Baleyrach, Gagil Municipality (Yap) 29/12/2004	Cultural (i), (ii), (iii), (iv)	The property consists of two sites in a Rock Island in Airai State (Palau) where oval/round disk calcite money was quarried by the Yapese before being transported back to Yap. In Yap State there are two sites associated with stone money production and display, Mangyol Stone Money Bank (Baleyrach) and Taraang Island (O'Keefe's Island).
Marshall Islands		
Likiep Village Historic District 24/10/2005	Cultural (ii), (iv)	Likiep Village Historic District consists of approximately 15 architecturally and/or historically significant buildings or remnants of buildings, along with several other structures, built between 1880 and 1937.
Mili Atoll Nature Conservancy (and Nadrikdrik) 24/10/2005	Natural	Mili and Nadrikdrik are paired atolls at the south-eastern perimeter of the Marshall Islands, which are amongst the richest and healthiest reef systems in the world.
Northern Marshall Islands Atolls 24/10/2005	Mixed	The property is a mixed cultural and natural serial site comprising seven largely uninhabited and unmodified low atolls and one low coral island. The atolls were important traditional areas for nearby populated atolls due to the presence of birds, turtles and their eggs.

'Micronesia' as a culture area

When European explorers of the Enlightenment encountered population differences among Pacific Islanders, a major and long-lasting division was drawn between Polynesians and Melanesians. While Polynesians inhabiting the east Pacific had a physical appearance, languages and cultural institutions suggestive of a relatively recent, common ancestry from Island Southeast Asia, Melanesians exhibited diverse socio-biological traits indicative of a much longer occupancy, in what the geographer, Charles de Brosses, in 1756 termed the equatorial 'torrid zone', that had been settled in the distant past by people of African origin. The different population origins (Asiatic and Negroid) and tenure length of the two groups in the Pacific were thought to starkly divide Melanesians from Polynesians (Tcherkézoff 2003), and a simple binary model of human diversity was further developed in 19th century socio-evolutionary thought as a polar opposition between light-brown skinned, culturally advanced, Polynesians and the dark-skinned Melanesians, who were condemned by authorities such as Dumont d'Urville (2003) as living in a primitive state of near barbarism.

Within this framework the position of Micronesians was uncertain, but many early observers thought western Micronesians had a physical appearance that suggested derivation from Island Southeast Asia, while the populations of central and eastern Micronesia were more diverse, but grouped closer to Polynesians than to Melanesians. Horatio Hale (1846) found the physical characteristics of Micronesians did not vary greatly from their neighbours in Polynesia (also Haddon 1909:22), while Dumont d'Urville (2003) thought Micronesia was populated by a series of migrations out of the Philippines after Polynesia had been colonized. This would have migrants from Island Southeast Asia arriving in western Micronesia with subsequent dispersals to central and eastern Micronesia, possibly through Kiribati and Tuvalu, to Polynesia. Howells (1973) followed Buck (1958) in suggesting that early Polynesians had likely come from Micronesia given the greater physical similarity of Micronesians and Polynesians to one another than either had to Melanesian populations.

Confusion about the status of Micronesians could not be satisfactorily resolved because the bio-cultural definition of 'Micronesia' was essentially a residual and arbitrary category to house the islands and people who could not be classified as either 'Polynesian' or 'Melanesian' (Rainbird 2003). While the geography of an area known as Micronesia can be defined straightforwardly, the history of its peoples and cultures is complicated by the small size, and precarious and restricted nature of its island environments, coupled with the probability of several human arrivals on many of its landmasses.

Physical environment

The islands of Micronesia are distributed from the equator north to 20° latitude and 130-170° longitude; an area of 7.5 million square kilometres of Pacific Ocean (Figure 1). There are 2100-2400 islands, depending on how the islands are counted which have a total land area of 2700-3626 square kilometres and a mean island area of only 1.3-1.5 square kilometres. The geographic suitability of the 'Micro' prefix (from the Greek mikrós = small) is further highlighted by comparison with the landmasses of Polynesia (mean island area = 1321 square kilometres, but New Zealand accounts for more than 90% of the total land area) and Melanesia (mean island area = 384 square kilometres).

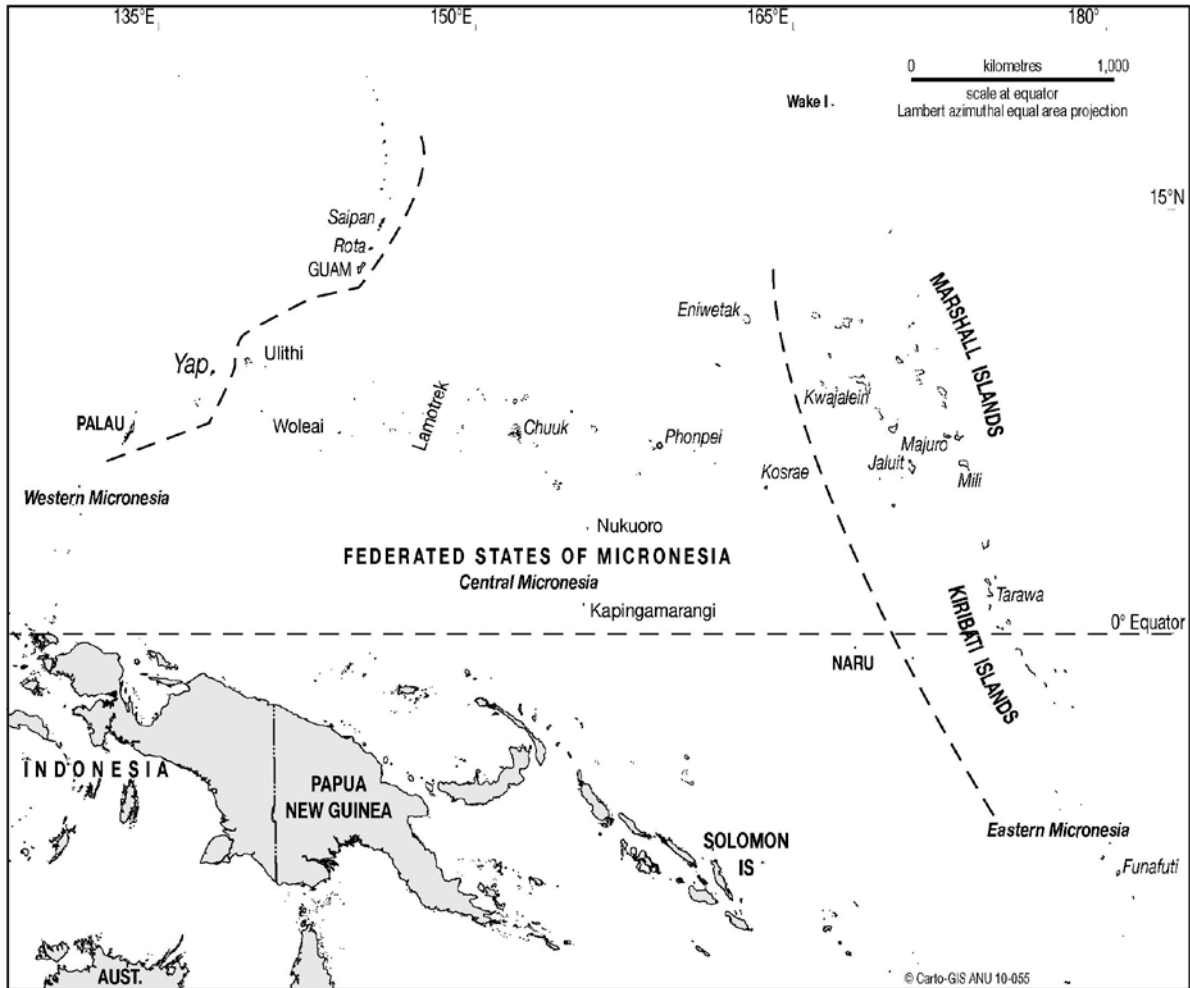


Figure 1. Map of Micronesia divided into Western, Central and Eastern zones.

The vast area of Micronesia can be divided into three geographic zones based on island type (Figure 1). Western Micronesia comprises the three largest island groups of Palau, Yap and the Mariana Islands, which are island arcs containing volcanic and sedimentary rocks as well as landmasses of volcanic-limestone, raised limestone and coral atoll type. Central Micronesia is characterised by several oceanic volcanic islands (Chuuk, Pohnpei, Kosrae) in addition to numerous low atolls, while eastern Micronesia, with the exception of two raised limestone islands (Nauru and Banaba/Ocean Island), is wholly an atoll world composed of the Marshall and Kiribati Groups. Tuvalu, the easternmost atoll group, is sometimes placed in Micronesia, but it was grouped with Polynesia by Dumont d'Urville (2003) and its occupants speak a Polynesian language. Polynesian influence is also present on Kapingamarangi and Nukuoro, which may have been settled from Tuvalu, demonstrating the arbitrary nature of a 'Micronesia' culture area.

Due to the large number of raised coral atolls in Micronesia changes in sea-level in the past have had a major impact on atoll environments, as will the advent of predicted sea-level rise in the future. During the mid-Holocene the sea was 1.2-1.8 metres higher than it is today, and many atolls would have been submerged and unavailable for human settlement until well after 3000 years ago when the sea stabilized to modern levels (Dickinson 2004). The timing of island emergence is a key issue, therefore, constraining the human colonization of atolls, as was the need to develop a raft of cultural and economic adaptations to survive on small landmasses which have no standing bodies of freshwater, few terrestrial resources and sediments that are hostile to traditional horticulture (Weisler 2001a,b).

In summary, Micronesia is characterised by island groups with extremely small land areas that are increasingly depauperate in natural resources from west to east. The majority of islands are geologically simple and hold significantly fewer taxa of marine and terrestrial flora and fauna than do the older and larger continental and volcanic islands of Melanesia and Polynesia. The modern vertebrate fauna is characterised by a lack of terrestrial mammals, as in other Pacific Islands, although there are several species of bat. There was, however, a bird and reptile fauna (although no megafauna) on many of the high islands that was depleted significantly by prehistoric activity, as with other Pacific Islands (Steadman 2006), and marine resources were, and are, an integral part of Micronesian subsistence, especially on atolls (Thomas 2007).

Colonization sequence

The timing and pattern of human arrival in western Micronesia is an important issue in world prehistory as an early ocean expansion would mark not only the first arrival of people in the remote Pacific, but also the earliest development of a maritime technology and nautical skills to make open-ocean crossings of up to 2000 km (to reach the Marianas from the Philippines). An early model proposed that settlement was sequential with the islands of Palau and Yap acting as stepping stones for the colonization of the Marianas Islands (Osborne 1958). Archaeological data falsified the incremental movement model as the Marianas were occupied at 1500 BCE, apparently well before Palau and Yap. Linguistics has shown a primary division between the languages of Palau and the Marianas that belong to Western Malayo-Polynesian – a high-order subgroup of Austronesian which originated in Philippines-Indonesia – while the languages of central and eastern Micronesia belong to the Nuclear Micronesian subgroup of Oceanic associated with the languages spoken by the descendants of the Lapita cultural complex. The linguistic model implied there was no connection between the earliest Neolithic maritime expansions to the Pacific, with direct movements from Island Southeast Asia to parts of western Micronesia around 1500 BCE, separate from Lapita dispersal (Bismarcks to Samoa) around 1300-1000 BCE. The waters were further muddied by palaeoenvironmental evidence suggesting that human arrival in Palau and the Marianas took place at 2500-2000 BCE and was archaeologically cryptic (Athens and Ward 2001), and a claim that the first people to colonize Palau had succumbed to insular dwarfing (Fitzpatrick et al. 2008).

Advances in our understanding of Micronesia's early prehistory result from archaeological investigations of early sites, palaeosea-level reconstruction, and recognition that Holocene change to climate regimes as a result of El Niño-Southern Oscillation (ENSO) activity and variation in the Inter-Tropical Convergence Zone (ITCZ) has resulted in enhanced precipitation variability, vegetation disturbance and increased charcoal production from natural fires rather than prehistoric people (Gagen et al. 2004; Sachs et al. 2009). Taken together, the available information suggests a series of distinct early movements east from Island South East Asia to several parts of western Micronesia, followed by later movements from western Micronesia as well as from the Solomons and Vanuatu to central and eastern Micronesia, with later inputs from the Fiji-West Polynesian region (Intoh 1997). The settlement of Micronesia then is still poorly understood, but is divided here into three phases of geographic expansion based on current archaeological evidence (Figure 2).

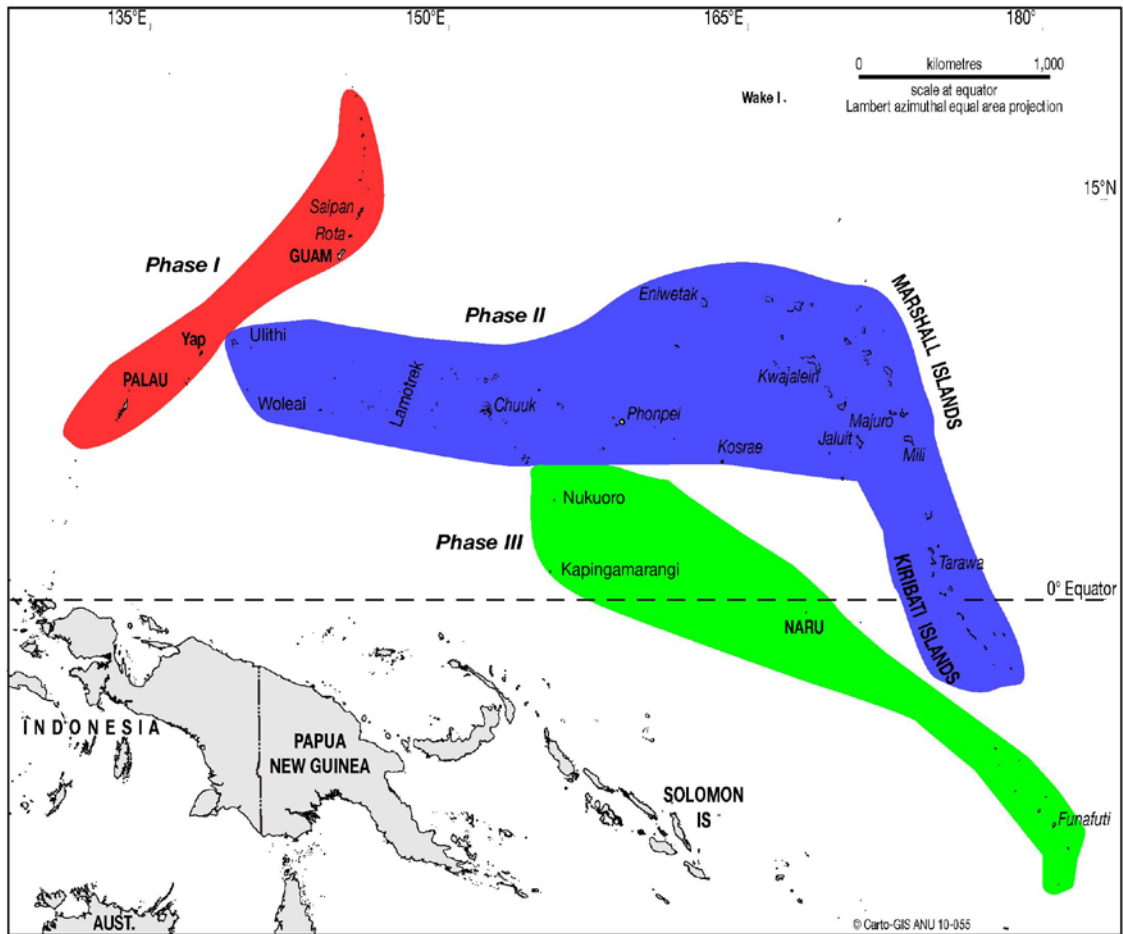


Figure 2. The colonization of Micronesia divided in three phases (Phase 1 = 1300-1000 BCE, Phase 2 = 0 CE, Phase 3 = 500-1000 CE).

Phase I – Western Micronesia

The oldest prehistoric sites in the Mariana Islands date to around 1400 BCE, while those in Palau extend to about 1100 BCE. Yap, like Palau, is subsiding and as a result many of the coastal locations where the earliest deposits might be found have been eroded by wave action, removed below sea level or hidden beneath mangrove mudflats. Palaeoenvironmental cores on all three island groups show extensive alteration of the environment by 1000 BCE consistent with dated archaeological sites, but differences in the material culture, particularly the pottery, of the early arrivals suggests colonists had different origins. The oldest pottery from the Marianas is a red-slipped ware in which small carinated jars with everted rims are prominent, and some vessels were decorated with a toothed-tool and circle markings in patterns reminiscent of Lapita-style decoration. In Palau, the early ceramics are medium-sized red-slipped jars (Clark 2005) and while older assemblages dating to 1400 BCE may exist there is currently no relationship between the two ceramics (the earliest sites and pottery of Yap are still poorly known).

The cultural variability of early western Micronesia contrasts with the relative homogeneity of the Lapita cultural complex. Both maritime expansions derive from Island Southeast Asia, date to approximately the same interval (1400-1000 BCE), and were made by people who made red-slipped ceramics. The similarities invite comparison between the early cultures of western Micronesia on the one hand and with Lapita culture on the other, in addition to conjecture about the events in Island Southeast Asia that propelled rapidly dispersing groups into the Pacific Ocean. Although a potential connection between the Mariana and Lapita cultures has been made (Bellwood 2005), there are several important differences in their prehistoric assemblages. Western Micronesia lacks several commensals found in west Lapita sites (dog, pig, Pacific rat), and the oldest ceramics of the Mariana

Islands carry significantly less toothed-stamp decoration on a simple set of vessel forms compared with the diverse ceramic vessels found in Lapita assemblages. As a result, material culture and domesticate animal assemblages do not support a direct dispersal sequence starting with a movement from Island Southeast Asia to the Mariana Islands, followed by a migration from the Mariana Islands to the Bismarck Archipelago.

The archaeological record of dispersal in Island Southeast Asia suggests the Neolithic arrived in the northern Philippines at 2000 BCE from Taiwan with people who took with them red-slipped ceramics, unibvelled stone adzes, the domestic pig and a subsistence focus on the cultigens yam and taro rather than rice (Piper et al. 2009). Reviews of radiocarbon dates (Spriggs 2007; Hung 2008) indicate the Neolithic extended to south Indonesia (Maluku) by 1500 BCE. Once Neolithic range extension had encompassed the Philippines-southern Indonesia at 1500-1000 BCE, there appear to have been a number of long-distance movements from different parts of the range. The Mariana Islands were probably colonized by a dispersal from the northern Philippines (Hung 2008), while Palau was likely occupied by a separate movement from the southern Philippines-northern Indonesia region (Callaghan and Fitzpatrick 2008). Recent mtDNA research found that 89% of Chamorros – the indigenous people of the Mariana Islands – belong to mtDNA haplogroup E (E1a2 and E2a), which is reasonably common in populations in the Philippines and Indonesia, and most similar to eastern Indonesian people of Sulawesi and Ambon (see Vilar et al. 2008; Carson and Kurashina n.d.). The language of Yap is thought to be a highly modified Oceanic language which suggests a possible derivation from the Bismarck Archipelago (Ross 1996).

The immediate source of Lapita culture is uncertain, but south Indonesia and the north New Guinea coast are potential locations. The overall picture is of territorial infilling in Island Southeast Asia, perhaps as a result of demic expansion along coastlines, followed by significant range extension in a series of discreet dispersals to remote Oceania. The pattern is analogous to some biological invasions where a species expands its range by making both short-distance and long-distance dispersals (Clark et al. 2010). Lapita expansion though was encouraged by the discovery of large uninhabited and geologically diverse archipelagos east of the main Solomon Islands, while further dispersal from western Micronesia after 1400-1000 BCE was curtailed by an absence of any large islands groups further east, while archipelagos to the south of Micronesia were already occupied by Oceanic-speaking Austronesians.

Phase II – Central and Eastern Micronesia

By the start of the CE sea-levels had fallen and stabilised to modern positions, and newly exposed atolls were colonized by sea birds, turtles and lagoonal species of fish and shellfish. Whether an abundance of wild resources on atolls encouraged intermittent visits and eventually permanent human occupation is uncertain, but many atolls in central and eastern Micronesia appear to have been colonized very soon after emergence. The volcanic landmasses of Chuuk, Pohnpei and Kosrae were settled around the beginning of the CE along with atolls like Fais, Ngulu and those of the Marshall Islands. The Nuclear Micronesian status of the languages of central and eastern Micronesia suggests they were settled from somewhere in the Bismarcks/Solomons-Vanuatu region (Kirch 2000). The high volcanic islands of central Micronesia have undergone subsidence, and their earliest ceramics are known from relatively small collections recovered from submerged contexts. Pottery on Chuuk spans the first 500 years of the CE and consists of semi-globular-bodied vessels with everted rims containing a calcareous sand temper (CST). Decoration is limited to linear notching on the lip surface and presence of a slip and burnishing. Early pottery on Pohnpei was made with CST-temper with some containing grog temper (crushed pre-fired clay/pottery) and CST temper was also present on Kosrae.

The vessel forms are difficult to reconstruct and compare, but Athens (1990:29) argues for the separate colonization of each of the high islands in central Micronesia from the southeast Solomons-

Vanuatu. An intriguing aspect of the Pohnpei pottery is the use of grog-temper in early CST wares and increase in the use of grog in later Non-CST ceramics. Temper type need not provide evidence of origin since habitually used tempers may not be available in new environments. However, the addition of grog-temper is a rare attribute in Oceania, and it is known only from Palau, Yap, Pohnpei and American Samoa (Fitzpatrick et al. 2003). On Pohnpei, grog was combined with volcanic sand and calcareous temper. This was also the case in Yap and Palau, although in Palau conversion to grog/volcanic-grog tempers was probably underway by 500 BCE. Pohnpei rim and vessel forms are unlike those known from Yap and the Marianas, but they have some similarity with Palauan pottery dating to around the start of the CE (Clark 2005).

Whether central Micronesia was settled from western Micronesia, by independent movements from the Solomons-Vanuatu area, or by migrations from both areas is still an open question. What is certain is that human adaptation to precarious atoll environments was rapid, with collection of freshwater on the larger islets made by tapping the freshwater aquifer (Ghyben-Herzberg lens) below sandy sediments, and the introduction or encouragement of salt-tolerant trees and crops. Chief among these were the coconut (*Cocos nucifera*), pandanus (*Panadanus tectoris*), breadfruit (*Artocarpus* spp.) and swamp taro (*Cyrtosperma chamissonis*). These plants furnished food and materials for building canoes, houses and items of portable material culture made with shell tools. Large and small adzes were made from *Terebra*, *Tridacna*, *Mitre* and *Cassis*, fish hooks and trolling lures were made from pearl shell, while awls and weapons utilised shark teeth and stingray barbs. Even coral was employed as pestles and pounders, for oven stones, paving and to make lime.

Phase III – Outliers and interaction

Around 1000 CE there is increasing evidence for prehistoric contact and interaction between the ethnological zones of Polynesia, Micronesia and Melanesia. Ceramics on the eastern border of Micronesia on Rotuma, Tuvalu and Tokelau have a Fijian origin, probably representing a much broader type of interaction as exotic ceramics co-occur with tools made in Samoan basalt. That populations from Melanesia and Polynesia affected Micronesia is demonstrated by the introduction of kava/sakau (*Piper methysticum*) to Kosrae and Pohnpei (Crowley 1994), and the presence of obsidian and a basalt adze of West Polynesian form in the Nan Madol complex on Pohnpei (Ayres and Mauricio 1987). In the Mariana Islands the probable introduction of rice in late prehistory attests to contact with Island Southeast Asia, while the arrival of the Pacific rat (*Rattus exulans*) suggests interaction with other parts of Oceania.

The inhabitants of two atolls, Nukuoro and Kapingamarangi, speak Polynesian languages that have affinities with the language of Tuvalu, which was settled around 1000 CE. This suggests that atolls settled by different groups acted as nodes for further expansion, with population mixing and interaction following reticulate pathways, mediated by the length of ocean crossings and the size of incoming groups relative to that of the inhabitants. Population flows from densely-settled high islands to atolls must also have taken place and contributed additional cultural and biological variability to atoll populations.

Early human expansion

The oldest sites in Micronesia are located exclusively on the major landmasses of Palau, Yap and the Mariana Islands. Of these island groups, both Palau and Yap are subsiding, which makes locating early sites difficult because millennia-old cultural deposits are at, or below, current sea level. There are no prehistoric sites on Yap older than 500-0 BCE and only two sites in Palau that extend to 1000 BCE, although it is likely that Yap was also settled around the same time as Palau and the Marianas (Dodson and Intoh 1999). As a result, the archaeological record is heavily biased toward sites in the islands of Guam-Commonwealth of the Northern Marianas (CNMI) that are not subsiding. Seven early sites from Western Micronesia are summarised below with Palau (2), Yap (1), Guam (1) and CNMI

(3). Sites with early ceramics are relatively common in Guam-CNMI and only a subset of the total number of sites which have been investigated are included. Additional early sites are listed in Table 2 followed by the seven site descriptions.

The oldest ceramic sites in Western Micronesia have several characteristics in common.

- 1 They are coastal or near coastal and were situated on beaches often in sheltered bays and coves protected from seasonal trade winds.
- 2 Site locations were in proximity to a variety of marine and terrestrial resources such as mangrove patches, estuary/lagoon, fringing reef, barrier reef and beach flat/limestone forest.
- 3 Fresh water and stone resources (metamorphic and volcanic) were important with several early sites located at points where the terrain give easy access to the resources of island interiors (gardening areas, plant, animal and stone material).
- 4 The cultural remains from early sites consist largely of discarded domestic items, and although several sites have remains such as post holes and hearths/fire places it has not been possible to reconstruct the shape or size of the oldest dwellings nor the prehistoric settlement pattern.
- 5 The oldest sites are variably exposed to modern activity with several ancient cultural deposits and layers located at surface-shallow depth while others have been deeply buried by beach sands and alluvial/colluvial deposits.
- 6 No early site in Western Micronesia has returned evidence for inter-archipelago voyaging within Micronesia or exotic materials with which to pinpoint the origin of the colonizing populations of Palau, Yap and the Marianas. Comparison of Micronesian pottery assemblages with those of Island Southeast Asia and Lapita has been attempted, but as dentate stamping and lime infilling are widespread decorative traits in the Neolithic of Mainland and Island Southeast Asia it has not been possible to determine archaeologically the origin of the first Micronesians with certainty.
- 7 Only a few of the oldest prehistoric sites in Western Micronesia are adequately dated by radiocarbon, and ambiguity in the colonization chronology has made it difficult to understand in detail the process of Neolithic dispersal in the Asia-Pacific region.

The coastal and near beach location in addition to the low visibility of many early prehistoric sites makes them vulnerable to natural hazards such as storm/tsunami damage and development which is frequent along the beach flats and bays where many sites are located. In Western Micronesia the states/territories have a comprehensive legal framework for the protection, conservation and management of cultural heritage sites (see below). The capacity of government cultural heritage organisations (generally through the State Historic Preservation Offices) to meet cultural heritage legislation varies, but there is considerable adherence in the case of federal funded projects which fall under Section 106 of the U.S. National Historic Preservation Act 1966, as well as the addition of significant prehistoric sites to the National Register of Historic Places.

Table 2. The oldest prehistoric sites in Western Micronesia: A preliminary list based on ceramic assemblages and radiocarbon dates.

Country	Name	Site	Reference
¹ Palau	Ulong	Inland coastal flat	Clark 2005
¹ Palau	Chelechol ra Orrak	Burial cave	Fitzpatrick 2003
Palau	Chomedokl	Burial cave	Berger et al. 2008
¹ Yap	Rungruw	Inland coastal flat	Intoh and Leach 1985
Yap	Pemrang	Inland costal flat	Intoh 1988
¹ Guam	Ritidian	Coastal flat	Carson 2009, In press
¹ Guam	Tarague	Coastal flat	Kurashina et al. 1981; Liston 1996
Guam	Hagatna	Coastal flat	Cordy and Allen 1986
Guam	Nomna	Coastal flat	Reinman 1977
Guam-Tuamon	Matapang	Coastal flat	Bath 1986
¹ Guam-Tuamon	Naton	Coastal flat	De Fant 2008
Guam-Tuamon	Ypao	Coastal flat	Olmo and Goodman 1994
Rota	Mochong	Coastal flat	Takayama and Intoh 1976
Tinian	Taga	Coastal flat	Pellett and Spoehr 1961
¹ Tinian	Unai Chulu	Coastal flat	Haun et al. 1999
Saipan	Laulau Rockshelter	Rockshelter	Spoehr 1957
¹ Saipan	Unai Bapot	Coastal flat	Clark et al. 2010
Saipan	Chalan Piao	Coastal flat	Moore et al. 1992
¹ Saipan	Achugao	Coastal flat	Butler 1994
Saipan	San Roque	Coastal flat	Butler 1994

1. Site described further below.

Early archaeological sites in Micronesia

The oldest sites of Micronesia are located exclusively in the west on the largest and geologically oldest island groups. Early cultural remains on Palau, Yap and the Mariana Islands contain ceramics, stone and shell artifacts and ornaments along with food refuse remains that suggest derivation from a number of distinct Neolithic groups who migrated from different parts of Island Southeast Asia. The precise source of Micronesia's first migrants is unknown, but the timing of human movement to Micronesia at around 1300 BCE is similar to that of Lapita arrival in the Bismarck Archipelago. The emerging picture is one of considerable human mobility in the Asia-Pacific area during the Neolithic, which in linear distance spanned 8000km from the Philippines to Samoa over about 700-500 years.

How a distinct series of movements to Micronesia relates to the human history of Island Southeast Asia is not known, yet the open ocean distance involved in reaching the Mariana Islands from insular Asia suggests that maritime technology and seafaring skills were widespread among early groups who were engaging in an unprecedented burst of oceanic colonization. This significant event in world prehistory is difficult to identify in the complex cultural sequences of Island Southeast Asia, but can be understood in part from the archaeological records of Western Micronesia, which were first settled by Neolithic migrants and subsequently had relatively small inputs from other cultures.

Republic of Palau

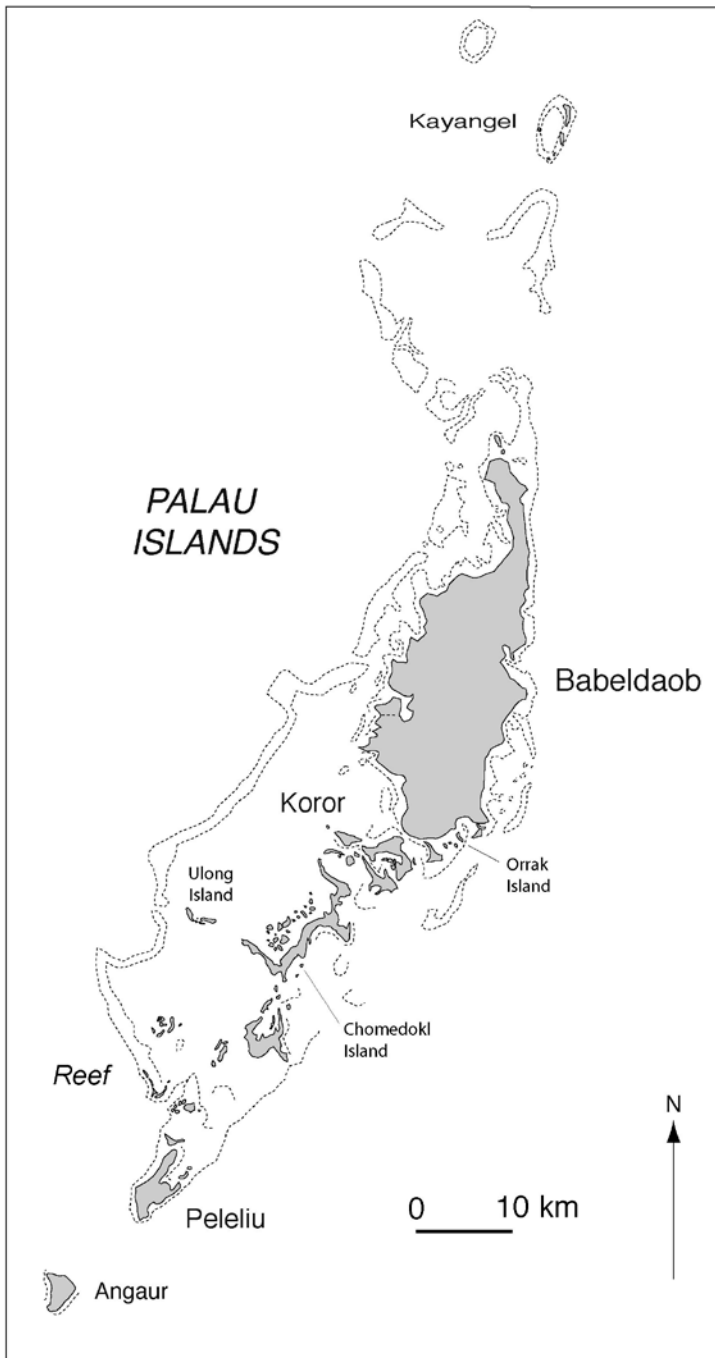


Figure 3. Map of the Palau islands excluding the Southwest islands.

Ulong Island

The Ulong Group consists of three major raised coralline reef islands that were once part of a single limestone landmass, but which are now separated by shallow tidal channels formed by wave erosion (Figure 2). The largest island of the group is Ulong in the northwest. It is a high, rugged landmass composed of layered limestone oriented NW-SE. On its west side Ulong has one of the largest sand plains in the Rock Islands, but is otherwise bordered by an erosion notch except where small coves and beaches are present. The beach flat is bordered by a steep cliff face to the east which rises 30-60m and splits into two arms that form a large sheltered cove in the southeast. The karst terrain contains numerous sink holes and two marine lakes. Like other Rock Islands, Ulong is heavily

vegetated with coconuts and several introduced species of vine on beach areas and native trees more frequent on rugged limestone substrates.

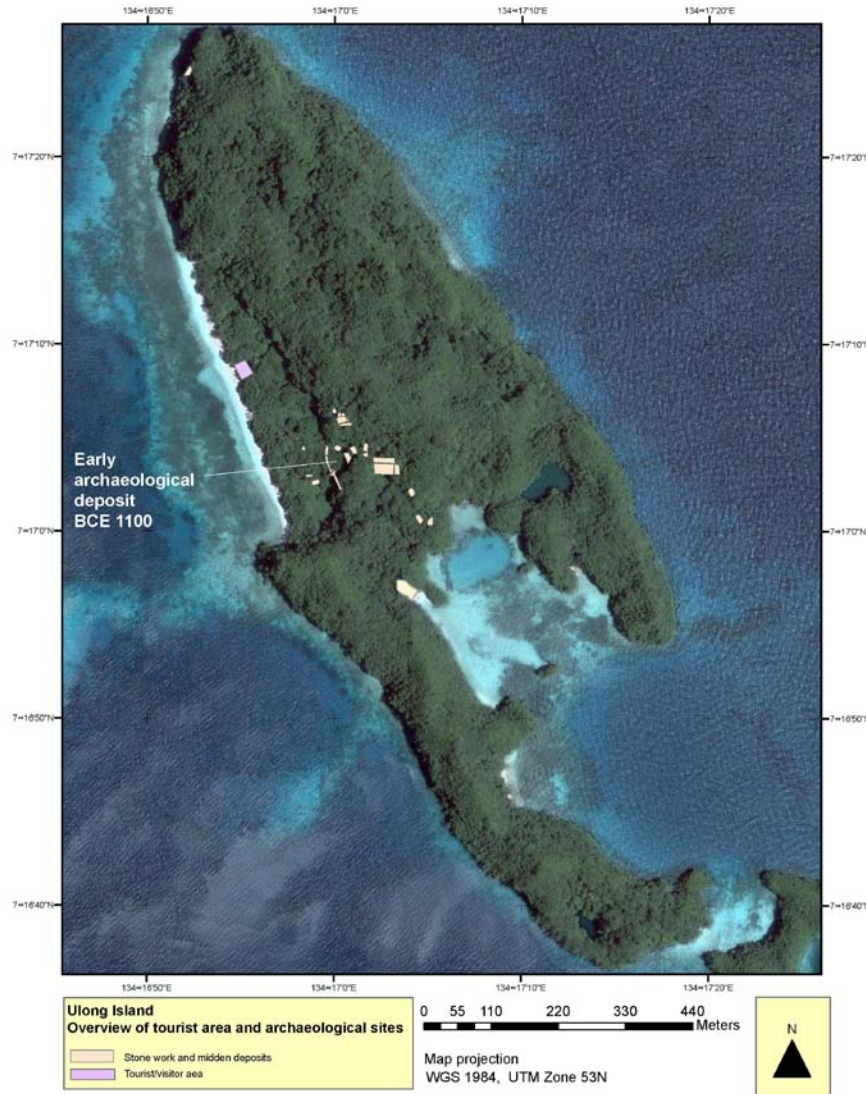


Figure 4. Map of Ulong Island showing location of stone work village features and the early cultural deposit.

Ulong Island has the most significant set of cultural remains in the Rock Islands with four significant sites that span Palau's history from initial human arrival through to early contact with Europeans in the 18th century, in addition to a spectacular rock art gallery. The oldest cultural site in the Palau archipelago is located in the southwest of the island where subsurface deposits have been dated to the period 1100 BCE to 500 CE (Clark 2005). Deposits of a similar age have not been located on any of the volcanic landmasses due to island subsidence, the burial of coastal sites beneath eroding upland sediments and the presence of highly acidic soils that chemically degrade prehistoric remains. Excavations at the site were made by Osborne (1979), and in 2002-2003 an ANU team located an early cultural assemblage dating to 1100 BCE (Clark et al. 2006). The stratigraphy at the Ulong site extends to 2.5m depth and it holds an important long-term record of Palauan material culture and life ways, particularly human use of the marine ecosystem.

The earliest cultural assemblage was deposited on a small intertidal beach in a sheltered cove that was one of the few canoe landing sites prior to progradation of the sand plain (Figure 5). Inshore resources were heavily utilised particularly large clams (Tridachnids) and parrotfish (Scarids). Pottery consisted of medium-sized globular jars with everted rims tempered with volcanic sands indicating the

manufacture and transfer of pots through the Palau islands. Early ceramics were decorated with a red slip and occasional tool marking, but are unlike pottery of comparable age in the Marianas Islands. The early cultural deposit at Ulong lies within a prehistoric stone work village dating to about 1000-1500 CE. Both sites are included in the pending mixed nomination of the Rock Islands/Southern Lagoon Area to the World Heritage List.

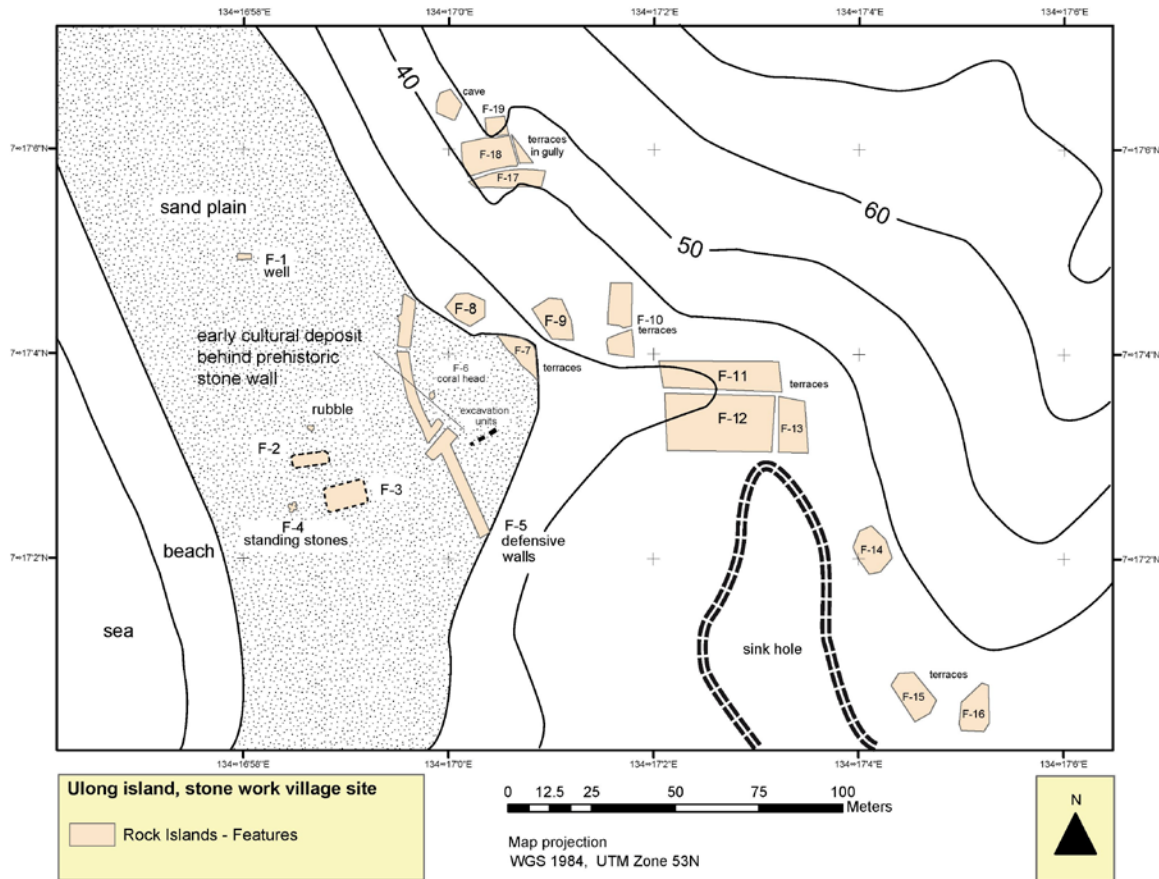


Figure 5. Excavated area on Ulong Island with cultural remains dating to 1100-1000 BCE.

Key reference

Clark, G. 2005. A 3000-year culture sequence from Palau, western Micronesia. *Asian Perspectives* 44:349-380.

Chelechol ra Orrak

The site of Chelechol ra Orrak ('beach of Orrak') is located along the western edge of Orrak Island (Figure 6). The island is situated among a small cluster of Rock Islands one km east of the southeastern tip of Babeldaob. The island is roughly 1.1km long and 0.5km at its widest point and is connected to Babeldaob by a prehistoric causeway constructed of coral rubble now covered in mangrove vegetation. Except for a few small beaches scattered along the perimeter, the island edge is extremely steep. In the interior of the island there is a small valley with two marine lakes. The Orrak site can be accessed easily by boat at high tide. The intertidal beach flat is relatively narrow and extends nearly the whole length of the island's west side. At high tide it is completely covered and at low tide, approximately 5-7m of intertidal flat is exposed. The site is obscured from the sea and dense vegetation including palms and mangrove forest fringe the edge of the island. The site was originally identified as a Yapese stone money quarry, and consists of several caves, rock shelters, and small overhangs that stretch for about 200m just behind the shoreline. The largest rock shelter has an opening about 12m long, 6m deep, and 10m high with actively growing speleothems on the ceilings

and walls. The actual interior is larger, extending roughly 20m from end to end. There are two small caves at the north and south ends of the site and evidence of still growing flowstone formations near the back wall that have covered or obscured deposits and other chambers.

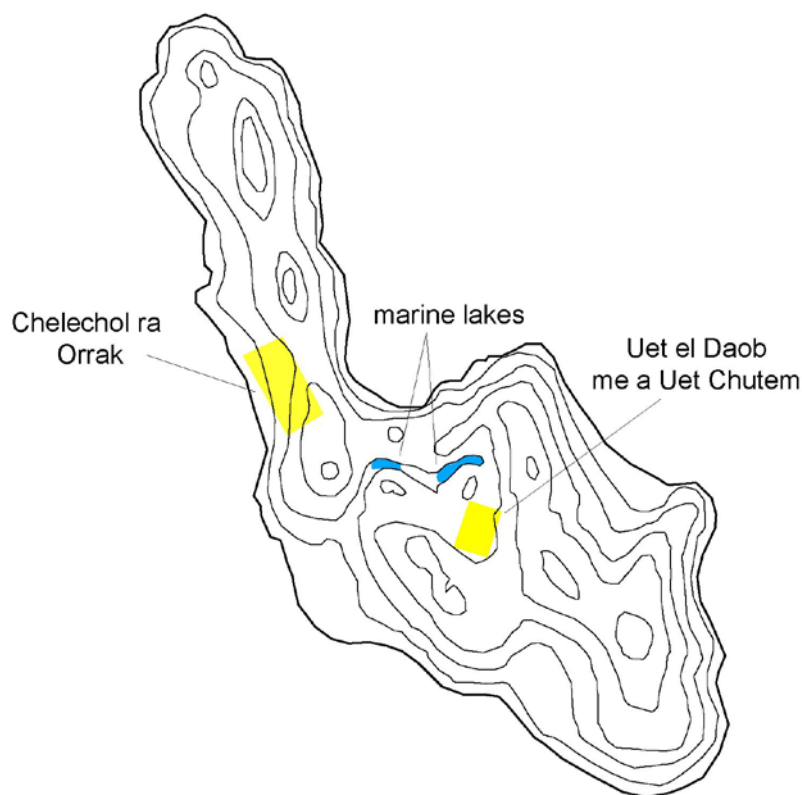


Figure 6. Map of Orrak Island showing location of cave with early human remains (Chelechol ra Orrak) and Yapese stone money quarry (Uet el Daob me a Uet Chutem).

Archaeological investigations conducted in 2000, 2002, and 2007 indicate that the site was initially used as a Palauan burial site dating back to 1000 BCE (Fitzpatrick 2003; Fitzpatrick and Nelson 2008). After about 200 CE, the site appears to have been used as a temporary living site, perhaps for fishing. The presence of stone constructions and limestone debitage indicate intensive quarrying activity by Yapese voyagers during the last 300 years. Around 26 individuals were found at the site including the remains of males and females, of adult, subadult, and juvenile development. Radiocarbon dating of human bone indicates the assemblage dates from 1000 BCE to 200 CE consistent with a mortuary tradition of cave burial extending over 1000 years. The fragmentary human bone assemblage is one of the oldest in the Pacific, and is significant as the remains have the potential to throw light on the nature of early human migration in Island Southeast Asia. The site is included in the transboundary Palau-Yap nomination of Yapese stone disk money sites to the World Heritage Tentative List (Uet el Daob ma Uet el Beluu and Chelechol ra Orrak in Airai State 29/12/2004).

Key reference

Fitzpatrick, S.M. 2003. Early human burials in the western Pacific: Evidence for a ca. 3000 year old occupation on Palau. *Antiquity* 77(298):719-731.

Yap State, Federated States of Micronesia

Rungruw

The oldest ceramic bearing sites so far found on Yap is at Rungruw in the southeast tip of Magachgil. The environment is a low-lying sandy flat around 100m and 165m from the shoreline. The earliest pottery is tempered with calcareous sand (CST) with coarse CST and fine CST variants. Vessel forms

are incurving and direct bowls with several tapering lips from outcurving vessels. Of note is a carinated vessel form which resembles early pottery vessels in the Marianas (cf. Intoh 1992:Figure 2 and Figure 5). Artifacts in shell included shell rings made in *Trochus* and *Tridacna*, fish hook parts in *Trochus* and sea urchin files. Radiocarbon dates extend back to 2500-2000 years, but the small size of the excavation means that very little is yet known about the oldest deposits of Yap (Intoh and Leach 1985; Intoh 1988; Intoh 1997), and how the settlement of Yap relates to migration events in Western Micronesia and Island Southeast Asia.

Key reference

Intoh, M. and Leach, F. 1985. *Archaeological investigations in the Yap Islands, Micronesia. From first Millennium B.C. to the present day*. BAR International Series S-277, Oxford.

Guam Territory and Commonwealth of the Northern Mariana Islands

Ritidian

Ritidian is the northern point of Guam and is situated in the limestone terrain that characterises the north end of the island while the southern end is volcanic. The Ritidian Unit is a reserve managed since 1993 by the Guam National Wildlife Refuge and the area was formerly a US Naval communications station. The limestone landscape is a series of steep upraised karst plateaus of Pliocene or Pleistocene age. Seasonal rainfall variability results in periodic water shortages, especially in the limestone formations of northern Guam that lack permanent streams and large standing bodies of fresh water. Access to fresh water was essential in prehistory and caves at the base of the limestone cliff were likely to have been used for water collection along with springs at the base of the cliff that drain plateau rain fall. Calcareous sand deposits have built up along the seaward edge of the raised limestone mass forming a substantial sand plain on the northwest side of the point. The rate of beach sand accumulation at the exposed northern tip exceeds that of other areas and a high-energy beach has built up from gradual events and episodic storm surges. The modern vegetation includes a number of historic introductions, invasive species, and secondary-growth taxa. Coconut and breadfruit trees are common in parts of the sand plain, which was used as a copra plantation in the 20th century.

Archaeological remains described from the general area included several small and damaged late prehistoric *Latte* sets (house foundations consisting of limestone pillars and cap stones), surface artifacts and the site of a Spanish church dating to the late 17th century. The oldest deposits lie some 150m landward of the beach berm in a discontinuous band 20-30m thick against the limestone cliff slope. Buried cultural material was found in two layers separated by more than 1m of storm surge deposit, but both contained early 'red ware' pottery. The two deposits are described as representing 'short-term camps' which may have been a major site type in Micronesia during the early occupation phase. Radiocarbon dates on charcoal and marine shell suggest an age of 1300-1000 BCE. The site is currently being investigated by archaeologists from Guam and Hawaii.

Key reference

Carson, M.T. 2009. Archaeological investigations in support of new fence line at Ritidian Unit of Guam National Wildlife Refuge, Part 1 of 2. Report prepared for U.S. Fish and Wildlife Service. Micronesian Area Research Center, University of Guam, Mangilao.

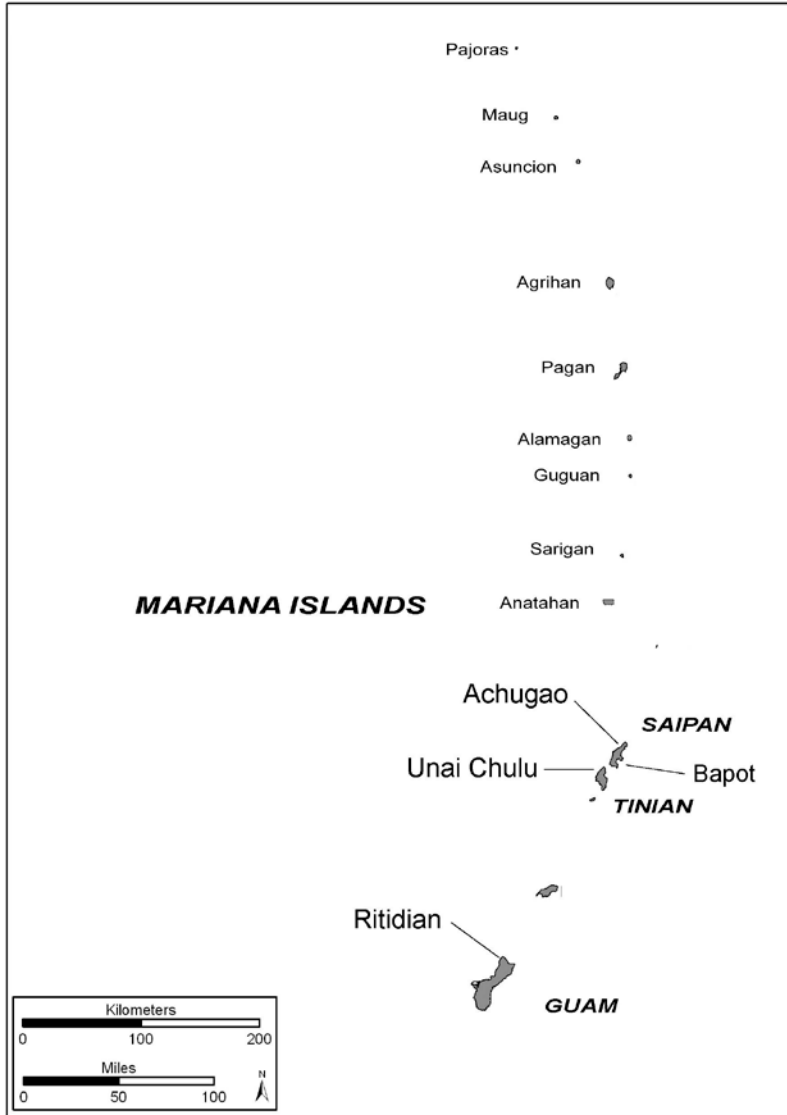


Figure 7. The Mariana Islands (Guam and Commonwealth of the Northern Mariana Islands) and location of Ritidian, Tarague, Naton (Guam), Unai Chulu (Tinian), Achugao and Bapot (Saipan).

Tarague

The Tarague embayment lies midway along the northern coast of Guam in an area used by United States Air Force personnel for recreation, weapons testing, ordnance disposal and water supply. The terrain is generally flat karst bordered by steep uplifted cliffs of coralline limestone. The karst plateau is tilted toward the southeast and reaches a height of 183 m above sea-level with low hills of intrusive volcanics. Freshwater drains through the porous limestone of the plateau and emerges at the base of the cliff as springs, seeps, caves and sinkholes. The soils tend to be thin, poorly developed and well-drained clays with occasional deep pockets. The vegetation of northern Guam is dominated by limestone forest species, which typically are drought tolerant, thin soils and tropical storms. Although there are dense stands of tangantangan (*Leucaena glauca*), which was introduced after World War II to control erosion, there are pockets of older forest (*Ficus*, *Artocarpus*, *Cycas*, *Mammea*). The limestone descends toward the coast in a series of terraces with lower areas planted in coconut from plantations started in the early 20th century with an undergrowth of shrubs (*Pemphis*, *Scaevola*, *Tournefortia*). Sand plain development below the cliffs has formed by high-energy storm waves with calcareous material from fringing reefs driven over the reef flat during typhoons. A narrow channel (Tarague Cut/Channel) cuts through the reef in the middle of the embayment. Beach rock and sections of Holocene reef are exposed in the beach strand indicating a higher sea level in prehistory.

Early archaeological survey by Hornbostel identified the Tarague area as holding numerous Latte structures although he may have been referring to the distribution of late-prehistoric village remains rather than limestone capstone and pillars. Subsequent survey and archaeological excavations by Osborne in 1946, and by Reinman (1977), and Ray (1981) confirmed the widespread distribution of late prehistoric deposits along the coastal strip in addition to locating older archaeological remains dating the 1st millennium BC. Excavations by H. Kurashina and others (1981) from the University of Guam investigated an area southwest of Tarague Channel where survey identified a dense concentration of prehistoric material culture located 74 m inland and 7 m above sea level. The full excavation report has not been published, but a 1 m x 3 m investigation known as the 'South Profile' disclosed a stratigraphy extending 6.2 m depth and consisting of 10 layers. The basal layers (Layer 9 and 10) had no cultural material while the upper layers contained ceramics of relatively recent age. The oldest ceramics from Layer 8 were from thin-walled (2.5-12 mm) small-sized jars and carinated jar vessels. Occasional lime-impressed pot sherds, *Tridacna gigas* shell adzes, shell fish, fire pits and fish bone were assigned to the pre-Latte era (Layers 2-8).

Radiocarbon dating of shell and fish bone from Layers 7 and 8 indicated an age of ca. 4000-1000 years ago, however, the association of the dating samples with early cultural deposit may have been the result of storm activity and the dates were not corrected for isotopic fractionation nor was a ocean reservoir factor applied. The Tarague ceramics indicated that the material culture sequence changed gradually during the pre-Latte phase. A decline in the amount of shellfish remains over time was coupled with an increase in fishing artefacts suggesting that sea-level fall and over-harvesting of gastropods led to a greater reliance on fish capture in late prehistory (Liston et al. 1996)

Early (Pre-Latte) material has also been found west of Tarague Channel close to Mergagan Point, and at other locations identified in the 1 Tarague Legacy Project undertaken in 1995-1996, which recorded 138 historic and prehistoric sites (Liston 1996). Radiocarbon dates from two sites excavated in the Legacy Project have age spans extending to the 1st millennium BC. Site 7-1605 is a limestone block rock shelter and associated bedrock mortar. A date on palm wood of 2680 ± 110 BP was obtained from Layer III, which was associated with early ceramics. Site 8-1588 is directly inland of the Tarague Channel on a 60 m terrace with well-developed and deep soils. Excavation of a limestone block rock shelter (Feature 30) recovered thin pot sherds in Layer IV dated to 2460 ± 60 BP indicating an early movement inland.

Key reference

Liston, J. et al. 1996. *The legacy of Tarague embayment and its inhabitants*, Anderson, AFB, Guam. Volume I: Archaeology. Report prepared for Andersen Airforce Base, Guam. International Archaeology, Inc., Honolulu, Hawai'i.

Naton Beach, Tumon Bay

The Tumon Bay on Guam area is heavily developed and projects associated with construction projects have been preceded by substantial archaeological projects, several of which have recovered early cultural remains (Ypao Beach, Matapang Beach, Tumon Beach, Gongga Beach). Recent excavations associated with renovation of the Guam Aurora Resort Villas and Spa located 367 prehistoric human skeletons including 177 individuals dating to 1000-500 BC. The early human remains are the largest and best preserved skeletal population from the Pacific, and they date to a time for which there is little biological information about the nature of the inhabitants (see Petchey et al. 2010).

All of the early burials at Naton Beach were fully extended with no consistent pattern of orientation. Several burials contained grave goods including complete or nearly complete ceramic vessels, shell bead necklaces, shell bracelets, stone and shell adzes, stone pestles, shell fish gorges, stone net sinkers, large unmodified oyster (*Pinctada* sp.) shells, a shell fishhook, and a shell net sinker. These

items are present in archaeological deposits from Guam-CNMI, but have not been previously recorded in association with human remains. Ceramics included calcareous-sand tempered pottery from thin- and thick-walled vessels with flat bases, some decorated with lime impression. Detailed analysis of the human remains and archaeological items and sediments is currently underway. The island of Guam is substantially more developed than nearby islands, and although early prehistoric remains from Naton Beach and other parts of Guam exist, they are often located and removed during large construction projects. Incorporating significant locations of early human settlement in Micronesia that have been, or are in the process of being, urbanized is an increasingly important heritage issue at state/territory and international levels.

Key reference

DeFant, D.G. 2008. Early human burials from the Naton Beach site, Tumon Bay, Island of Guam, Mariana Islands. *Journal of Island and Coastal Archaeology* 3: 149-153.

Unai Chulu, Tinian

The Unai Chulu site is located on the northwest coast of Tinian lying between Aguigan and Saipan and is listed as CNMI Site TN-1-073. The island consists of five limestone terraces over a Eocene volcanic core exposed over only 3sq. km of island surface. Mariana Limestone of Pliocene to Pleistocene age covers 82% of the island and is rugged and heavily vegetated terrain. Drastic alterations to the native vegetation have occurred over the years on the island of Tinian. In the mid-1700s, the forest was open from the introduction of ungulates. During the Japanese era (1914 to 1944), nearly the entire island of Tinian was deforested and replaced with sugar cane fields, except for the craggy, forested cliffs and ridges with shallow soils. During World War II, all vegetation on Tinian was virtually leveled, and only small pockets of native vegetation remained. After the war, areas where sugar cane had formerly grown were overgrown with tangantangan (*Leucaena leucocephala*). Cattle grazing and agriculture increased during the 1980s, resulting in a mosaic of forest habitats within a matrix of grasslands, pastures and cultivated fields. Vegetation density has increased since the 1980s due to less grazing pressure by cattle. Tinian's vegetation has been classified by Falanruw et al. (1989) as less than 7% in native forest, 17% in other forest (introduced and *Casuarina*), 54% in secondary vegetation (mostly tangantangan), 1% in agroforest and 21% in non-forest (Berger et al. 2005).

Unai Chulu is located on the largest beach flat on the northwest coast, which extends for 150m and has a narrow fringing reef some 150m offshore. The location is 700m west of brackish Hagoi Lake and is 2-3km from several pyroclastic rock exposures. Vegetation is beach strand and secondary undergrowth. The main species present are hibiscus (*Hibiscus tiliaceus*), ironwood (*Casuarina equisetifolia*), elephant grass (*Pennisetum purpureum*), tangantangan and coconut. The general area has been affected by WWII activities associated with US invasion of Tinian including a military cemetery. In 1985, an area of 3000m² behind the beach was subject to unauthorized bulldozing. Subsurface testing revealed a cultural deposit down to 1.5m depth. In 1993, 28 shovel test pits and three 1m² test units were dug into the site identifying an early cultural deposit with an estimated area of 3000sq. m between the southern end of the strandline and extending inland for 150m (Craib 1993).

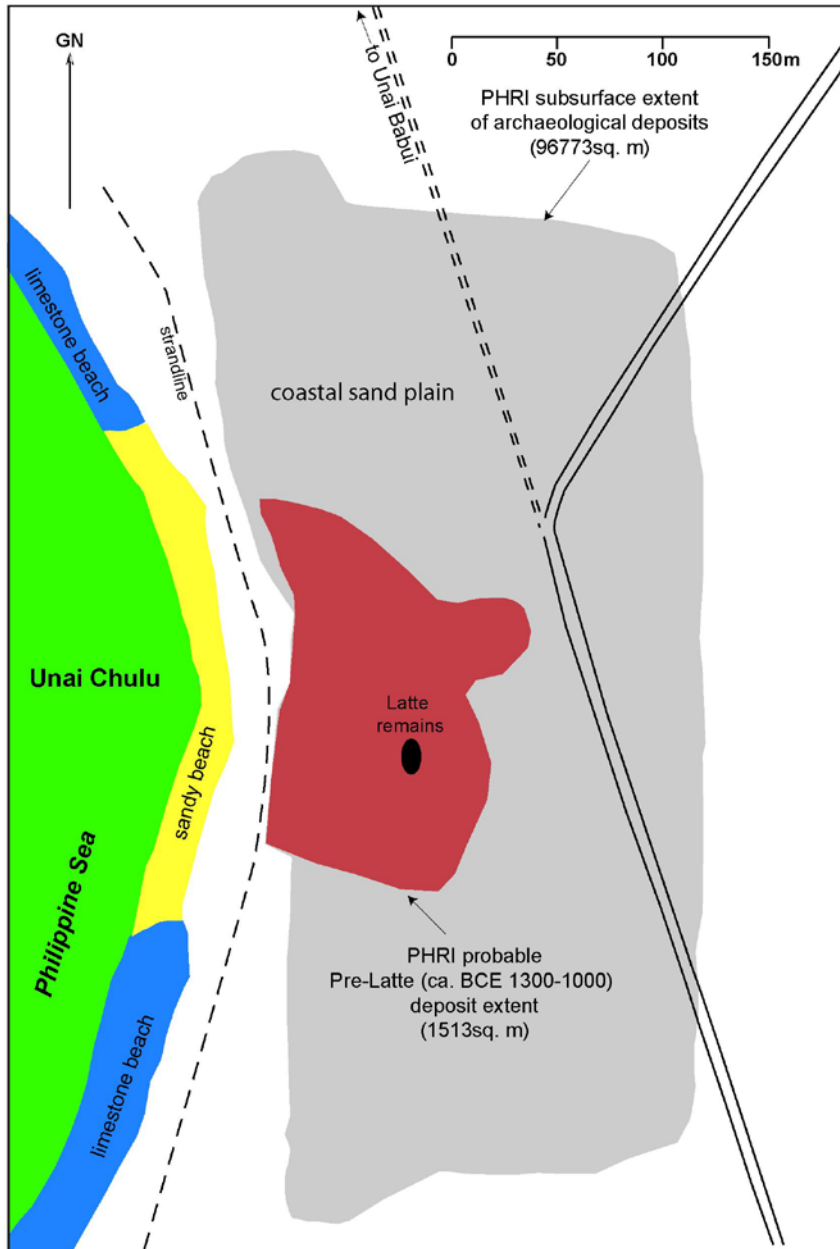


Figure 8. The extent of early cultural remains at the Unai Chulu site.

Subsequently, the site was investigated in a major contract archaeology investigation by PHRI involving 239 0.5m² shovel test pits, 23 1m² test pits and areal excavation of a 12m x 12m block with the deepest deposits samples in a 4m x 4m excavation (Figure 8, Haun et al. 1999). Of the 31 radiocarbon determinations obtained, the eight oldest indicate a deposit antiquity of 1400-1200 BCE. The ceramics represent thin-walled (mean = 5.31mm) shouldered sub-globular jars with everted rims although there is considerable diversity in the large 'Pre-Latte' sherd assemblage as indicated by the variability in orifice diameter which ranged from 10-40cm. Sherds carried a red slip and were contained volcanic, calcareous or mixed volcanic-calcareous temper sands. Decoration was infrequent, but included stamped circles and incision, punctate and dentate. Several stamped circle-incised and stamped circle-incised plus punctate designs appear to represent human figures with dentate and stamped circle patterns similar to those found at Achugao and Bapot. Lithic remains, usually flakes and some adzes in basalt, limestone, chalcedony and chert were recovered along with one piece fish hooks made in pearl shell and a variety of shell ornaments (beads, pendants, and bracelets). As at Bapot on Saipan, the majority of bird bone came from the basal levels of Unai Chulu and was from rails. Fish remains were predominantly from inshore species such as Scarids, Labrids and Acanthurids.

Key reference

Haun, A.E., Jimenez, J.A. and Kirkendall, M. 1999. Archaeological Investigations at Unai Chulu, Island of Tinian, Commonwealth of the Northern Mariana Islands. Report prepared for Department of the Navy, Naval Facilities Engineering Command. Paul H. Rosendahl, PhD., Inc., Hilo.

Bapot, Saipan

The Bapot-1 site (SP-1-0013) is located in the north of Laulau (Laolao, Magicienne) Bay on the east coast of Saipan (Figure 9), with archaeological deposits concentrated on a coastal sand plain bordered to the north by limestone terraces and outcrops of Pleistocene (Tanapag limestone) and Miocene (Tagpochau limestone) age (Dickinson 2000). The site is one of three locations east of the large Laulau site containing remains of Latte structures defined by worked limestone pillars and capstones, called Bapot-1, 2 and 3 by Spoehr (1957:Fig. 6). Behind and intruding into the limestones are rocks of the geologically diverse Hagman Formation, containing andesitic breccia, tuff, conglomerate and tuffaceous limestones (Carruth 2003). Vegetation is characterised as mixed forest (*Acacia confusa*, *Cocos nucifera*, *Carica papaya*, *Barringtonia asiatica*), with stands of introduced tangantangan (*Leucaena leucocephala*) (Liu and Fischer 2006). Rainwater from the low-permeability upland volcanics forms small streams that in the wet season transport black volcanic sands to the coast where they form placer deposits. The Laulau Bay reef platform extends to a fringing reef around 100m from the shore and contains echinoderms (Holothuriidae), marine shellfish (e.g. *Tridacna*, *Trochus*, *Conus*, *Lambis*, *Cypraea*, *Turbo*, *Conus*) and a variety of fish taxa, especially Acanthuridae, Labridae and Scardiae. Saipan did not experience forearc uplift as did Rota and northern Guam. Dickinson (2000) suggests that coastlines on Saipan expanded after a post-mid-Holocene drawdown in sea level estimated at 1.75m, which is likely to have led to coastal progradation and the infilling of sheltered embayments colonised by mangroves (*Rhizophora*). Another effect of sea-level fall and mangrove stranding was the loss of quiet intertidal settings preferred by the gregarious bivalves *Anadara* cf. *antiquata* and *Gafrarium* sp., which were a popular prehistoric food source used by colonising groups in Remote Oceania

Archaeological investigations of the Laulau area began in the 1920s with the recording of a rock-art site in a cave by Hans Hornbostel (Thompson 1932), and the site survey and subsurface investigations of Spoehr (1957:52-58). Excavations at Bapot-1 (SP-1-0013) were carried out in April-May 1977 by Jeffrey Marck, who excavated a 3m x 3m square between two Latte structures after initial test pits suggested the presence of an ancient occupation (Figure 9). Marck (1978) reported pottery, stone flakes, adzes, shell ornaments and fish hooks. Ross Cordy (1979) conducted surface survey of the coastal plain in the Bapot area, and Graeme Ward and John Craib excavated Bapot-1 in 1985 under contract to the Historic Preservation Office (CNMI). Based on test-pit results, the site has an area of some 12,000sq. m from the southern margins of the coastal plain inland to the base of the elevated limestone ridge. Six radiocarbon results on *Anadara antiquata* were obtained for the deposit, and megascopic observation of mineral grains showed that calcareous sand (CST) was the dominant temper in the earlier redware ceramics (3.1m to 1.1m depth), and volcanic sand temper (VST) and mixed (CST+VST) temper dominated ceramics from the upper levels (Ward 1985).

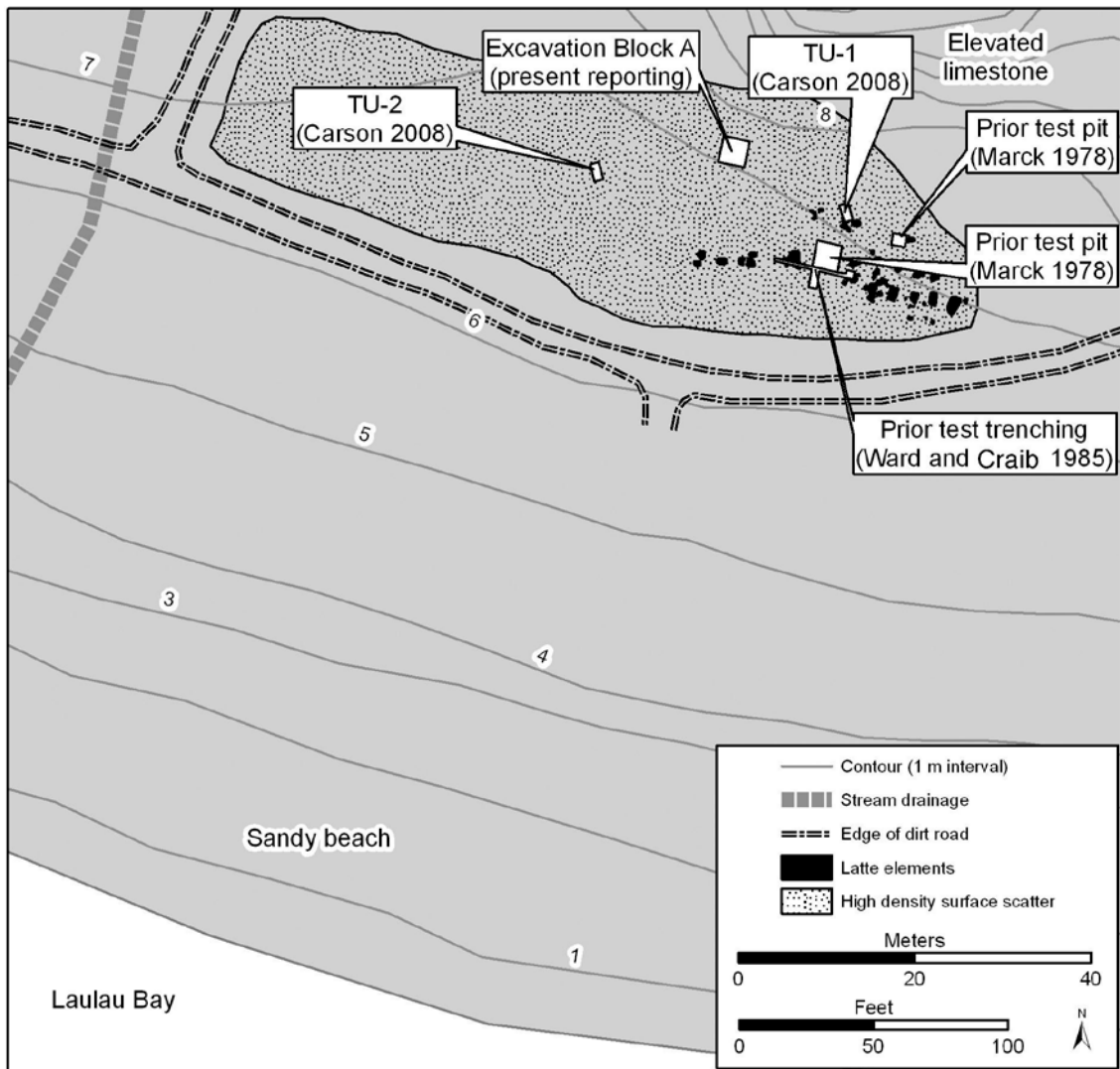


Figure 9. Excavations at the early Bapot site.

Additional survey and testing in the Bapot-1 area was made by Michael Graves during 1986-1987 and Richard Olmo in 1992, with the most recent investigations by Carson (Carson 2008), and Clark and colleagues in a 3m x 3m excavation (Figure 9 Block A; Clark et al. 2010). The oldest cultural deposit contains abundant red-slipped ceramics representing small, very thin-walled shouldered jars (3-6mm thick) with some larger ceramic containers. Extensive radiocarbon dating of the basal deposit, which contained abundant bird bone from rails including bird bone from an extinct species and a varied lithic assemblage, suggests an age range of 1400-1100 BCE. The lithics and bird bone in addition to the presence of rare dentate-stamped ceramics indicate that Bapot is early in the West Micronesian culture sequence. The distance from the Philippines to the Marianas is 2000km and represents probably the longest sea passage at that time in the world with Lapita voyaging extending to 850km (Vanuatu to Fiji) and possibly further only after around 1000 BCE.

Key reference

Clark, G., Petchey, F., Winter, O., Carson, C. and O'Day, P. 2010. New radiocarbon dates from the Bapot-1 site in Saipan and Neolithic dispersal by stratified diffusion. *Journal of Pacific Archaeology* 1(1):21-35.

Achugao

The Achugao site is on the northwest coast of Saipan on a small west protrusion created by a portion of raised fossil reef of late Pleistocene age (Tanapag Limestone). The early deposits were identified in mitigation excavations carried out from 1988 to 1990, which revealed that the site covered a small area of 1500sq. m of sand deposits that had been preserved behind a raised section of fossil reef (Figure 10). Environmental reconstruction indicates the early site was on a low island or peninsula at the mouth of a small lagoon. Sea-level fall since about 1300 BCE led to infilling of the lagoon causing it to be sealed from the ocean and becoming brackish with abundant stands of reeds (*Phragmites karka*). Pollen and shellfish remains from the site demonstrate that parts of the Achugao coastal area were once in mangrove with a variety of shellfish habitats in the vicinity of the ancient settlement (Amesbury 2007). With sea-level fall there has been extensive reworking of the oldest cultural deposit except for the portion which was preserved behind the section of fossil reef.

Ceramics were the main item recovered with small amounts of lithics, and a shell artifact assemblage of fish hooks, *Conus* shell rings and bracelets and *Cypraea* shell beads. Similar ornaments have been found at other sites including Unai Bapot and Unai Chulu. Ceramics were red-slipped jars (shouldered and without a shoulder) with everted rims, short necks along with direct and everted bowls. Early decoration consisted of rare complex incised and stamped designs which were applied exclusively to the neck and shoulder of jars. Only about only one in 50 ceramic vessels was decorated with tool marking. Incised rectilinear or curvilinear outlines were infilled or bordered by dentate stamping and stamped circles with lime infilling of punctate and dentate markings. Some tool impressions appear to have been made with a single rather than a composite dentate tool. Five radiocarbon results were obtained on charcoal from the site which suggests an age of 1300-1000 BCE for the Achugao site.

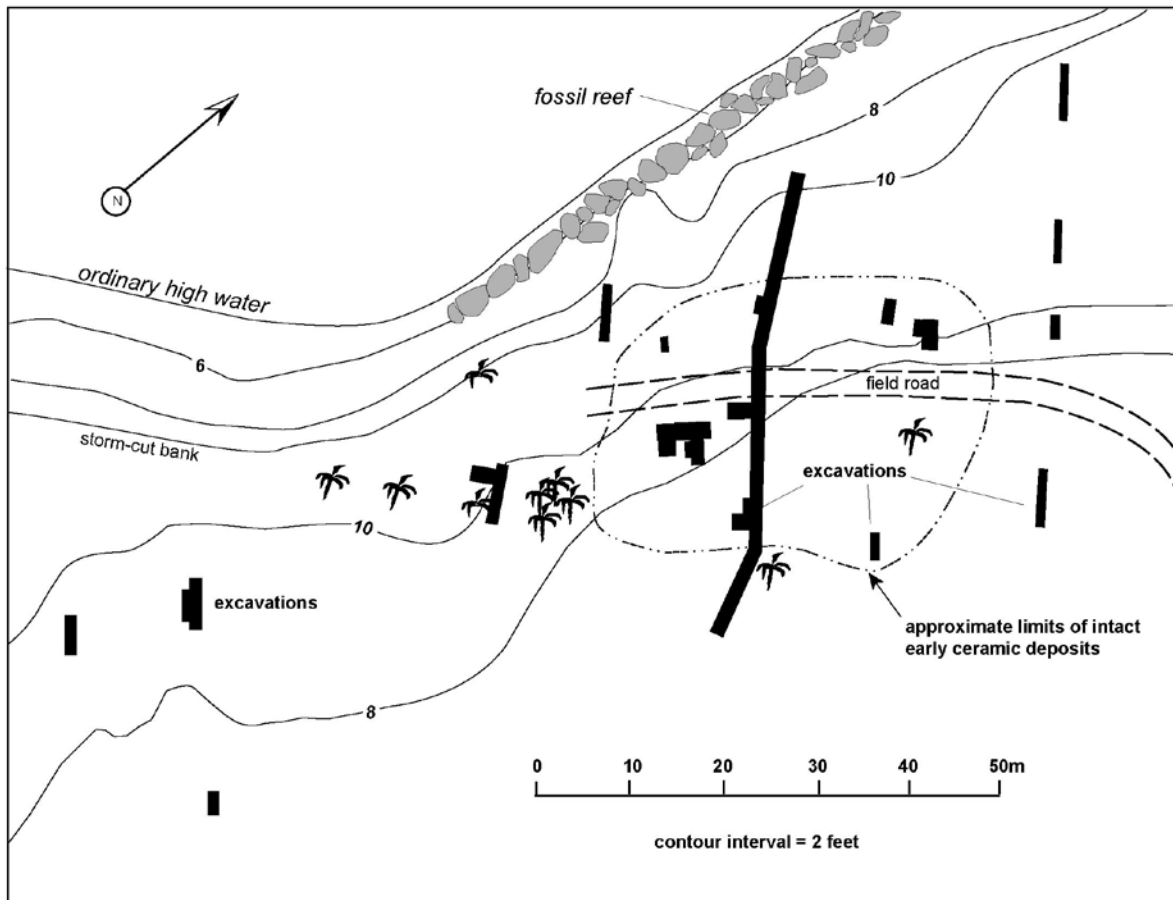


Figure 10. Excavations at the early Achugao site.

Key references

Butler, B.M. 1994. Early prehistoric settlement in the Mariana Islands: New evidence from Saipan. *Man and Culture in Oceania* 10:15-38.

Butler, B.M. 1995. *Archaeological investigations in the Achugao and Matansa area of Saipan, Mariana Islands*. Micronesian Survey Report No. 30. Micronesian Archaeological Survey, Division of Historic Preservation, Department of Community and Cultural Affairs.

Potential for World Heritage:

Early human expansion

Serial nomination of a representative set of Micronesia's oldest sites could be feasible under the Operational Guidelines. Serial properties include component parts related because they belong to: a) the same historico – cultural group; b) the same type of property which is characteristic of the geographical zone; or c) the same geological, geomorphological formation, the same biogeographic province, or the same ecosystem type; and provided it is the series as a whole – and not necessarily the individual parts of it – which are of Outstanding Universal Value. Serial nomination would be facilitated by the similarities in the cultural heritage legislation of Palau, Yap, and Guam-CNMI, and close ties between their populations and governments, as these issues are always a challenge for serial/ transboundary nominations. The oldest prehistoric sites could for example be included as a subset in a serial nomination of Lapita sites based around the concept of initial voyaging and migration to the remote islands of the Pacific, or alternatively could be presented as a separate nomination for Western Micronesia. Yap is under-represented in early archaeological sites, but it is likely that a program of targeted archaeological survey and investigation based on knowledge of early sites in Palau and Guam-CNMI would locate sites of comparable antiquity.

Potential World Heritage selection criteria for nomination of cultural sites

Criterion ii: to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;

Criterion iii: to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared.

Human innovation:

Adaptation to carbonate islands

The landforms of Micronesia are predominantly carbonate islands with atolls dominant in Central and Eastern Micronesia (Figure 11). Raised 'makatea' limestone islands occur in Palau and the Marianas, and both Nauru and Banaba are entirely raised limestone islands. In Palau, raised sections of coralline reef have weathered to form the distinctive coralline limestone Rock Islands in the Southern Lagoon. The carbonate islands of Micronesia have been described as 'hostile', 'precarious' and 'marginal' environments for humans, and a variety of subsistence and behavioral innovations were required to establish viable settlements. Archaeologically, prehistoric deposits on atolls usually consist of subsurface domestic debris with garden/plantation areas and sparse mounds/monuments, with stone architecture present on several raised reef islands.

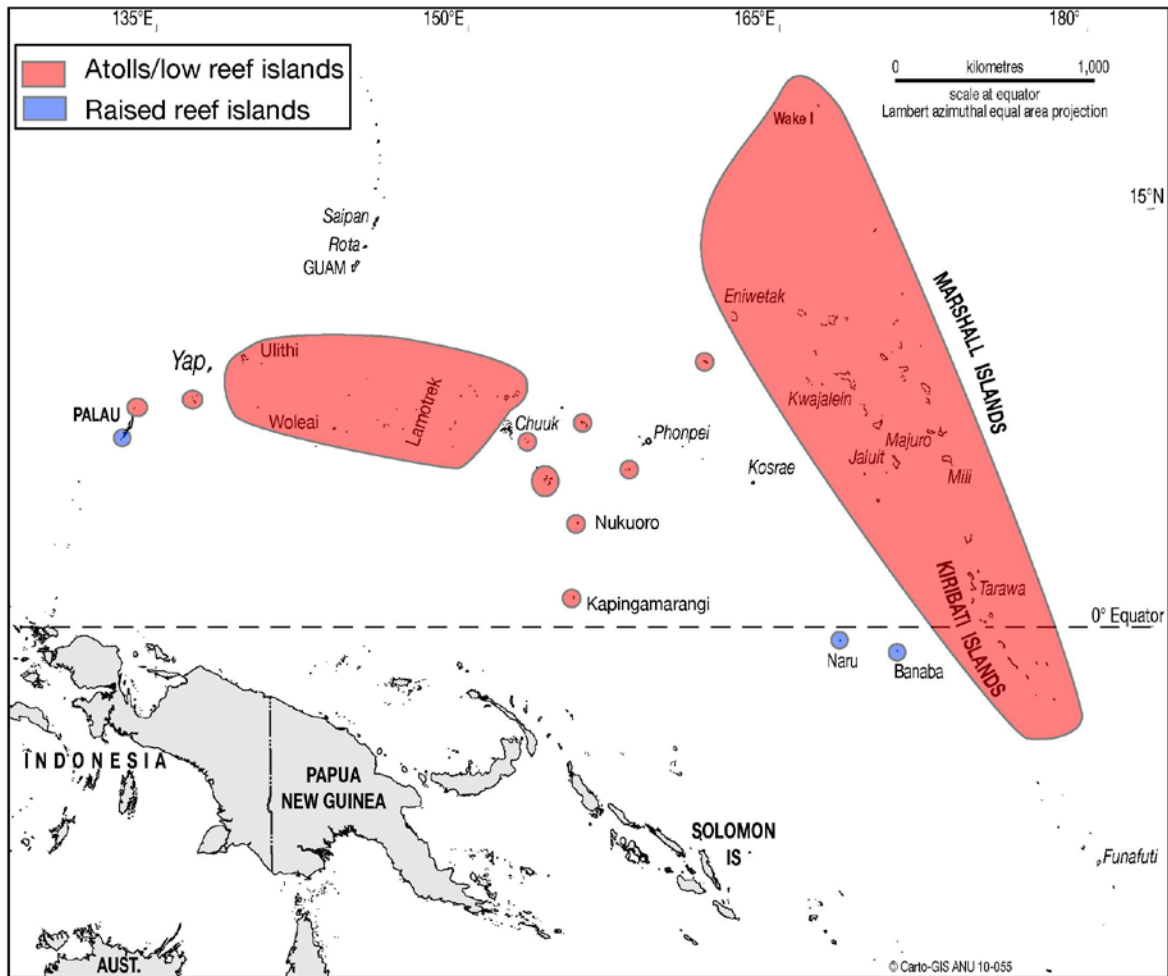


Figure 11. Distribution of carbonate islands in Micronesia. Large parts of Guam-CNMI are limestone.

Atolls

Atolls are annular low coral reefs formed on top of carbonate platforms which cap buried volcanic edifices. The classic shape of an atoll is a discontinuous oval ribbon of islets surrounding a central lagoon that developed after a mid-Holocene decline in sea level. The exposure of reef flats formed atoll foundations with subsequent contributions of calcareous reef material deposited by wind, wave and storm activity. The timing of atoll emergence was variable due to different rates of sea-level fall, subsidence and the magnitude of tidal range with many atolls in the Indian Ocean and the Pacific Ocean only available for human settlement between 1000-800 CE (Dickinson 2004). Human use of atolls appears to have been coincident with the use of these islands as nesting grounds for sea birds and turtles.

Low coral atolls are considered the most precarious landscapes for human habitation as they have limited land area, nutrient poor undeveloped humic soils, and potable fresh water can only be obtained by the collection of rain water or by tapping the thin fresh water lens (Ghyben-Herzberg lens) underlying the largest islets in an atoll. Rainfall and island size are the key factors influencing human occupation of atolls. Terrestrial diversity of plants and animals is extremely low and the absence of major topographic relief means there is no orographic precipitation. Marine resources especially those of the lagoon environment are often rich in fin fish, sharks, turtles and shell fish while pelagic fish species frequent the seas around atolls. For human settlement, atolls are challenging environments and settlements on atolls located close to volcanic islands which emerged relatively early such as Kayangel in Palau and Ulithi and Ngulu proximate to Yap could be partially sustained by close contact with their neighbours. For example, the atolls between Chuuk and Yap lie in the heart of the typhoon

belt and their small size makes them vulnerable to storm damage, particularly destruction of their gardens. The people of these atolls are closely linked through matrilineality with the people on volcanic islands. In contrast, the distant atoll environments of the Marshall and Kiribati Islands along with isolated atolls such as Kapingamarangi and Nukuoro were almost entirely reliant on depauperate atoll resources for their survival. The well-developed seafaring abilities of atoll dwellers reflects the importance of marine foods (open sea as well as lagoonal) an emphasis on voyaging mobility, and the inter-dependence of communities living in marginal environments.

Archaeological investigations have been carried out on several atolls including Kayangel, Fais, Ngulu, Woleai, Lamotrek, Marshall Islands (Majuro, Kwajalein, Arno, Utrok, Maleolap, Bikini). The notion that atolls are impoverished environments has been challenged (Hunter-Anderson and Zan 1996), but what is particularly noteworthy is the extent to which human groups survived by focusing on a narrow range of terrestrial foods combined with an exceptionally broad marine subsistence strategy. The absence of complex and highly stratified prehistoric societies on any atoll points to human systems that were closely aligned to the productive limits of carbonate islands. Compared to the terrestrial ecosystem of atolls, the lagoon and reef environments surrounding the islets provide a wide range of resources. The key to this high level of productivity is the rapid internal recycling of nutrients. However, even atoll marine environments do not match the level of biological productivity found near continental margins or around most volcanic high islands (Thomas 2007).

Subsistence innovations in tandem with high levels of marine mobility allowed humans to settle on Micronesian atolls for at least two millennia. Archaeological and ethnographic research shows that early human use of atolls involved pit agricultural systems, probably for growing giant swamp taro (*Cyrtosperma chamissonis*), which is the main starchy crop of Micronesian atolls along with coconut, arrowroot (*Tacca leontopetaloides*), green bananas and *Pandanus*. Swamp taro can withstand unpredictable rainfall, drought, salt spray and high winds and was grown by excavating a large pit down to the water table and mulching the pit soil. Tubers of 20-30kg can be produced and large pits more than 100m long have been recorded with pits belonging to different family groups and marking modern and prehistoric land boundaries (Weisler 1999).

Breadfruit (*Artocarpus* spp.) is a significant and nutritious staple tree crop and hybrid varieties of *A. mariannensis* and *A. altilis* were made to increase its salt tolerance allowing it to be widely grown on atolls where there was sufficient rainfall. Breadfruit is long-lived, hardy and productive tree with 3-5 tons of fruit recorded from an average acre with long-term storage of surplus fruit in pits. Hybridisation of different breadfruit subspecies resulted in a tree crop that fruited continuously through the year. Where breadfruit could not be grown because of inadequate rainfall *Pandanus* fruits were substituted.

Shellfishing is a significant subsistence activity on atolls with large clams (Tridacnids) and univalves (*Lambis lambis*) preferentially taken compared to smaller species. Archaeological evidence from several carbonate islands indicates that local stocks of tridacnids were depleted in prehistory (Weisler 2001a, Ono and Clark In press). Fishing on many atolls concentrates on inshore lagoon species with parrotfish comprising between 25-75% of the prehistoric fish catch in the Marshall Islands, while on Fais pelagic species of tuna and shark were captured in large quantities prior to 1200 CE. The decline in open ocean taxa might represent an absence of large trees to build open-ocean fishing canoes or fluctuation in tuna stocks from climate change during the Little Ice Age.

The significance of seafaring to atoll populations is widely acknowledged (Intoh 1996), and the best known example is the maritime network centered on Gagil Village on Yap. In the proto-historic era Gagil was connected to many atolls from Ulithi in the west to Namonuito 1200 km from Yap in the east by the *sawei* system (Figure 12). The *sawei* is sometimes conceived as a simple form of maritime 'empire', and it certainly involved, at least nominally, elements of social authority and hierarchy of atoll people relative to Yap. Once every 1-3 years, the *sawei* voyage would be begun by

canoes from Namonuito atoll which would travel west and be joined by canoes from other atolls carrying tribute and exchange valuables. Atolls were ranked according to their importance in the exchange system with Lamotrek, Wottagai, Fais and Mogmog higher than other outer islands. On arrival in Yap, reciprocal hospitality and gift giving would have occurred involving items that were valuable or scarce according to the values of the receiver. Atoll dwellers gave mats, canoes, woven goods like coconut-fiber cordage (sennit) and shell valuables (mother of pearl, *Tridacna*, *Spondylus*), while Gagil provided basalt, timber, tumeric and staples such as bananas, taro, yams and sweet potato.

The function of the *sawei* is debated, but it was thought that if annual tribute was not given Yapese magic could destroy and damage the low islands through violent storms. In local terms, exotic items from the *sawei* could be used by Yapese chiefs, especially those from Gagil, to build village and district alliances and to manifest their authority, while the *sawei* gave atoll people legitimate access to the high-status people and resources of Yap. The *sawei* also allowed Yapese access to the seafaring resources of atoll people. Navigation chants recorded on Yap were in the language of Ulithi atoll and Yapese sought canoes from Woleai atoll (D'Arcy 2001). The origins of the Yapese exchange relations with atoll people and with Palau have been investigated in archaeological excavations where exotic materials from high islands stand out in the calcareous sediments of atolls. Ngulu and Fais atolls have deposits dating to 300 CE containing Palauan and Yapese ceramics, and intensification of maritime interaction between Palau, Yap, Chuuk and Lamotrek is evident after 1200 CE as well as on Ulithi possibly marking a formalisation of inter-island relations that subsequently developed into the *sawei*.

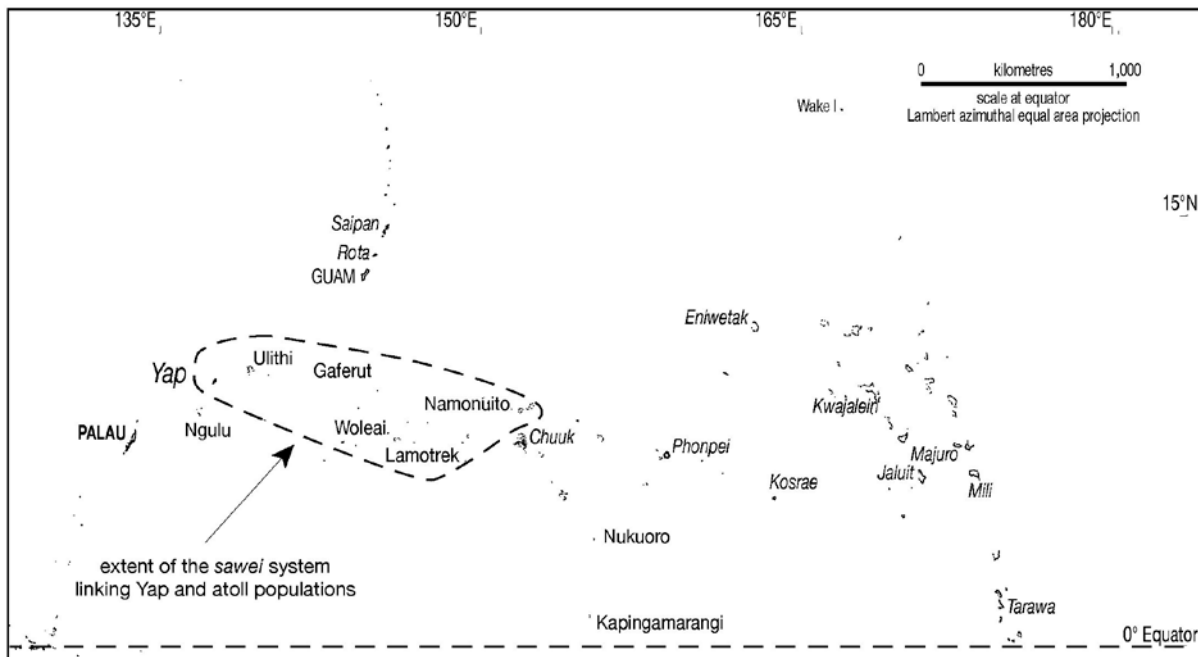


Figure 12. Extent of the Yapese *sawei* interaction system with atoll dwellers.

Key references

Weisler, M.I. 2001b. Life on the edge: Prehistoric settlement and economy on Utrok atoll, northern Marshall Islands. *Archaeology in Oceania* 36:109-133.

Intoh, M. 1996. Multi-regional contacts of prehistoric Fais islanders in Micronesia. *Bulletin of the Indo-Pacific Prehistory Association* 15:111-117.

Reef Islands

The Rock Islands of Palau consist of small raised-reef limestone islands which have only sparse pockets of sand plain and arable soil suitable for gardening that lie between a set of volcanic islands to the north and the large platform islands of Peleliu and Angaur to the south. The Rock Islands are highly susceptible to climatic fluctuations. Recurrent droughts limit the production of starchy crops in sink holes and on sand plains, and access to potable water is dependent on a high and consistent level of precipitation as the freshwater aquifer (Ghyben-Herzberg lens) tapped by humans has to be continuously recharged by rainfall. In addition, El Niño/La Niña events involve disruption to marine organisms, especially common subsistence taxa, from increased variability in tidal range, sea temperatures and nutrient concentration.

Palau's climate is in the wet equatorial zone with 3,700mm of annual rainfall. The palaeoclimate record of Palau for the last thousand years shows large-scale variation in precipitation. A wetter period at 950-1250 CE known as the 'Medieval Warm Period' (MWP) and an increasing dry climate known as the 'Little Ice Age' (LIA) which peaked around 1650 CE. During the transition from the MWP to the LIA, the decrease in precipitation was accompanied by increased frequencies of El Niño Southern Oscillation (ENSO) events: fluctuations in the Walker Circulation, the movement of the Inter-Tropical Convergence Zone (ITCZ), and change in the distribution of sea-surface temperatures (SST).

Intensification in human use of the Rock Islands by 1250 CE occurred at the end of the MWP when archaeological evidence shows that permanent settlements were first established in the Southern Lagoon as a result of a growing population and an increasing frequency of warfare on the main volcanic islands. Intensive use of the Rock Islands is marked by large and dispersed stone work settlements on many islands in the Southern Lagoon. These settlements are defined by stone architecture made by stacking locally available cobbles and boulders of coral limestone to construct house and sitting platforms, walls, pathways, docks, uprights and wells. Domestic village space is associated with rich midden deposits composed of ceramic sherds, marine shell and fin fish remains, in addition to tools and ornaments made of stone, bone and shell.

Radiocarbon dating of stone work villages and historic records demonstrate that the Rock Islands were uninhabited by about 1700 CE. Palaeoclimate results indicate an unpredictable and dry climate during the period when many Rock Islands were deserted (Sachs et al. 2009; Figure 13). Over-harvesting of local marine resources is witnessed by the smaller size of marine shell fish and fin fish remains through time (Masse et al. 2006). The archaeological record correlates well with traditional Palauan explanations referring to resource deprivation and warfare as the cause of settlement extinction in the Rock Islands.

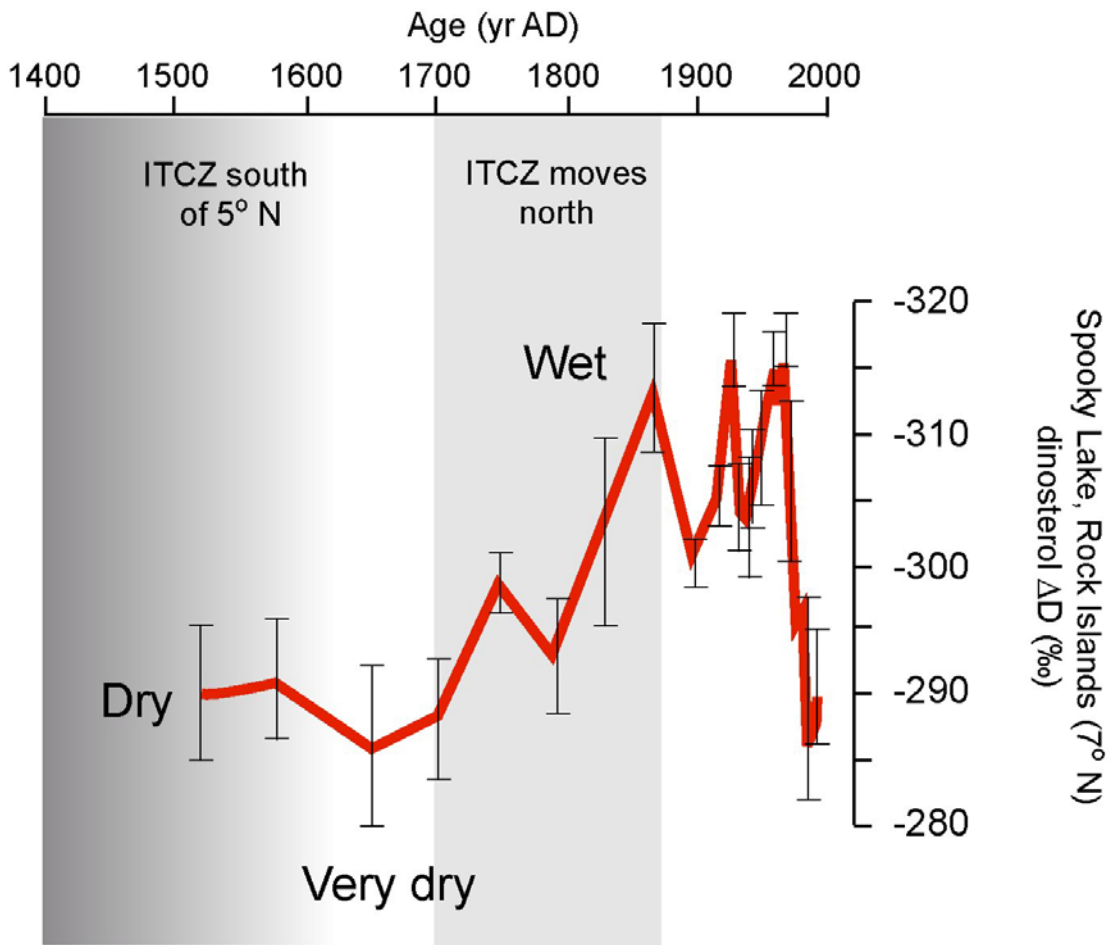


Figure 13. Evidence for a dry climate in Palau (after Sachs et al. 2009).

Traditional history in Palau substantiates the authenticity of a unique prehistoric settlement pattern made up of individual stone work villages that were ranked within a larger regional system headed by a high-status village led by a paramount chief. The people of Ngerchemai Village came from the Rock Islands and were allowed to settle in Koror as they were instrumental in helping Koror to overcome the villages of Ngeruktabel Island. The chiefs kept the titles and relative rank that they had in the Rock Islands preserving the structure of the ancient socio-political pattern prior to the Koror migration (Nero 1987).

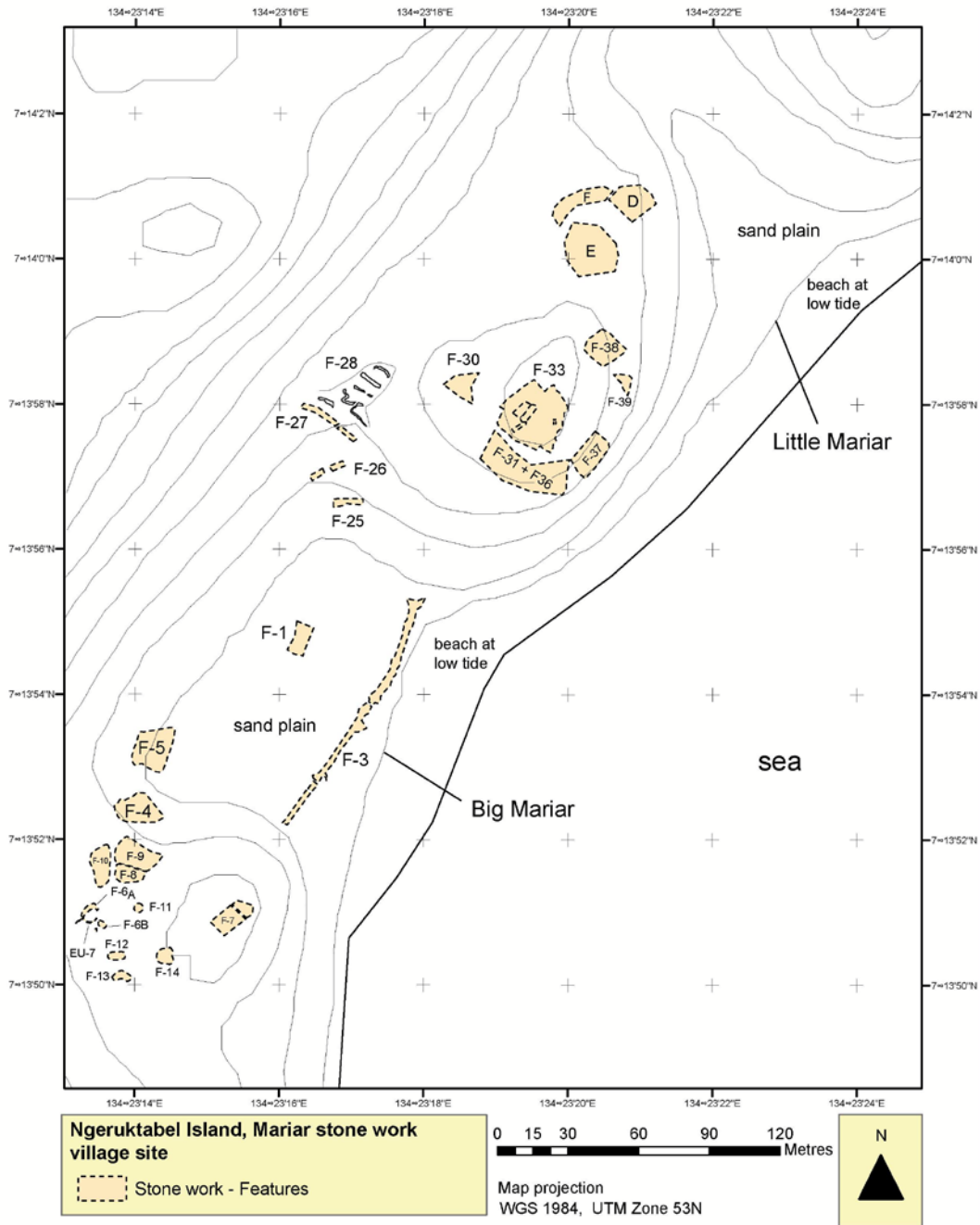


Figure 14. Stone work features on Ngeruktabel Island of Palau. F-3, F-26 and F-27 are defensive walls. F-7 and F-33 are platforms on high points in the limestone.

The regional village system was hierarchical with lower ranked villages owing tribute and allegiance to the paramount village (klou el beluu). Demand from the paramount for food, artifacts, women and weapons from subject villages was a constant source of inter-group friction. The defensive aspect of Rock Island villages can be seen in the strategic placement of stone walls across sand plains and trails, along with the presence of numerous observation points on the ridges and peaks of limestone islands (Figure 14). These structures highlight the presence of endemic conflict, as do platforms and terraces high up in karstic terrain. The formation of ranked multi-village units in the Rock Islands allowed communities to use the widespread marine resources within the Southern Lagoon and to defend their settlements when attacked by another district polity (renged). The socio-political arrangement of the stone work village systems clearly illustrates the environmental and cultural

tensions faced by people living in a marginal environment. The political hierarchy of villages bound the communities together so that the subsistence and defensive needs of dispersed communities could be met. Episodes of water and food shortage as a result of drought, the over-harvesting of natural foods, population increase, warfare, and mounting tribute demands, however, produced instability in the regional system resulting in high rates of migration out of the Rock Islands.

Key reference

Masse, W.B., Liston, J., Carrucci, J. and Athens, J.S. 2006. Evaluating the effects of climate change on environment, resource depletion, and culture in the Palau Islands between AD 1200 and 1600. *Quaternary International* 151:106-32.

Potential for World Heritage: Adaptation to carbonate islands

Atoll environments could be considered under a World Heritage serial nomination that brought together atoll locations associated with the Yapese *sawei* exchange system, or a focus on atolls distant from high islands that exemplify the subsistence and other adaptations necessary to live on low carbonate islands such as those in the Marshall Islands.

Potential World Heritage selection criteria for nomination of cultural sites

Criterion v: to be an outstanding example of a traditional human settlement, land use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;

Criterion vi: to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.

Management of cultural properties

Republic of Palau

The preservation of culture and environment is of paramount importance to the Republic of Palau which is stated in §102 of the Title 19 'Historical and Cultural Preservation Act':

(a) The historical and cultural heritage of the people of Palau constitutes a precious national resource which should be preserved and fostered for the benefit of all.

Sites which are deemed to be culturally, historically, or archaeologically significant are eligible for protection under Title 19 'Cultural Resources' of the Republic of Palau's National Code.

Title 19 Palau National Code (19 PNC) – Chapter 1: Historical and Cultural Preservation Act. The purpose of this act was to establish a comprehensive historical and cultural preservation program (formerly called the "Division of Cultural Affairs", now designated as the "Bureau of Cultural Affairs" [BAC]). This agency's primary responsibilities, among others, include:

- 1 maintaining the Palau Register of Historic Places which lists the nation's significant tangible cultural properties;
- 2 developing a nationwide survey to identify documents and gather information on actual or potential historical sites;
- 3 preparing, reviewing, and revising a national historical and cultural preservation plan; and

- 4 serving as a depository for research materials generated or recovered through historical or cultural preservation projects.

Protective designation for both Chelechol ra Orrak and Uet el Daob me a Uet el Chutem are based on their inclusion in the Palau Register of Historic Places and therefore protected under Title 19, (Chapter 1, Sections 154 and 191) of the Palau National Code. They are also governed by the Rengarairai Chiefs, Ordomeh hamlet, Airai State.

Protective designation for Ulong Island and Chomedokl Island burial cave as well as any other early cultural sites in the Rock Islands is through Koror State Public Lands Authority holds title to public lands (such as the "Rock Islands") above the ordinary high water mark (*House of Traditional Leaders, et al., vs. Koror State Government, et al.*, Civil Action Nos. 06-070 and 06-075, Judgment and Decision dated December 17, 2008).

As of this date, none of the "Rock Islands" of Koror have been awarded to any individual, lineage, or clan, so that none of the Rock Islands are being developed for private interests. The Koror State Legislature has zoned all of the Rock Islands as a "Conservation" Zone (Koror State Public Law No. K6-100B-99), and more recently, Koror State Public Law No. K9-222-2010 prohibits any permanent construction or development in the Rock Islands (other than tourist related facilities).

Yap State, Federated States of Micronesia

The State Historic Preservation Act of 1989

The State Government is empowered by the Constitution of the Federated States of Micronesia and the Constitution of the State of Yap to protect, conserve, and develop objects and places of historic and cultural interest within the State. It is the policy of the State to exercise that power to preserve the sites, structures, buildings, objects, areas, traditions, arts, crafts, stories, and songs of historic and cultural significance for the benefit of present and future generations. In addition to those functions exercised by the Council of Pilung and Council of Tamol by virtue of the Constitution of the State of Yap, the Councils shall exercise the following functions as they may concern tradition and custom

In Section 405 of the State Historic Preservation Act of 1989 (Chapter 4), the "Implementation of Policy" states that:

- 1 The State Government, including its agencies and political subdivisions shall implement a program to identify, protect, preserve, and develop historic properties and traditional culture. The program shall be known and referred to as the "Yap Historic Preservation Program".
- 2 The State Government, including its agencies and political subdivisions, prior to permitting, assisting or engaging in any activity which may have an impact on historic properties shall notify the Division of Civic Affairs.
- 3 The Division shall take all steps reasonable and necessary to determine the nature and magnitude of the impact such activities are likely to have on historic property or traditional culture. Should the Division determine that significant effects are likely, it shall initiate consultation with any concerned agency, political subdivisions, or person to clearly identify the historic properties or traditional culture subject to impact.
- 4 The Division shall maximize beneficial effects and eliminate or mitigate any harmful effects to historic properties or traditional culture.
- 5 Any agency, political subdivision or person, upon receipt of notification that consultation is

necessary in the opinion of the Division, shall enter into such consultation. Any activity which is the subject of consultation shall cease if there is a threat of immediate and irreparable harm to an historic property or traditional culture.

The Registration of Historic Properties signed in 2003 establishes a system of registering and protecting properties on Yap which possess unique historical, cultural, or archaeological significance. Once registered, historic properties are preserved and protected with funding from both the Historic Preservation Office and the U.S. National Park Service.

Guam, United States Island Territory

Antiquities Act of 1906, 16 USC 431-433

The Antiquities Act of 1906 provides for the protection and scientific investigation of historical and prehistoric sites and objects on federal lands. It authorizes the president to designate historic sites and natural resources of national significance on federally owned or controlled lands. It also provides for criminal sanctions against excavation, injury to, or destruction of objects of antiquity under federal control. Uniform regulations for implementing the Antiquities Act are found in United States Code of Federal Regulations at 43 CFR Part 3. Historic Sites Act of 1935, 16 USC 461-467 The Historic Sites Act of 1935 allows for the designation of national historical sites and landmarks and encourages interagency efforts to preserve historic resources. It also establishes fines for violations of the act. The act gives the secretary of the interior authority for documenting and evaluating historic property.

National Historic Preservation Act
(NHPA) OF 1966, 16 USC 470 *et seq.*

The NHPA of 1966, as amended, established historic preservation as a national policy. All federal agencies are responsible for implementing NHPA requirements. The ACHP and the Department of the Interior, through the NPS, are responsible for coordination. Section 106 is a key section of the NHPA in terms of potential and actual impact on federal undertakings. Section 106 of the NHPA requires that the agency with jurisdiction must:

- 1 take into account the effects of the undertaking on cultural resources that have been included in or are eligible for inclusion in the NRHP);
- 2 consult with the ACHP, the SHPO, and others to seek binding agreement on how to avoid, reduce, or mitigate damage to the property. As such, the Section 106 review process must occur for virtually anything that is planned by a federal entity or its tenant, including ground disturbance, building modification, land use change, or alteration of the visual character of an area.

Archaeological and Historic Preservation Act
(AHPA) of 1974, 16 USC 469-469 c-2

The AHPA of 1974 extends protection to archaeological data from all federal undertakings. It directs federal agencies to notify the Department of the Interior when a historic property is threatened by federal construction or other federally licensed activities and that activity will result in the loss or destruction of data.

Archaeological Resources Protection Act
(ARPA) of 1979, 16 USC 470 aa-mm

The ARPA of 1979, as amended, expands the requirements of the Antiquities Act of 1906 provides for

both civil and criminal penalties for excavation or removal of protected resources from federal or Indian lands without a required permit, establishes a program for regularly reporting suspected violations, and requires response to cultural resources discovered with projects in progress. ARPA also requires federal land managers to establish a program to increase public awareness of the significance of and need to protect the archaeological resources located on public lands. ARPA also authorizes agencies to develop permit procedures for investigations of archaeological resources on lands under their jurisdiction. All archaeological sites and resources, whether or not on or eligible for the National Register, are protected. Fines up to \$10,000 and imprisonment for up to one year are specified for a first offense under ARPA.

Title 21 Guam Code Annotated (GCA), Chapter 76, Historical Objects and Sites

This codified law (Public Law 12-126), as amended, establishes public policy to engage in a comprehensive program of historic preservation, undertaken at all levels of government, to promote the use and conservation of historic, archaeological, architectural, and cultural heritage property for education, inspiration, pleasure, and enrichment of Guam residents and visitors.

Commonwealth of the Northern Marianas

National Historic Preservation Act
(NHPA) OF 1966, 16 USC 470 *et seq.*

Under Public Law 3-39, the Division of Historic Preservation (Department of Community and Cultural Affairs) is mandated to comply and take into account all federal laws and regulations governing the protection and preservation of these historic and cultural resources. The Section 106 Review under the U.S. National Historic Preservation Act of 1966 (NHPA), as amended, and associated 36 CFR Part 800 provides the strength behind this protection and preservation regulation (see National Historic Preservation Act above).

A Section 106 Review must be undertaken for projects that involve a direct, indirect, or an adverse impact on a site or sites that are on or are eligible for inclusion in the National Register of Historic Places. The responsibility of initiating and completing the Section 106 Review lies with the head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking. Furthermore, the Section 106 Review must be completed prior to the approval of expenditure of any federal funds committed to the project or prior to the issuance of any license, as the case may be.

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East Polynesia

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Cover photo

An early New Zealand Māori settlement locality on Motutapu Island. Rangitoto Volcano (in background) formed entirely within the period of human settlement, erupting in the 15th century when the site was occupied and showering local residents with ashfall. Footprints in the ash layer show that Māori and their dogs returned to the site before the ash had fully consolidated, perhaps to gather their belongings (photo, M. Allen).

Figure 1

East Polynesian island groups (in bold) within their larger Pacific context. 144

Figure 2

A deeply buried early East Polynesian settlement site, Hakaea Valley, Nuku Hiva, Marquesas Islands; the excavator is standing on the early occupation layer (photo, M. Allen). 146

Figure 3

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Figure 4

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Figure 5

The Tahanga Basalt Quarry was an important raw material source for flaked adzes early in the New Zealand sequence. Top left: adze performs; top right: quarry site with debitage piles (the dark mounds) and person on left for scale; bottom: broader context of quarry which lies near the bend of the bay (photos, M. Allen). 156

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Early style pearl-shell fishhook from Hakaea Beach, Nuku Hiva, Marquesas Islands (photo, A. Crown). 160

Figure 7

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Figure 8

One of many traditional Hawaiian canoe moorings at Ka Lae, Hawai'i near the Pu'u Ali'i Dune, situated to take advantage of the exceptional fishing opportunities offered by the confluence of sea currents and local upwelling (photo, M. Allen). 162

Figure 9

Important Polynesian crop plants derived from both West Polynesia and South America. On left, banana, taro, and sweet potato (top to bottom) and on right, white-flowered bottle gourd (photos, M. Allen).

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Figure 10

Cape Reinga at the northern tip of New Zealand's North Island. According to Māori traditions, this is the point of departure for spirits after death, from which they make their way north to the ancestral homeland of Hawaiki (photo M. Allen).

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Introduction

Existing, Proposed and Related World Heritage Sites

Encompassing around 22 million km² of open sea, East Polynesia is a vast region stretching north-south from Hawaiian Islands to New Zealand and its outliers, and west-east from New Zealand to Rapa Nui (Figure 1). It was the last major region of the world to be explored and permanently settled by human populations, a grand dispersal process that concluded in the southern Pacific Ocean. The ancestors of modern East Polynesians managed to find nearly every habitable island, colonizing and then abandoning some, but permanently settling most. Over time, diverse art forms, innovative architecture, and novel material culture developed within individual archipelagos, giving rise to the distinct island cultures and languages that we recognise today. Early European explorers found vibrant island populations with a diversity of complex social, political, and economic systems inhabiting most East Polynesian land masses of consequence.

This chapter concentrates on the earliest period of East Polynesian prehistory, and identifies known settlement sites and landscapes that relate to the ICOMOS theme of “*Early Human Expansion and Innovation in the Pacific*.” The aim is not to suggest any sites for nomination or Tentative Listing, but rather to provide background for any further nominations to the World Heritage List, which currently includes only two East Polynesian cultural properties:

- Tongariro Mountain in New Zealand which has been recognised as an “associated cultural landscape” (1990, 1993)
- Rapa Nui (Easter Island) National Park (1995)

The current chapter also expands on the recent thematic study and site portfolio drafted by Smith and Jones (2007), *Cultural Landscapes of the Pacific Islands*, where another 12 East Polynesian properties (out of twenty-two) are identified as relevant to a variety of World Heritage themes (Table 1). Five of these properties also relate to the theme of “*Early Human Expansion and Innovation*” considered here, and are marked in bold on Table 1.

In addition to the foregoing, four properties that include important early East Polynesian archaeological sites are already on the World Heritage List, identified on the basis of natural or mixed natural and cultural criteria (<http://whc.unesco.org/>). These include:

- Te Wahipounamu, southwest New Zealand (1990)
- Sub-Antarctic Islands, New Zealand (1998)
- Henderson Island, French Polynesia (1998)
- Papahānaumokuākea Marine National Monument, Hawai’i, USA (2010)

Another three tentative nominations made in 2007 on other criteria (listed at <http://whc.unesco.org/en/tentativelists/state=nz>) could include sites that are relevant to the theme of “*Early Human Expansion and Innovation in the Pacific*”:

- Auckland Volcanic Fields
- Kermadec Islands and Marine Reserve
- Whakarua Moutere (Northeast Islands)

To add to this list, a proposal was made at the “Thematic Framework for World Cultural Heritage in the Pacific” meeting held in September 2005 at Port Vila, Vanuatu to nominate Maungakiekie (One Tree Hill), a fortified Māori settlement complex in New Zealand, for World Heritage status. Comments from a 1997 Global Strategy meeting in Suva, Fiji are also relevant to the current discussion. At that meeting it was recognised that the Pacific region contains “a series of spectacular and highly powerful spiritually valued natural features and cultural places” and that “preference should be given to serial

nominations linked by themes of relevance to the region as a whole extending over vast distances. Places of origin, spiritual routes, and other sacred places are powerfully bound by spiritual and natural connections with the life and destiny of Pacific peoples.”

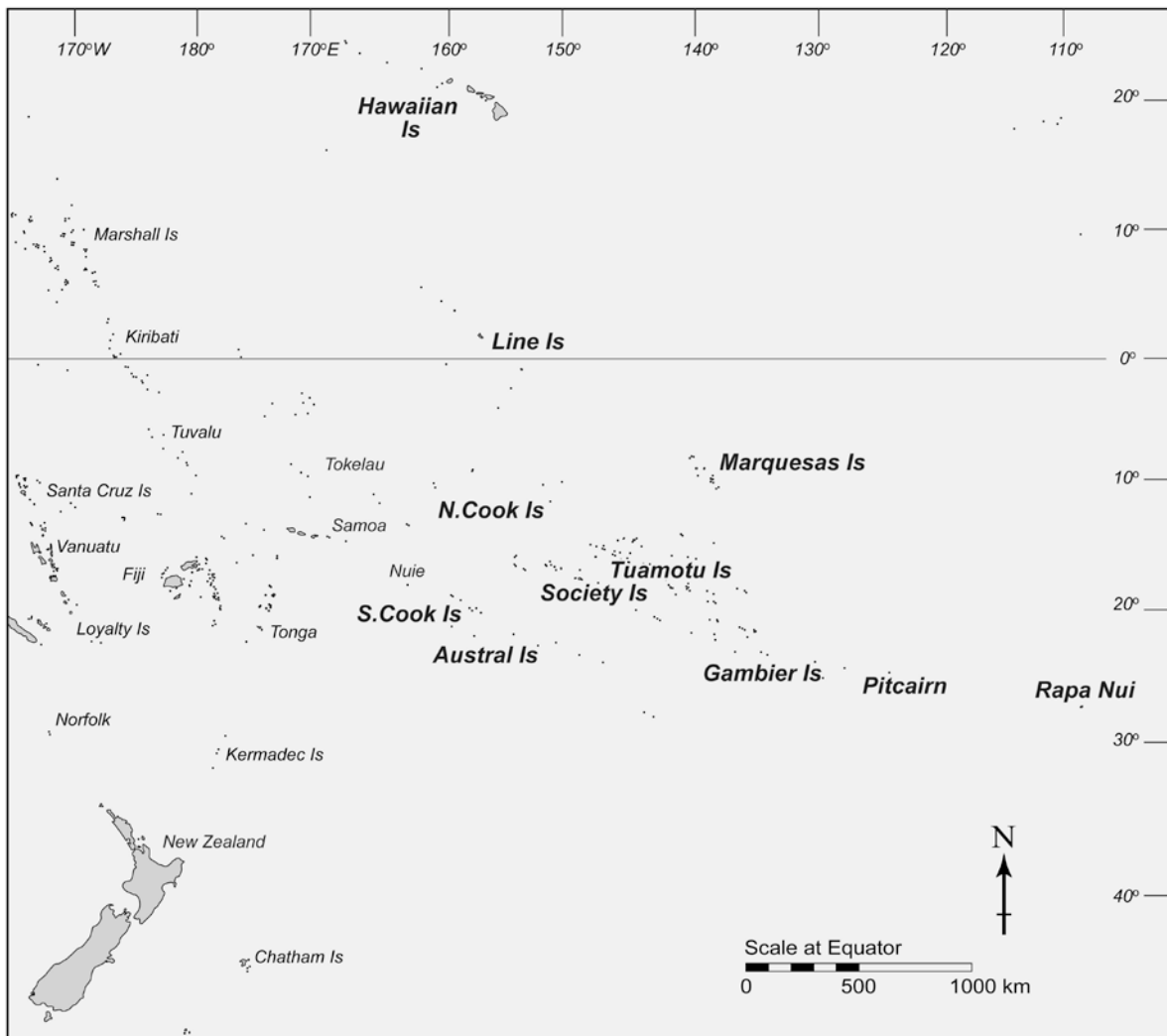


Figure 1. East Polynesian island groups (in bold) within their larger Pacific context.

Table 1. Summary of East Polynesian cultural landscapes previously identified by Smith and Jones (2007)

State Party	Name	Landscape type	Themes
Chile	Rapa Nui Island¹	Organically evolved, relict. Associative	Environmental restrictions, catastrophe, Polynesian settlement pattern
Hawaii	North Kohala region	Organically evolved, relict	Polynesian SP horticulture, settlement patterns
	Mauna Kea Adze Quarry (Hawai'i Is)	Organically evolved, relict. Associative	Polynesian stone quarries, ritual

East Polynesia

State Party	Name	Landscape type	Themes
	Papahānaumokuākea Marine National Monument²	Associative land- & seascape	Seascape, Polynesian traditions, WW II
French Polynesia	‘Opunohu Valley, (Mo‘orea Is)	Organically evolved, relict	Polynesian settlement pattern
	Taputapuātea <i>marae</i> site (Raiātaea Is)	Associative land- and seascape	Polynesian traditions, social organization, oceanic voyaging and navigation
	Rapa Island	Organically evolved, relict	Polynesian settlement pattern, traditions, environmental restrictions, fortifications and warfare
	Atoll <i>marae</i> , Tuamotu Archipelago² (Napuka & Tepoto Is)	Organically evolved, relict. Seascape and landscape. Part of Central Pacific World Heritage Project	Polynesian settlement pattern, oceanic voyaging and subsistence
Republic of Kiribati	Line Islands² (Kiritimati & Tabuaeran Is)	Associative and Relict landscape and seascape. Part of Central Pacific World Heritage Project	Micronesian (Polynesian?) traditions, social organization, navigation
Cook Islands	Mangaia Island	Organically evolved, relict and continuing elements	Polynesian horticulture, wet and dry
New Zealand	Bay of Islands region (North Is)	Organically evolved, relict. Associative	Polynesian settlement patterns, Associations with the colonial process in New Zealand, fortifications, horticulture.
	North Taranaki district (North Is)	Organically evolved, relict. Associative.	Polynesian settlement patterns, Fortifications, Associations with colonial process in New Zealand

¹Properties marked in **bold** are relevant to the World Heritage theme of “*Early Human Expansion and Innovation in the Pacific*”.

²Properties marked with an asterisk also have high intrinsic biodiversity values.

The Aims of this Chapter

This chapter builds on the earlier study of Smith and Jones (2007) by detailing early human expansion into the East Polynesian region and identifying innovations and adaptations that took place coincident with, and immediately following, this dispersal. It also expands on the properties Smith and Jones (2007) identified as noteworthy, which in many cases are late prehistoric and early contact period sites. These late sites are often visually impressive structures or remains, and in some cases

are associated with specific oral traditions. Such properties have heritage value for both indigenous communities and visitors alike.

The heritage value of early settlement sites, in contrast, may be more difficult to identify, even when the events, traditions, and/or processes they relate to may be of global importance. Many East Polynesian settlement sites are buried, some deeply, and consequently may have few or no visible surface manifestations (e.g., Figure 2). Their direct historical associations with current communities, given their separation in time, may be weak or lacking. Early settlement sites are, however, crucial repositories of information about the origins, arrivals, and adaptations of the region's first peoples. Specific places of early settlement may be evocative of the process of oceanic voyaging, and occasionally do link with specific ancestors and founding communities as identified in oral traditions. Early East Polynesian sites also help demonstrate the transference of distinctive insular technologies, architectural and artistic traditions, ecological knowledge, and even religious beliefs and values, over vast distances and sometimes several thousand years (e.g., through connections with ancestral Lapita populations). The materials they produce, and the landscapes they lie within, are tangible connections to what was one of humanity's most impressive colonisation feats and the remarkable adaptations that followed in response to diverse, often challenging, and frequently rapidly evolving environments.



Figure 2. A deeply buried early East Polynesian settlement site, Hakaea Valley, Nuku Hiva, Marquesas Islands; the excavator is standing on the early occupation layer (photo, M. Allen).

This chapter outlines important aspects of the East Polynesian settlement process, initially considering the timing of settlement, paths of dispersal, patterns in early site locations, and inter-island relationships. In doing so, it provides additional context for the voyaging history, technologies, and practices of East Polynesia that are considered elsewhere in this volume in terms of their larger Pacific context (see Irwin's chapter). Early innovations are reviewed as well, stressing the remarkably diverse environmental conditions which East Polynesian settlers adapted to, within a very brief time

frame by global standards. Among these highly varied conditions were places of extreme isolation, climates ranging from equatorial to subantarctic, resource poor carbonate atolls, and very small volcanic land masses. Human adaptation in this region also needs to take account the considerable post-settlement changes to island biota and landscapes that arose from early human activities; in many cases initial human impacts adversely affected the productivity of island environments and additional innovations were required to maintain stable economic systems.

Environmental Context of Early Human Expansion and Innovation¹

Polynesia includes around 250 islands, but much of this culturally and linguistically defined region is open ocean. Stretching from the Hawaiian Islands in the north, to New Zealand in the southwest, and Rapa Nui in the southeast, this geographic space is often referred to as the “Polynesian Triangle”. However, the extent of Polynesian voyaging, and sometimes settlement, reaches well beyond the conventional “Polynesian Triangle” if Polynesian outlier settlements in Melanesia and Micronesia, and American continental contacts are included (Anderson 2005; Irwin 1992). A further sub-division into West and East Polynesia recognises differences in the antiquity of human settlement and corresponding variations in social practices, material culture, biology and languages. West Polynesia is a fairly small geographic area settled some 2800 years ago by Lapita colonists (see Sand, this volume). East Polynesia, in contrast, is vast and colonised more than a millennium and a half later, with the southerly islands being amongst the last permanently settled places on the globe. In this chapter, a distinction is frequently made between the central islands of the Cooks, Australs, Societies, Tuamotus, Gambiers, and the Marquesas and the marginal islands of Hawaii, New Zealand, and Rapa Nui.

The largest land masses of East Polynesia, the islands of New Zealand (270,535 km²) and the Hawaiian chain (16,636 km²), lie at the region’s margins, while Society Islands with 1,680 km² of land spread across 720 km, are the largest central group. The north-south trending Cook Islands, dominated by small coralline islands, are the first land-falls east of Samoa and Tonga. This island chain continues to the southeast, giving rise to the geologically varied Austral Islands. The Tuamotu Archipelago, with 79 islands (mostly low atolls) is the region’s most extensive group and extends roughly 2000 km in a northwest-southeast direction, but has a total land area of only 850 km². The rugged Marquesas, volcanic islands that generally lack fringing reefs, are 480 km to the northnorthwest of the Tuamotus. At the southeast end of the Tuamotu Archipelago lie the Gambier Islands and Pitcairn Group. Several hundred kilometres further to the east is Lonely Rapa Nui. Between central East Polynesia and the Hawaiian chain is a ca. 2,500 km long string of eleven atolls and low coral islands which make up the Line Islands. Unoccupied at Western contact, the Line Islands are today largely under Republic of Kiribati governance (two are unincorporated territories of the U.S.) but their archaeological record suggests settlement from central East Polynesia around the 12th century AD (Anderson *et al.* 2002).

As colonists moved into East Polynesia, they typically met with smaller and more widely spaced islands relative to those of the west. The combination of smaller targets and greater inter-island distances could have slowed the pace of colonisation through the region and quickened regional differentiation, but intriguingly the evidence suggests otherwise (see below). These factors not only affected the “costs” of island discovery, but also had important consequences for human settlement and persistence. Smaller land masses are typically associated with reduced biodiversity, which usually translated into fewer resources for human settlers. Smaller islands also are more vulnerable to environmental perturbations, and the native flora and fauna more susceptible to extinction. Geographic isolation in turn impinged on broader socio-cultural networks that might otherwise have offset risks and disasters, such as cyclones, droughts, and tsunamis. Some of the more isolated East

¹ Details of island size and distances are in large part derived from Smith and Jones (2007).

Polynesian localities include Caroline Atoll at 1500 km from Kiritimati (Christmas) Island, the Chatham Islands 860 km east of the New Zealand mainland, the Marquesas Islands 480 km from the Tuamotus, and Henderson Island 400 km from Mangareva. Rapa Nui, at 3700 km from the South American coast and 2250 km from Pitcairn Island (its nearest neighbour), is probably the most isolated island in the world. Already recognised as a World Heritage site, Rapa Nui illustrates how isolation can give rise to highly distinctive social, political, and agronomic practices (Kirch 2000).

As might be expected, a region this large is also environmentally diverse. Three kinds of processes have contributed to this diversity: differing geological histories, spatial and temporal variability in climate, and variable dispersal abilities and adaptations of plants and animals. East Polynesian island chains are the result of millions of years of volcanic activity, combined with the slow northwest movement of the geological Pacific Plate over stationary volcanic hotspots (N.B. Rapa Nui is on the Nazca Plate). A variety of island types occur within East Polynesia, including high volcanic islands, atolls, and makatea or uplifted coral islands. The array of island land forms is accompanied by diverse marine habitats, atolls typified by large productive lagoons, and volcanic islands often associated with fringing and barrier reefs. But some islands have quite limited shallow-water environments, such as the Marquesas with their steep volcanic coasts and poor coral development.

As the first colonists moved into Samoa and subsequently East Polynesia, they crossed the “Andesite Line”, a name given to the submerged margins of multiple continental plates. In doing so, they left behind the more complex geologies of places such as Fiji and Tonga, and entered a region of comparatively uniform volcanic basalts; only in New Zealand were the more varied continental rock types once again encountered. Some islands, such as the coralline atolls of the Tuamotu Archipelago and the northern Cook Islands, were altogether lacking in volcanic rocks which were preferred raw materials for adzes, other tools, and oven stones. This geologic impoverishment required adaptation of tool kits that were originally designed for more complex lithologies.

Differences in island age, sea-level and tectonic histories, and local climate conditions also have intersected to produce variable landforms, soils, and vegetation patterns, with differing potentials for traditional Polynesian agriculture (e.g., Rolett and Diamond 2004; Vitousek *et al.* 2010). Soils on older islands tend to be less productive and a number of innovations aimed at maintaining and enhancing soil fertility were developed.

Climatic factors also played a crucial role in evolving Polynesian landscapes. While the islands of the central region are tropical to subtropical, they experience variable climate conditions. Some, like the southern Cook Islands, lie within the South Pacific Convergence Zone, a band of low-level convergence, cloudiness, and precipitation where tropical cyclones are common and can be quite severe, damaging both the built environment and food resources. Other islands more rarely experience cyclones, but suffer from extremes of wet and dry, sometimes enduring extended and devastating droughts (e.g., the Marquesas Islands).

At the region’s southern margin, climate conditions severely challenged Polynesian settlers in other ways. Tropical conditions give way to temperate and even subantarctic climates in New Zealand and its outlying islands. Few of the species cultivated by Polynesians for food, medicines, clothing, fibers and timber were successfully introduced to New Zealand, and even the hardy sweet potato (*Ipomoea batatas*) was unproductive throughout much of the country. Nevertheless, Polynesians discovered and occupied not only the inclement Chatham Islands, where tropical horticulture was abandoned, but also two of the five subantarctic island groups, the Auckland Islands and the Snares (Anderson 2005).

Temporal variability in climate was also important. Both the decadal “El Niño-Southern Oscillation” (ENSO) and the multi-decadal “Inter-decadal Pacific Oscillation” (IPO) climate cycles are known to affect local patterns of rainfall, temperature, and storminess, and by extension island flora and fauna.

Although not fully understood, connections have been drawn between these climate cycles and agricultural success, warfare, and socio-political transformations (e.g., Allen 2010, Field 2004). Centennial scale variability, particularly the “Medieval Climate Anomaly” (~AD 900-1200), the “Little Ice Age” (~AD 1550-1900), and the transition between the two, have been linked with cycles of Polynesian voyaging (see Irwin, this volume; Anderson *et al.* 2006). Periods of anomalous westerly winds, such as those associated with intensified ENSO activity, might have aided eastern exploration, while increased storminess associated with the “Little Ice Age” may have reduced long-distance voyaging and the frequency of offshore fishing (e.g., Bridgman 1983; Leach and Leach 1979).

Most East Polynesian plants and animals derive from the exceptionally rich Indo-Malaysian province. Dispersal abilities, diminishing island sizes, and increasing inter-island distances combined to inhibit the eastern establishment of many species. The result is a marked decline in biodiversity from west to east, with reductions in most biotic groups, including flowering plants, mammals, fish, and birds, although the latter are moderately well represented in the eastern Pacific because of their dispersal abilities. Many large edible taxa exploited by Lapita colonists in the west, such as crocodiles, iguanas and megapodes, did not extend into East Polynesia (Steadman 2006).

The failure of some species to disperse, however, opened up new niches for those taxa which were successful; the result is a comparatively high level of endemism (organisms which evolved in place) on East Polynesian islands. This is particularly apparent amongst birds and plants, but also true of inshore fish and shellfish in some isolated localities like the Marquesas Islands.

These patterns of biodiversity had major implications for the region's first human colonists. With movement east, many useful wild plants and animals were simply no longer available, having failed to disperse naturally. Moreover, Pacific islands are impoverished with respect to edible plants, particularly the nutritionally important starches. These conditions placed added importance on the successful transfer and establishment of domestic animals and cultivated plants.

This brief review outlines a few key environmental features that shaped and challenged early East Polynesian peoples as they spread across this extensive seascape. East Polynesia was not only different from the western “homeland” but also a region where geologic histories were diverse, climate regimes highly varied, and floras and faunas both biologically impoverished and vulnerable to humans and their commensals. As settlers moved out from the central East Polynesian core, even further adaptations were required to deal with the novel conditions of Hawai'i, New Zealand, and Rapa Nui. Moreover, East Polynesian land and seascapes were not stable over time; vulnerable island faunas were quickly reduced or altogether lost, forest clearance set in motion new sedimentary and geomorphic processes, and climate change operated at multiple temporal scales.

The Pacific Islands have long been touted as laboratories for the study of biodiversity and adaptation (Kirch 2000: 41). Their remarkably varied landscapes, combined with their relative isolation, makes them ideal sites for analysing evolutionary processes across a range of species. These ideas are often extended to the region's human populations where there is the added benefit, especially in East Polynesia, that the early settlers were closely related peoples. East Polynesia in particular presents a rare opportunity to examine how humans adapt to highly varied circumstances, including not only differences in natural environments, but also variability that arises from anthropogenic impacts. With the recent advent of new dating technologies, such as Uranium/Thorium (U/Th) dating which provides decadal scale precision (e.g., Kirch and Sharp 2005), we can now track and study these processes with unprecedented chronological resolution.

Early Human Expansion

The Timing of Discovery and Colonisation

The first explorers of East Polynesia covered greater distances and more open sea than their better-known Lapita ancestors. In so doing, they negotiated considerably more complex wind and current systems, and not only located nearly every habitable landmass, but also reached the coasts of the Americas and then returned home, bearing sweet potato, gourd, and possibly other goods and ideas. Precisely when human populations began moving out of West Polynesia is uncertain (see below) but we do know that this third phase of Pacific colonisation, and humankind's last major dispersal into previously uninhabited territory, was more than a millennium and a half after Lapita settlement of West Polynesia. Important sailing principles, constraints and opportunities of wind and weather, and likely strategies of exploration have been well considered through modelling, computer simulations, and experimental voyages (see Irwin, this volume; also Howe 2006; Irwin 1992). But the details of how this process unfolded, the routes, and speed of dispersal, and relations between specific archipelagos are largely unknown. These unresolved questions highlight the importance of preserving early settlement areas for future study, a concern that becomes even more urgent as sea levels rise with global warming (Erlandson 2008).

When the final phase of Pacific colonisation began has been debated for more than fifty years (see Suggs 1961; Sinoto 1970). In the 1950s, the newly-developed radiocarbon dating technique was applied to the Marquesan site of Ha'atuatua and a date of 2080 ± 150 (uncalibrated) obtained. For many years that finding shaped (and distorted) scholarly thinking about both the time-depth of the Marquesan sequence and the importance of this archipelago as a dispersal centre for other East Polynesian localities. Only recently has it been demonstrated that the initial Ha'atuatua result is unlikely to be an accurate age estimate for the basal occupation at this site (Rolett and Conte 1995).

Early settlement models have also been developed from palaeoenvironmental evidence. One historically important pollen study in the Cook Islands identified forest clearance and sedimentary changes from 2500 BP, both processes suggestive of agricultural activities (Kirch and Ellison 1994). Other Cook Island pollen records suggest similar kinds of disturbances, and even Polynesian plant introductions, in the early to mid first millennium AD (Parkes 1997). A key interpretive problem, however, is separating vegetation and sedimentary changes stemming from human activities from those relating to climate variability. The latter was (and still is) poorly understood in Polynesia generally. Questions also have been raised about the dating of these swamp cores and the possibilities of contamination (Anderson 1995). Although scholars continue to refine these proxy approaches, it is improvements in radiocarbon dating combined with new field studies that have led the way to new understandings of the timing and patterning of regional settlement.

Recent advances in radiocarbon dating are multi-faceted and highly technical. They include new laboratory techniques and calibration procedures which allow for more precise and accurate results on new materials and smaller samples, along with improved analytical protocols for sample selection and post-analysis interpretation. Application of these improvements to both previously investigated sites and materials from new localities (e.g., Allen and Wallace 2007; Anderson *et al.* 1999; Anderson and Sinoto 2002; Bollt 2005; Dye and Pantaleo 2010; Kirch *et al.* 2010; Rolett and Conte 1995; Spriggs and Anderson 1993) has narrowed the period of hypothesised human arrival from a millennium or more, to within a few centuries. New analyses on previously-analysed sites are routinely returning more uniform and younger age estimates, with many settlement sites from throughout the region unambiguously dating to the period AD 1000 to 1300.

Nevertheless, most East Polynesian archipelagos remain poorly sampled with respect to the early settlement period. Because these early deposits are often buried, they can be difficult to identify and costly to investigate, while their vulnerable locations in dynamic coastal environments lessens the likelihood of preservation. Currently our best understanding of the timing of human settlement comes

from New Zealand (Figure 3), where there is broad consensus for human arrival between AD 1200 and 1300 (Furey and Holdway 2004; Wilmshurst *et al.* 2008). Importantly, this agreement is built not only on direct archaeological evidence but also a robust palaeoecological record that was generated by scholars from several disciplines, often for other purposes. However, given the sailing challenges of reaching New Zealand (Irwin, this volume, also 1992, 2006), it is unlikely that this settlement date is representative of the region as a whole.

Given the foregoing, what conclusions can be drawn about the timing of East Polynesian settlement, particularly in the central islands which may have been settled first?

- The timing of early human settlement in East Polynesia is currently a “moving target” as re-assessment of previously-analysed sites continues. The evolving record is unusual in that the chronology of settlement is increasingly compressed, rather than extended, as is more often the case with increased study.
- A small number of *palaeoenvironmental records* suggest human arrival could pre-date the 8th century AD although this evidence is controversial.
- There is now unambiguous *archaeological evidence* for established human settlements between AD 1000 and 1300 in all but one East Polynesian archipelago, the Tuamotus (Table 2).
- Although at least one early settlement site is known from every archipelago, with the exception of New Zealand, the early settlement history of most islands is very poorly known. The large and centrally located Society Islands represent a particular gap in our understanding about paths of dispersal and inter-island relationships.



Figure 3. Rapidly eroding early Māori settlement site, perched on sand dune (left of photo), at Tauroa Point, North Island, New Zealand. Note passage through reef rock in relation to the site location (photo, R. Wichman).

Table 2 lists most of the East Polynesian sites that are widely accepted as early, are reasonably well investigated, and at least partially published. The exception is New Zealand, where quite a few early sites have been identified; only a sample of these are included here, with a focus on those that are particularly good illustrations of connections with central East Polynesia or novel adaptations to the temperate New Zealand environment. Notably, there are other East Polynesian localities not included here where isolated early dates have been obtained (usually on unidentified materials) or the material culture suggests an early age assignment.

Origins and Dispersals

Language, biology and material culture traits have traditionally identified West Polynesia as the immediate homeland of East Polynesian peoples (Jennings 1979), a view largely unrefuted by more recent studies (Kirch 2000). Although no specific island group has been definitely identified as a source area, there are many archaeological links with the islands of Samoa (e.g., Green 1974; Kirch and Hunt 1993; Weisler 1998).

One could easily gain the impression, from this and other accounts, that East Polynesian colonisation resulted from the explorations of a single cultural group. However, it remains to be seen whether this is an accurate portrayal, or simply the result of insufficient evidence to argue otherwise. Several models have been proposed that suggest preferred directions of dispersal and, by extension, potential cultural affinities, but these are largely hypothetical on current evidence (e.g., Allen and McAlister 2010; Green and Weisler 2002; Irwin 2008; Kirch 2000). Both potential source populations in the west, and early East Polynesian communities, are insufficiently sampled to make definitive conclusions. It is likely that as additional localities throughout Polynesia are investigated, more textured and complex understandings of the East Polynesian settlement process will emerge. In this regard, western archipelagos besides Samoa could have contributed to the early East Polynesian culture(s), as suggested by growing evidence for mobility and interaction between West Polynesia, Micronesia and Melanesia during the first millennium AD (see Clark, this volume).

Historically, early East Polynesian sites have been identified by a suite of material culture traits that are linked to West Polynesian forms but either are more abundant in the east or differ in details, some purely ornamental, others functional (see below). Artefacts that are considered new developments in East Polynesia, or undergo some kind of change in abundance, design details, or raw materials, include whale-tooth pendants, reel beads, breast plates, one- and two-piece fishhooks, trolling lures, harpoon heads, adzes, and hand-clubs. Often referred to as the “East Polynesian Archaic” assemblage, this terminology is somewhat misleading, as the most distinctive forms suggest *in situ* development in East Polynesia and, by extension, the passage of some time, which strictly speaking means they are not “archaic” or foundational (Kirch 1986: 29; Walter 1996). Moreover, assemblages from some early East Polynesian sites lack many of the more distinctive elements. For example, shaped whale-tooth pendants, ornamental reels, and harpoon heads are not represented in early Hawaiian assemblages. Even in the central East Polynesian heartland, occupations containing archetypical “archaic” artefacts are in a few cases underlain by earlier strata where diagnostic items are lacking (Kirch 1986).

Currently, whale-tooth pendants, reel beads, breast plates, certain forms of pendants and hand-clubs are best represented, albeit unevenly, in the Societies, Australs, Marquesas, Mangareva, and New Zealand, where they have been found in both burial and domestic contexts. Sites where such artefacts have been well represented include Wairau Bar and Houhora (among other New Zealand sites), Atiahara (Australs), Maupiti and Vaito’otia-Fa’ahia (Societies), and Hane (Marquesas). However, given the limited number of early settlement sites which have been fully excavated, it is not actually possible to specify whether particular distributions are the result of: 1) founder effects (e.g., some artefact types were not transferred in the colonisation process); 2) small sample sizes (i.e., too

few sites have been investigated); 3) differences in functional contexts (ornaments may be best represented in burials), 4) post-colonisation developments that were geographically limited to a subset of interacting archipelagos, or some combination of these factors. Additional research is needed to evaluate these different possibilities.

Early Site Locations and Preservation Issues

Most early East Polynesian settlements are located in coastal areas often, but not always, near or adjacent to reef passes (Figures 3 and 4). These reef breaks, sometimes the result of fresh water outflow, allowed for the ingress and egress of large ocean-going vessels. They also provided smaller canoes easy access to offshore fisheries, which in some places were common activities (e.g., Hane, Marquesas; Davidson *et al.* 2000). Settlement locations suggest that other resources were important too, including fresh water sources, canoe landing areas, land suitable for cultivation, access to shallow water marine resources and, in some cases, proximity to nesting seabirds, turtles, and/or seals. With respect to early Māori settlements, Duff (1977:69) noted, "...it is remarkable how constantly they occupy sites bounded in front by the main current of the river entering the sea, one flank by an estuary, swamp, or lagoon, on the other by the sea" and suggested the lagoons and estuaries provided water-fowl, fish and molluscs, while the rivers carried an "inexhaustible supply of firewood" to the coast and gave passage through the breakers for fishing canoes.



Figure 4. Teavau'ua, an early Marquesan site on Nuku Hiva Island, lies at the north end of the beach, adjacent to a reef pass (coloured dots indicate late prehistoric structures; IKONOS photograph, courtesy of M. Allen).

Although many early sites are coastal there are exceptions; early East Polynesian explorations were not limited to the open sea. In the 13th century AD, native Hawaiians scaled the archipelago's highest mountain, Mauna Kea, travelling more than 45 km from the coast and enduring extreme cold as they explored the high-altitude stony alpine desert. At 3750 m they found an enormous source of fine-grained stone that was ideal for adze manufacture and, in time, they returned to occupy the mountain for extended periods (McCoy 1990). At the same time, New Zealand Māori had worked their way well into the South Island interior, in search of flightless moa birds and stone resources such as quartz sandstone and chert (Anderson 1989; Davidson 1984). Elsewhere, limited instances of early inland occupation may also relate to the availability of novel resources. Tangatatau (Cook Islands) is a large rockshelter on the interior side of Mangaia's encircling makatea escarpment that was occupied at an early point in time. The interior lakes with their freshwater eels and fishes, along with swamps suitable for taro cultivation, may have been key attractants, particularly given Mangaia's narrow fringing reef (Kirch *et al.* 1995).

The coastal location of many early settlement sites has several implications. The land-sea interface is an exceptionally active geomorphic environment, and stream or river outflow areas especially so. There is some urgency to systematically investigate prime settlement areas and build the sample of early settlement sites before these records disappear. Rising sea levels are a further concern for coastal sites (Erlandson 2008). Lastly, coastal areas are among those most likely to be affected by contemporary developments.

Settlements and Structures

Settlement size, components, and internal spatial organisation can potentially inform on group size, social relations, and cultural affinities, attributes which aid understanding of the practicalities and dynamics of colonisation. While several early East Polynesian settlements have been investigated, few have benefitted from areal excavation. In general, findings suggest a range of settlement sizes, from hamlets comprised of a few households to small nucleated villages.

At the late 13th century Wairau Bar (New Zealand) site, discrete areas for cooking, dwelling structures, and burials were identified in the early investigations of Duff (1977; Higham *et al.* 1999). More recent studies, carried out as a prelude to the reburial of human remains from the site, have identified additional dwellings with verandas, pavings, and discrete areas of stone-working (Walter, pers. com., 2010). Similarly, at the slightly later Shag River Mouth site, several kinds of activities were identified within spatially discrete areas, including domestic structures associated with stone-lined hearths, burials, and processing activities including moa carcass processing and bone and stone-working (Anderson *et al.* 1996). These New Zealand examples may not typify central East Polynesian communities, however, given the colder climate, the economic focus on large game, and the lack of horticulture.

The 14th century southern Cook Island site of Anai'o on Ma'uke Island is useful in this respect. Six structures, in a settlement estimated to be at least 5000 m², were partially excavated (Walter 1998). Some were associated with cooking, and shell and basalt tool-working, while others were relatively free of food remains and thought to be dwelling/sleeping houses. Where identifiable, the structures were uniformly rectangular, often with a clearly demarcated veranda, and sometimes associated with pebble pavings and stone-lined hearths. The dwelling structures measured roughly 16 m², while a single larger one, also free of food remains, was interpreted as a communal building. The clear separation of cooking and other living areas is a practice shared with both ancestral Lapita and many contemporary Polynesian communities, while the possible communal structure may link to early Māori superior houses. The latter ultimately gave rise to the modern Māori *wharehau* (great house) which lies within a meeting complex known as the *marae*; this meeting complex is today a central and spiritually important component of most Māori communities and used for a variety of activities. These brief examples demonstrate how the spatial organisation of activities and internal site proxemics can

inform on East Polynesian ideologies and provide important links to both ancestral and contemporary populations.

Another excavated example comes from Hālawā Valley in the Hawaiian Islands and illustrates some of the variability in early East Polynesian residential structures. This 13th to 15th century example was a round-ended rectangular structure, outlined by stones, and measuring ca. 5 x 2 m (Kirch 1975; Kirch and McCoy 2007). The interior was bisected by a stone alignment, one half being paved with slabs and the other with pebbles. This dwelling structure is similar to ethnographically recorded examples from the Tuamotus and Mangareva. Although pebble and slab pavements are relatively common in other early contexts, as for example at Ureia, Hanamiai, and Hane, (see Table 2 for location details), rarely have structure shapes and sizes identified.

Finally, an extraordinary settlement record comes from a 13th century water-logged site in the Society Islands, initially uncovered by construction activities and investigated over several field seasons (Sinoto 1988). The wealth of perishable materials recovered from the Fa'ahia-Vaito'otia locality gives rare insights into early community life. Spread over a large area, several discrete areas of specialist activities were identified, including canoe manufacture, adze-making, and fishhook production. Posts and floorboards from at least four structures were found away from the main settlement, along with low foundation supports of wood, stone and whale bone; these were interpreted as storage structures, possibly for root crops. Among the remarkable artefact finds were fragments of fishing canoes, over a dozen whale-bone and wooden hand-clubs, two kinds of adze hafts, 91 turtle-bone scrapers, cordage, a bark-cloth beater, fragments of a wooden bow and arrows, and a whale-bone dagger and mallet. The most spectacular remains, however, were remnants of an ocean-going canoe, including side planks suggestive of a 14 m long vessel, a 2 m steering paddle, possibly a mast, and several canoe bailers; these finds are the only direct evidence for early ocean-going canoes excavated to date.

Evidence for early religious architecture is even more limited. One of the best examples of an early *marae* or shrine is a small pavement with a few uprights found at the 14th century Emily Bay site on Norfolk Island (Anderson and Green 2001). Although the large ceremonial complex of Taputapuātea on Ra'iātea Island is cited as a ritual space of both historical and contemporary importance in relation to voyaging, its construction is relatively late, dating from the 16th century (see Smith and Jones 2007:51).

The examples discussed above point to well organised settlements with clearly demarcated activity areas related to cooking, tool manufacture and sleeping. Although some of the early sites listed in table 2 are suggestive of short-term camps, the examples reviewed here are more consistent with the idea of permanently occupied settlements. Some regional variability is indicated in the form of domestic residences but further examples are needed to determine the relevance of these different structure forms.

Intra-regional “Homelands” & Early Interaction Spheres

Over the last decade, major advances have been made in our understanding of historical inter-island relationships and spheres of interaction. In particular the use of high-precision geochemical techniques, such as X-ray fluorescence, allows stone tools from archaeological sites to be traced to their original raw-material sources (e.g., Weisler 1997). Fine-grained stone has been identified and geochemically profiled from several large manufacturing centres, as well as smaller quarries and exposures (Figure 5). Among the region's largest and most important rock sources are the high elevation Mauna Kea Adze Quarry (Hawai'i Island), Eiao Island Basalt Quarry (Marquesas Islands), Tautama Quarry (Pitcairn Island), Nelson Region Argillite Quarry and Mayor Island Obsidian Quarry, the latter two both in New Zealand. Although other quarries are known, tools and raw materials from these localities were the most widely distributed in prehistory, and from an early time. Eiao adzes have been recovered from the Societies and Mangareva (Weisler and Green 2001, Weisler 1998),

Nelson Region argillite distributed throughout New Zealand (Walter *et al.* 2010), and Mayor Island obsidian carried to the Kermadecs and Chathams (Anderson 2005). Altogether four early long-distance East Polynesian interaction spheres have been archaeologically defined (Weisler 1998), with the Eiao basalts travelling the farthest (1750 km to Mangareva). The large Tatagamatau Basalt Quarry in Samoa also is noteworthy, as adzes from here were widely distributed within the southern Cooks between the late 13th to mid-15th century AD, being found at Moturakau Rockshelter (Aitutaki Island), Ngati Tiare (Rarotonga), Tangatatau Rockshelter (Mangaia), and Anai'o (Ma'u'ke) (Allen and Johnson 1997; Sheppard *et al.* 1997).

Sourcing studies are useful both for identifying homeland-colony relations and for mapping post-settlement patterns of interaction. Inter-island contacts probably were especially important during the early settlement period when newly-founded communities were being established. Exchange networks would have mitigated crop failures and unsuccessful animal transfers, and may have ensured a supply of marriage partners, craft specialists, and leaders. Archaeologically, we can track the movement of valuable utilitarian goods between islands; fine-grained basalts for adzes show up on coral islands and pearl-shell was imported to reef-poor islands for making fishhooks, other tools, and ornaments. Exchanges of rocks and shell were probably accompanied by other perishable goods, as has been modelled for the Gambier-Pitcairn network (Weisler and Green 2001). In some cases exchange may have been more socially motivated, as basalt adzes also were moved between high islands that had locally available basalts. The Henderson Island record illustrates how exchange networks might have supported permanent communities on small, isolated islands. Although Polynesians occupied Henderson for some 600 years, exchange relations with Pitcairn and the Gambier Islands broke down around the mid-15th century AD. Unable to sustain a local population in isolation, Henderson was abandoned soon thereafter, becoming one of Polynesia's "mystery islands" – places that were once settled but found unoccupied at western contact (Weisler 1995).



Figure 5. The Tahanga Basalt Quarry was an important raw material source for flaked adzes early in the New Zealand sequence. Top left: adze performs; top right: quarry site with debitage piles (the dark mounds) and person on left for scale; bottom: broader context of quarry which lies near the bend of the bay (photos, M. Allen).

By the mid-15th to early 16th centuries these long-distance relationships were diminishing. Various causes have been proposed, including changing weather conditions, economic priorities, and socio-political conditions (Bridgman 1983; Rolett 1998; Walter 1996, 1998). Exchange and interaction continued in many localities (e.g., the southern Cook Islands, New Zealand, Marquesas Islands and possibly elsewhere) but on reduced geographic scales. In some cases, the geographic scale of exchange diminished, but the amount of materials moving increased, as suggested at Palliser Bay, New Zealand (Leach 1978). Despite the spectacular evidence for long-distance voyaging and interaction well beyond the period of initial island discovery, there is still much to learn about how much material was moved, through what means (direct interaction or through intermediaries), and why.

The Settlement Process

Given the foregoing, the early East Polynesian period might usefully be divided into three chronological phases. *Phase I* represents an early period of island exploration and discovery, and possibly initial use of some archipelagos. Presently this phase is poorly represented by a small number of controversial dates and palaeoenvironmental evidence. These records date to between ca. AD 700 and 1000 and mainly derive from the southern Cook Islands, the Society Islands, the Marquesas Islands, the Gambier Group and Henderson. It may be relevant that prior to the 10th century AD, sea level in central East Polynesia was a meter or so higher than today, and the shorelines of many islands may have been both unstable and limited in near-shore resources until the 9th to 10th centuries AD (Dickinson 2003, 2009). These conditions could have resulted in a “leap-frog” pattern of island settlement with larger, higher islands (e.g., the Societies and Marquesas) being settled first (Allen and McAlister 2010).

Phase II, dating to ca. AD 1000 to 1300, is well represented both in the region’s central islands and in the margins by a well-dated suite of sites. Many communities have long-distance contacts at this time, as indicated by exotic stone tools and, to some degree, a shared material culture. Initially, wild fauna figure importantly in the diets of many communities, but it is clear that the basic elements of West Polynesian agro-economies were transferred and stabilised early in time (see below). Reliance on wild resources is often short-lived and in some cases (e.g., Hanamiai, Marquesas), the transition between intensive use of wild resources and increased use of domesticates is so rapid that it cannot be measured with radiocarbon dating, but is apparent stratigraphically (e.g., Rolett 1998). Initial occupation layers are often succeeded by ones where the evidence suggests more intensive site use, including more permanent architectural remains (e.g., house pavements), overlapping and intercutting features such as ovens, higher densities of faunal and other domestic refuse, and changes in soil characteristics such as increased organic matter. By this time, exploration had extended to island interiors and several key stone resources that were to be important throughout prehistory had been identified and were widely circulated.

It is also during this period that New Zealand and its outliers, Norfolk Island, and the Kermadec, Chatham, Auckland and Snares Islands were discovered and in some cases permanently settled (Anderson 2005; Sutton 1982). Some of these outlier islands may have been settled after populations were established on the New Zealand mainland, as suggested by the Chatham record. Others may have been identified at the same time as the main New Zealand islands, as for example, Norfolk Island and the Kermadecs.

During this period there were important innovations in material culture. Changes in one-piece shell fishhooks, and adoption of pearl-shell as a preferred raw material (see below), may have been among the earliest given their widespread distributions. Stylistic elaborations of ornaments may be somewhat later, as these are most fully developed in late 13th to 15th century sites such as Wairau Bar (New Zealand) and Maupiti (Society Islands). As outlined above, these ornaments (e.g., whale tooth

pendants, reel beads, etc.) were apparently concentrated in a subset of islands within the central East Polynesian core, generally not dispersed to Rapa Nui or the Hawaiian Islands, and are poorly represented in the southern Cook Islands. Variability in adzes is best represented in New Zealand and the idea that initial experimentation was centered here has been periodically flirted with, but largely dismissed, as none of the more valuable New Zealand stones (e.g., argillite, obsidian, or greenstone) has been recovered farther north than the Kermadec Islands (Anderson *et al.* 1999).

Phase III, dating to ca. AD 1300 to 1500, represents a period of “settling in”. The associated dates are somewhat arbitrary given that processes of adaptation and innovation undoubtedly proceeded at different rates in different island settings, dependent on factors such as island size, geological diversity, local marine habitats etc. During this period many communities maintained both intra- and inter-archipelago contacts. Evidence from several locations suggests economic changes were in-train, as the more vulnerable wild faunal resources were reduced (see below). Widely-shared artefact types were increasingly rendered in local materials, and modifications made reflecting both adaptations to local conditions, and over time, decreasing contact with other archipelagos and development of local fashions. By around AD 1450 to 1500, most if not all habitable islands are settled and long-distance contacts reduced. New socio-political and economic developments related to local factors are increasingly apparent. Given these changes, AD 1500 is used here as the terminus of the early East Polynesian period.

As should be apparent from this discussion, considerably larger samples from a greater number of sites are required to determine more clearly whether inter-island similarities and differences reflect historical connections, differential isolation, the functional contexts in which the artefacts occur, or simply different original source populations. What does seem clear is that one or more groups of related peoples began entering the East Polynesian region after AD 700 and before AD 1100. Their historical relations and on-going interactions are apparent from not only material culture but also similar social practices and more directly, through stone tool geochemistry studies. Over time long-distance contacts were reduced and interaction networks became more localised. This was accompanied by cultural divergences, more specifically, local innovations to deal with local conditions, new styles and artistic traditions, and alternative practices. Some changes were very rapid (e.g., economic), others delayed and/or sometimes more protracted (e.g., agricultural innovations), and some practices persist even today, as for example tattooing. Particular knowledge gaps lie in the northern Cook Islands, the Society Islands, and the Tuamotu Archipelago.

Early Human Innovation: Adaptation to Spatial and Temporal Variability

Pristine Landscapes & Ecosystem Dynamics:

Coping with Bounty, Coping with Loss

Colonists departing from islands to the west carried with them numerous species of plants, animal domesticates (pig, dog, and chicken), the commensal Polynesian rat, and smaller “hitchhiker” species, including tiny land snails, exotic insects, and weed seeds. These introductions are sometimes referred to as “transported landscapes”, recognising both the translocation of plants and animals necessary for survival, as well as their associates (Kirch 2000). While the transported elements may not have all been introduced as a tidy package, without domesticated plants in particular, it would have been very hard to sustain human settlement on these eastern islands. Early East Polynesian explorers also carried with them sophisticated knowledge, developed over millennia in their western homeland islands, of tropical marine environments, island forests, and their resources

The region’s first settlers found “virgin” islands teeming with birds, fish, and shellfish and, in some places, shore-nesting turtles and seals. Colonists took advantage of these plentiful resources, and birds in particular are well represented in the earliest archaeological assemblages. At the Marquesan site of Hane, for example, more than 11,000 specimens were recovered, including extinct parrots,

pigeons, and rails (Steadman 2006). However, 90% of the assemblage was ground-nesting seabirds (shearwaters and petrels), none of which nest on Ua Huka Island today. Birds were important not only as foods but also for their feathers, which featured prominently in chiefly garb and rituals, and for their bones which provided raw materials for a variety of tools and crafts (Steadman 2006). Unfortunately, the East Polynesian avifauna were quite vulnerable to humans and their exotic animals, particularly species which were flightless, ground-nesting, or slow-maturing, and a wave of extinctions closely followed human arrival.

Nowhere is the record of dietary importance and avifaunal loss more dramatic than in New Zealand. Early Māori communities, particularly along the eastern seaboard of the South Island, consumed enormous quantities of flightless moa with the capture, processing, and bone working of moa essentially structuring Māori settlement locations and logistics (Anderson 1989; Anderson and Smith 1996). In addition to moa, numerous other native birds were important sources of food, feathers, and raw materials for tools for early Māori. Many of these were amongst the nearly 30 land birds other than moa that went extinct during the Polynesian period (Duncan *et al.* 2002; Worthy 1997; Worthy and Holdaway 2002).

Although the East Polynesian avifaunal record is particularly dramatic, human impact on other plants and animals also is apparent. Changes are seen in shellfish, fish, and sea mammal populations which are suggestive of “resource depression” or localised population collapse as the result of harvesting pressures (e.g., Allen 2003; Nagaoka 2002). The East Polynesian records illustrate how even small populations with relatively simple technologies can adversely affect island ecologies.

While direct hunting played a role in native faunal losses, habitat alteration and predation by Polynesian-introduced animals also contributed, particularly rats (Athens *et al.* 2002). Several island records suggest the extinction of native fauna was quite rapid and followed by extensive restructuring of local economies. Losses often were offset by greater reliance on marine resources and increased use of plant and animal domesticates. Beyond straight-forward changes in biodiversity, however, it is likely that island environments were affected in other complex ways that are not yet fully understood, particularly with the loss of keystone species (e.g., bats which were important pollinators), apex predators which promote ecosystem stability (e.g., sharks and carnivorous fish), and ecosystem drivers (e.g., seabirds) – all groups which had important roles in ecosystem processes (e.g., Allen 2003; Harrow *et al.* 2006).

It follows from the foregoing that East Polynesian avifaunal records have an importance far beyond reconstruction of ancient diets. The earliest settlement sites provide unique views of a completely different island world from the one we know today. These records have been pivotal in understanding the timing, causes, and biology of avian extinctions in island settings, including assessments of what makes some species vulnerable to anthropogenic conditions and others resilient (e.g., Steadman 2006; Worthy and Holdaway 2002). The records also have provided crucial information on the region’s natural biodiversity, species ranges and, increasingly, ecological relationships prior to and after human arrival. This information has been used to re-evaluate classic biogeographic models (Steadman 2006), and increasingly figures in habitat restoration efforts (see Nagaoka and Allen 2009). These kinds of broader values of East Polynesia’s earliest settlement sites might well be considered in future assessments of potential Outstanding Universal value.

Technological Innovations

The rapid loss of native birds probably encouraged use of other wild resources, particularly marine fisheries. However, technologies developed in West Polynesian contexts required adjustment for effective use with eastern Pacific habitats and prey. One-piece fishhooks demonstrate the process of innovation and adaptation in response to changing conditions and raw material opportunities (Figure 6; Allen 1996). In West Polynesia, one-piece fishhooks can be traced to early Lapita settlers, who

used several shell species, including *Trochus*, *Turbo* and pearl-shell (*Pinctada*) (Kirch 2000). The largest West Polynesian assemblage, however, consists of a handful of relatively simple *Turbo* hooks found at To'aga in the Manu'a Islands (American Samoa) (Kirch and Hunt 1993). In contrast, far greater quantities of fishhooks are found in early East Polynesian assemblages, such as the 583 complete hooks recovered from Hane, Marquesas (Sinoto 1966) and the enormous assemblage of 1,700 fishhooks from Pu'u Ali'i Dune in Hawaii (Figures 7 and 8).

The prominence of one-piece shell fishhook production in East Polynesian, indeed a hallmark of early settlements, is thus enigmatic, particularly in the absence of major changes in prey preferences. A distinctive feature of the early East Polynesian hook assemblages is the wide range of forms, some rather unusual such as the out-curved shank forms, which suggests a period of experimentation. One hypothesis is that pearl-shell, a particularly strong raw material with a high iridescence, was more readily available in the East Polynesian region (particularly in the atolls of the northern Cooks, the Tuamotus, and Mangareva) and thus facilitated development of the shell fishhook industry.



Figure 6. Early style pearl-shell fishhook from Hakaea Beach, Nuku Hiva, Marquesas Islands (photo, A. Crown).

As populations moved into the marginal East Polynesian islands, pearl-shell was rare or altogether lacking. In these settings, rapid re-adjustments once again took place; in Hawai'i and New Zealand one-piece hooks were rendered in bone, while in Rapa Nui they were made from both bone and stone. Two-piece hooks also increase in importance in Hawai'i and New Zealand, apparently as a response to the opportunities provided by bone as a raw material. By reinforcing bone hooks at the weakest point, the bend, larger hooks could be produced, and presumably were useful in angling for larger prey.

Other fishing technologies included trolling rigs aimed at fast-moving surface-feeders and nets, the latter indicated by stone sinkers, net fragments, and bones from species rarely caught with hooks, such as parrotfish. The shanks and points of the composite trolling lures underwent small-scale modifications mainly related to line attachment devices. However, two quite novel design changes occurred in the Māori sequence (Davidson 1984). An early development was a cheap but efficient trolling lure for barracouta (*Thyrsites atun*) which involved a rough wooden shank and bone point, while a later more sophisticated hook aimed at kahawai (*Arripis trutta*) consisted of a bone point lashed to a curved wooden shank with abalone shell inlay.

The importance of fishing also is reflected in early faunal assemblages. One of largest and best-studied central Polynesian fishery records comes from tiny Moturakau Islet in the Aitutaki lagoon (Cook Islands). Here the protected conditions of a small overhang shelter preserved an extremely rich bone assemblage with more than 11,000 distinctive fish bones representing at least 28 different fish types, as well as a small but varied shell fishhook assemblage (Allen 1996; Allen and Craig 2009). During the early settlement period, both inshore and offshore species were targeted, particularly parrotfish, rock cod, snapper and jack/trevally. Over time, however, inshore resources became more important, and shell fishhooks were abandoned in favour of netting technologies, many still in use in the early 20th century. Similar changes in prey types and habitat use are hinted at in other stratified sites with smaller assemblages (e.g., Hanamiai, Marquesas; Rolett 1998). However, in some sites tuna, bonito and other offshore fish figure prominently at all times, as for example, at the Marquesan site of Hane (Davidson *et al.* 2000).



Figure 7. Pu'u Ali'i Dune in distance, an early Hawaiian site on Hawai'i Island, which produced an extraordinary record of fish bone and fishhooks (the white sign, ca. 2 m high, marks dune back-slope; photo M. Allen).

In some islands, larger prey also figured importantly in the diet, including a variety of sea mammals, sharks, and large birds. Harpoons made from bone, pearl-shell, ivory and wood in variable sizes and morphologies, were probably used for this kind of “big game” hunting. Harpoons, on present evidence, appear to be an East Polynesian innovation. More delicate “barbed points” were used for birding in New Zealand and the Chatham Islands (Davidson 1984).

With settlement of temperate New Zealand there was a major economic re-orientation around large game species, most prominent on the South Island where moa were plentiful, but also apparent in some North Island settings, as for example at Houhora (Furey 2002; Nagaoka 2002). Many early Māori settlements are located close to fur seal colonies, and their bones are well represented in these

sites. Sea lions, leopard seals, dolphins and other large sea-mammals were also targeted on a smaller scale (Smith 1985). The Shag River Mouth faunal record illustrates the early importance of large game species, as well as their rapid depletion and subsequent economic changes. A suite of quite striking changes took place within the span of 50 years or so, with moa and fur seal being supplanted largely by fish and small birds, and eventually site abandonment (Anderson *et al* 1996; Nagaoka 2002). The Shag River Mouth site appears to have been part of a more widespread South Island pattern, one of permanent but short-lived serial coastal villages, with sites being abandoned as resources were depleted (Anderson and Smith 1996).



Figure 8. One of many traditional Hawaiian canoe moorings at Ka Lae, Hawai'i near the Pu'u Ali'i Dune, situated to take advantage of the exceptional fishing opportunities offered by the confluence of sea currents and local upwelling (photo, M. Allen).

In the tropical central East Polynesian islands large game resources were more limited and use of them often even more short-lived. In some localities turtle bone is prominent in early strata but often less abundant than in early West Polynesian sites (e.g., Allen 2007; Kirch 1973; Leach *et al.* 1984; Weisler 1995). Dolphin hunting is indicated in some places as well, including Anakena on Rapa Nui (Steadman *et al.* 1994) and Fa'ahia in the Society Islands (Leach *et al.* 1984).

Transported Landscapes & Adaptations of Agro-economies

A major feat of early settlers was the successful transfer of three animal domesticates and some 35-odd economic plants across the considerable geographic area of East Polynesia. While these were not uniformly distributed to all islands, the key crop plants were widely established. Nevertheless,

specific crops were variably emphasized in different island locations: Marquesans favoured breadfruit, Hawaiians wet and dryland taro, while in New Zealand sweet potato cultivation dominated by necessity. Pig, dog and chicken were widely distributed in the early period, and at least chickens, were carried as far the South American coast based on recent genetic evidence (Storey *et al.* 2007). No animal domesticates are well represented in the earliest contexts and it is likely that it took some time for their numbers stabilise. Although they become more important as avifaunal resources disappeared, over time domesticates themselves also disappeared from some sequences, typically on smaller islands, where they may have competed with human populations for food resources (Kirch 2001).

Direct evidence for specific Polynesian crops is more elusive but the record is improving, aided by fortuitous finds and novel technologies such microfossil and wood-charcoal analyses (e.g., Allen and Wallace 2007, Table 4; Horrocks 2004; Horrocks and Rechtman 2009; Kirch *et al.* 1995; Ladefoged *et al.* 2005; Wozniak *et al.* in press). Among the crops and cultivated plants introduced from West Polynesia were taro (*Colocasia esculenta*), yams (*Dioscorea* spp.), breadfruit (*Artocarpus altilis*), bananas (*Musa* hybrids) and coconut (*Cocos nucifera*), while sweet potato (*Ipomoea batatas*) and gourd (*Lagenaria siceraria*) (Figure 9) were obtained by East Polynesians from South America at some point relatively early in the settlement sequence (Hather and Kirch 1991).

Field structures, such as stone rows, mounds, ditches, and planting terraces, along with sedimentary changes and systematic burning also point to early cultivation efforts. Examples of early agricultural activities are found in New Zealand, Hawai'i, and the Society Islands, where they are most reliably dated from the 13th to 14th centuries AD (e.g., Kirch 2002; Ladefoged and Graves 2008; Leach and Leach 1979; Lepofsky 1995; Lepofsky *et al.* 1992; McElroy 2007).

Complex innovations were required in temperate New Zealand to render tropical Polynesian crops and technologies productive. Only six Polynesian cultivars were successfully established – illustrating the difficulties involved in plant transfers and maintenance. Key to Māori's agricultural success was the effective transformation of the perennial sweet potato into an annual crop and their development of storage structures, including sophisticated cellars, for overwintering of both food-stores and “seed” for the next annual cycle (Yen 1961).

Even the more benign central East Polynesian conditions called for local innovations. Marquesans developed simple but highly-effective anaerobic pits for the long-term storage of processed breadfruit which was an important buffer against their devastating droughts. In Hawai'i, considerable effort was directed towards irrigated taro cultivation, using pond-field as well as flow-through terrace systems, developments which over time gave rise to large populations, surplus production, and highly stratified chiefly societies (Kirch 2000). Atoll life, in contrast, required adaptations to nutrient-poor coralline soils and limited fresh water resources, conditions which were unsuitable for many species. In these settings aroids were a common crop, cultivated in deep pits that were excavated down into an atoll's fresh water lens and sustained with heavy mulching. Notably, marginal environments also were encountered in the larger volcanic islands and often were brought into production using novel technologies (e.g., Kirch *et al.* 2004; Vitousek *et al.* 2010). Active selection on the part of East Polynesian farmers for characteristics relating to productivity, drought tolerance, taste, colour and seasonality produced numerous new varieties (e.g. Handy and Handy 1972).

Overall, the archaeological record indicates the rapidity with which early East Polynesian agriculturalists grappled with the demanding cultivation conditions presented by diverse East Polynesian environments and their success at adopting a limited suite of tropical cultigens and agronomic technologies to these conditions.



Figure 9. Important Polynesian crop plants derived from both West Polynesia and South America. On left, banana, taro, and sweet potato (top to bottom) and on right, white-flowered bottle gourd (photos, M. Allen).

Early Burial Practices & Human Health

Historically, burial grounds have played an important role in defining early East Polynesian culture and discerning inter-island relationships, with some of those findings outlined here. In 1939, the chance discovery of human remains at Wairau Bar, New Zealand, along with some quite spectacular grave goods, ended decades of scholarly debate about the origins of New Zealand Māori, unambiguously associating them with tropical East Polynesians. The initial find was extended to include another 41 individuals and more grave goods, located within an early settlement which included dwellings, cooking areas, and refuse dumps (Duff 1977). Remarkably, in 1962 a second burial ground was found on Maupiti Island (Society Islands), with an uncanny number of similarities, including the types and details of grave goods, the layout and orientations of the skeletons, and the placement of burial artefacts on the bodies.

Several patterns emerge from the Wairau Bar finds. Contrasting with later Māori practices, the Wairau individuals were buried close to the main settlement area, a pattern also seen in other early New Zealand, Hawaiian and central East Polynesian sites (e.g., Kirch 1985, Leach and Leach 1979; Suggs 1961). Three separate areas of interment were identified, which also varied in the associated grave goods; these differences were thought to reflect either chronology or differences in social status. Grave goods were numerous and included adzes, reel-style beads, perforated moa-eggs, trolling-lure shanks, whale-tooth-shaped pendants made from various sea-mammal ivories and moa bone, and necklaces of shark teeth (Duff 1977). Several burials contained more than one adze and these were frequently placed on the chest or at the shoulder. One young adult male burial was clearly a special individual, adorned with two necklaces of “whale tooth” units (one of moa bone and the other of sea-mammal ivory), two necklaces of porpoise teeth, a fifth necklace of eleven large moa-bone reels with a central sperm-whale tooth pendant, and fourteen baked argillite adzes, some quite massive. The bodies were placed in a variety of positions, including extended side, extended prone, and flexed or trussed. Most intriguingly, several were laid out with their heads to the east or southeast and their faces oriented northwest, the direction of Hawaiki, the mythological homeland (Figure 10).

On diminutive Paeao Islet at Maupiti in the northern Society Islands, a small burial-ground contained fifteen individuals placed around a square basalt marker which was itself encircled by five small whale-tooth pendant units (Emory and Sinoto 1964). As at Wairau Bar, the bodies were laid out in a variety of positions, with extended prone, extended side, flexed and “squatting” examples. In the case of the extended individuals, several of the heads were oriented towards the southeast, and with skulls generally facing the northwest, suggesting a preferred orientation, again as at Wairau Bar. Some individuals had adzes laid across their upper chests, and trolling-lure shanks, pairs of whale-teeth ornaments, and pearl-shell breast plates were among the burial goods.

Recently, the Wairau Bar series has been re-studied preparatory to reburial (Buckley *et al.* 2010). Both sexes and young, mid and mature adults are represented, along with one adolescent and two children. The post cranial remains (mostly males) suggested a vigorous and active life style with “greater use of the upper limbs.” Although the population was relatively long-lived, with several individuals exceeding 50+ years, there were indications of childhood stresses sufficient to disrupt growth, and evidence of gout, anaemia, an undetermined infectious disease, excessive tooth wear, and periodontal disease.

The information provided by these rare burial sites is multi-faceted. The similarities of grave goods and body positioning seen at Wairau Bar and Maupiti speak not only to close cultural affinities, but also inform on less tangible spiritual and symbolic concepts that relate to the afterlife, and indirectly to voyaging and homelands. The variation in grave goods potentially offers insights into differences in social status, while rendering of regional styles in local materials (e.g., moa bone, serpentine, etc.) informs on the development of local craft traditions. More pragmatically, at the time of the Wairau Bar excavations, the placement of grave goods on the bodies and the occurrence of intact ornaments (e.g., necklaces) aided interpretation of numerous isolated finds from elsewhere. The spiritual connections between contemporary indigenous peoples and these ancestral resting places also should not be under-estimated, even when direct historical linkages are lacking, as demonstrated by the rites and ceremonies associated with the recent reburial of the Wairau Bar people.



Figure 10. Cape Reinga at the northern tip of New Zealand’s North Island. According to Māori traditions, this is the point of departure for spirits after death, from which they make their way north to the ancestral homeland of Hawaiki (photo M. Allen).

Lastly, the Wairau Bar analyses, undertaken with full support of the indigenous community, point to the largely unrealised potential of human skeletal remains in the East Polynesia to provide information on health and individual life histories. Osteological and genetic information may be of considerable value to contemporary indigenous communities for health-related issues, and can inform on conditions which may have stimulated early colonising expeditions, motivated social interactions, or given rise to conflict. New bone and tooth chemistry technologies now make it possible to trace individuals to their places of childhood (e.g., Shaw *et al.* 2009). Moreover, individual diets can be assessed and compared with others in a population to identify differences in diet related to sex, age, or status (see Allen and Craig 2009 for a related study).

World Heritage Themes & General Recommendations

Early Human Expansion

This chapter has sought to provide a general understanding of early human expansion into the East Polynesian region. It is important to note that nearly all islands of this vast area were involved in the earliest period of exploration, including several which were not occupied at the time of Western contact (e.g., Henderson Island, Pitcairn Island, the Line Islands, Nihoa and Necker Islands). Irwin's chapter on *Navigation and Sailing* in this volume considers the principles, strategies, and technological requirements of Pacific colonisation, and in the East Polynesian case also provides important historical context for this third and final phase of Pacific settlement. This chapter has aimed to complement that story by exploring the economic and social aspects of expansion into and colonisation of East Polynesia.

The contribution of specific places to our current understanding has been reviewed as well, but it is stressed that sites which have provided information in the past may not be the best candidates for World Heritage listing (see below). This is not to say, of course, that these sites should not be protected. They are of significance notwithstanding their World Heritage potential.

Based on this review, an ideal East Polynesian site relevant to the World Heritage theme of *Early Human Expansion* would exhibit some combination of the following attributes:

- high potential to provide important new information on material, economic, social and/or spiritual aspects of early East Polynesian life;
- can be linked with other early regional sites in the broad heritage theme of East Polynesian exploration and settlement, such as an exemplar of a founding community within a regional network of similar sites;
- are associated with environmental settings that retain their natural properties and are thus evocative of conditions at the time of first human arrival;
- are associated with landscapes of direct relevance to voyaging histories (e.g., adjacent to reef passes) and communicate regularities of early settlement locations (e.g, proximity to key stone resources or environments suitable for early food sources, such as reef flats or rocky headlands);
- have oral history associations which could extend their cultural value and interpretive potential.

Several gaps in current knowledge also have been identified. Very few early settlement sites have been identified for East Polynesia relative to the geographic size of the region. Moreover, the Society Islands, Tuamotu Islands, and northern Cook Islands represent places where further work is critically

needed to better understand regional colonisation processes and patterns. A third problem is that several early settlement sites have been investigated but are not well reported. Finally, the process of World Heritage nomination would be considerably facilitated by a detailed assessment of current conditions, further informational potential, and immediate threats to known early sites (i.e. those in Table 2).

Early Human Innovation: Adaptation to Spatial and Temporal Variation

This chapter also sought to provide information on innovations which followed from colonisation, as settlers were both rewarded and challenged by new environments, and faced the loss of familiar resources. It is the diverse and multi-faceted environmental conditions of the broad East Polynesian region, and the opportunity this presents to visualise the process of human adaptation, that makes this region an exceptional heritage resource. The diversity of environmental conditions includes:

- climates ranging from equatorial to subantarctic;
- geologies varying from simple volcanics, to impoverished carbonates, to complex continental situations;
- island sizes ranging from the grand landscapes of New Zealand to the diminutive Nihoa (0.6 km²) and Necker Islands (0.2 km²) of the leeward Hawaiian chain;
- instances of extreme isolation.

Further, while geographic variability was considerable, so too was the rapidity with which anthropogenic impacts were set in motion, particularly extinctions and extirpations of native biota.

With respect to the theme of *Early Human Innovation*, it is the region's margins that are best known: New Zealand, Hawai'i and Rapa Nui. This is owed in part to urbanisation in the former two localities combined with their well-developed heritage management practices and legislation. In the central Pacific Islands, in contrast, including much of French Polynesia, island sequences are less well studied and early innovations and local adaptations more poorly explored.

Four issues were identified in relation to *Early Human Innovation* and specifically to the subtheme of *Adaptation to Spatial and Temporal Variability*. These are:

- *Pristine Landscapes and Ecosystem Dynamics*
- *Technological Innovations*
- *Transported Landscapes & Adaptations of Agro-economies*
- *Early Burial Practices and Human Health*

These combine with the themes considered in the *Early Human Expansion* section to pinpoint some key innovations and adaptations that are currently demonstrated and could be further developed with on-going research. However, site protection and management are essential to this process.

Some General Concluding Thoughts

- 1 This review has highlighted the importance of particular sites in relation to early East Polynesian settlement and innovation. In many cases this is based on their information content rather than visual characteristics. There also may be oral histories and associative values that warrant further investigation.
- 2 The further information value of the sites in Table 2 is uncertain. In several cases, these were inadvertent discoveries made during major earthworks such as mining, ploughing, or dredging. In

other cases, excavations have been extensive and remaining intact deposits may be limited. These sites are still important historic places, associated with early colonisation events, but the extent of intact deposits should be investigated to better inform site management.

- 3 Regional sampling issues are also a concern. Beyond New Zealand and Hawaii, the archaeological records of most East Polynesian islands are poorly known, and early settlement sites are particularly rare. It is highly unlikely that all settlement sites have been identified. It is thus questionable whether the examples reviewed here are representative. Systematic assessments of key coastal regions, with particular attention to past coastal geo-dynamics, would be very useful.
- 4 Some sites of the key sites identified here are already protected by World Heritage status which has been conferred partly or wholly on the basis of non-cultural criteria (e.g. Nihoa and Necker Islands in the Papahānaumokuākea Marine National Monument and the sites of Henderson Island). In these cases, effort should be directed to updating the related records to insure that the archaeological properties are recognised and correctly recorded. For example, the Henderson Island World Heritage site description (below) is at odds with published archaeological findings which indicate at least 600 years of human settlement (Weisler 1994, 1995):

Henderson Island, which lies in the eastern South Pacific, is one of the few atolls in the world whose ecology has been practically untouched by a human presence. Its isolated location provides the ideal context for studying the dynamics of insular evolution and natural selection. (<http://whc.unesco.org/en/list/487>)

- 5 Finally, given that some important sites are already protected by national or regional citations while others are not, the most urgent need might be to add to national Tentative Lists important properties that may meet the criteria for Outstanding Universal Value but which are currently completely lacking in other protection.

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ISLAND	SITE NAME	SITE TYPE	FEATURES OF NOTE	KEY SOURCES
Cook Is				
Aitutaki	Ureia	stratified open site	record of inter-island exchange	Bellwood 1978; Allen 1992, Allen & Wallace 2009
Aitutaki	Moturakau Rockshelter	rockshelter, stratified deposit	rich faunal record, adze & fishhook production	Allen 1992; Allen and Craig 2009
Ma'uake	Anai'o	open site, stratified	structural evidence; settlement complex	Walter 1998
Mangaia	Tangatatau Rockshelter	rockshelter, stratified deposit	rich avifaunal record	Kirch <i>et al.</i> 1995
Rarotonga	Ngati Tiare	open site	structural evidence	Bellwood 1978
Society Is				
Maupiti	Maupiti	open site	burials with elaborate grave goods	Emory & Sinoto 1964; Anderson <i>et al.</i> 1999
Huahine	Fa'ahia-Vaito'otia	open waterlogged site	water-logged site, canoe remains, artefact record	Sinoto 1988; Anderson & Sinoto 2002
Mo'orea	Opunohu Valley	agricultural sites	example of early agricultural activities	Lepofsky 1994, 1995
Austral Is				
Rurutu	Peva	dune, stratified	record of inter-island exchange	Bolt 2005
Tubuai	Atiahara Dune	dune, stratified	exceptional artefact record	Eddowes 1998; various, unpublished data
Rapa	Tangarutu Rockshelter	rockshelter, stratified deposit	stratified sequence	Kennett <i>et al.</i> 2006
Gambier Is				
Taravai	Onemea Dune	dune, stratified	rich avifaunal record	Kirch <i>et al.</i> 2010
Kamaka	Kamaka (GK-1)	rockshelter, stratified deposit	stratified sequence of artefacts & fauna	Green & Weisler 2002; Green 1960
Henderson Is				
	HEN-1	rockshelter	adaptation to makatea conditions	Sinoto, unpublished ms
	HEN-3	rockshelter, stratified deposit	rich faunal & artefact record; adaptation to makatea	Weisler 1994, 1995
	HEN-5	coastal midden	rich faunal record; adaptation to makatea conditions	Weisler 1994, 1995
	HEN-10	cave	rich faunal record; adaptation to makatea conditions	Weisler 1994, 1995
	HEN-11	rockshelter	food preparation; adaptation to makatea conditions	Weisler 1994, 1995
Pitcairn Is				
	Tautama	basalt quarry	important stone source; abandoned before contact	Weisler 1998
Marquesas Is				
Nuku Hiva	Teavau'ua	open site, stratified	stratified sequence of artefacts & fauna	Allen 2004
Nuku Hiva	Ha'atuatua Dune	dune, stratified	stratified sequence of artefacts & fauna	Rolett & Conte 1995
Nuku Hiva	Hakaea Dune	dune, stratified	stratified sequence of artefacts & fauna	Allen & McAlister 2010
Nuku Hiva	Hatiheu	open site, stratified	early site; poorly known	Orliac 2003
Ua Huka	Hokatu	dune	early site	Conte & Anderson 2003
Ua Huka	Hane Dune	dune, stratified	exceptional artefact & faunal record	Sinoto 1966, 1970; Anderson & Sinoto 2002
Ua Huka	Manihina Dune	dune, stratified	early site; poorly known	Conte 2002

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Tahuata	Hanamiai	open site, stratified	stratified sequence of artefacts & fauna	Rolett 1998
Ua Pou	Anapua Rockshelter	rockshelter, stratified deposit	rich fishhook record	Ottino 1985; 1992a, 1992b
Hiva Oa	Hanatekua Rockshelter	rockshelter	important artefact record	unpublished work, reported in Kirch 1986
<hr/>				
Rapa Nui	Anakena Dune	dune, stratified	important artefact & faunal record	Steadman <i>et al.</i> 1994
<hr/>				
Line Islands				
Fanning	FAN1-7	open site	midden; adaptation to equatorial conditions	Sinoto 1973
Kiritimati	Emory's site 3	open site	adaptation to equatorial conditions	DiPiazza & Pearthree 2001a, 2001b
Tabuaeran	un-named sites (2)	open site	adaptation to equatorial conditions	DiPiazza & Pearthree 2001a, 2001b
Kiritimati Is	KKI-03, KKI-14, KKI-15, KKI-18	open sites	adaptation to equatorial conditions	Anderson <i>et al.</i> 2002
<hr/>				
Hawaiian Is				
Hawaii Is	Pu' Ali'i Dune	dune, stratified	exceptional artefact & faunal record	Emory <i>et al.</i> 1959; not fully published
Hawaii Is	Waiahukini Rockshelter	rockshelter, stratified deposit	exceptional artefact & faunal record	Emory <i>et al.</i> 1969
Hawaii Is	Mauna Kea adze quarry	complex of sites	adze production, shrines; high altitude adaptations	McCoy 1990
Moloka'i	Halawa Dune	dune, stratified	structural evidence	Kirch 1975
O'ahu	Bellows Dune	dune, stratified	important record of features, burials & artefacts	Pearson <i>et al.</i> 1971; Dye and Pantaleo 2010
O'ahu	Kuli'ou'ou Rockshelter	rockshelter, stratified deposit	rich avifaunal record	Emory & Sinoto 1961
<hr/>				
Kermadec Is				
Raoul	Low Flat (KE/1)	open site	short-term occupation	Anderson 1980; Higham & Johnson 1996
Raoul	Farm Terraces (KE/2)	open site	short-term occupation	Higham & Johnson 1996
Raoul	Coral Bay (KE/4)	open site	short-term occupation	Higham & Johnson 1996
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Norfolk Is	Emily Bay	open site	early religious site	Anderson & White 2001
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New Zealand				
North Is	Houhora (Mt Camel)	open site, stratified	important faunal & artefact record; settlement	Furey 2002
North Is	Auckland volcanic fields	agricultural complex	agricultural complex	Sullivan 1975
North Is	Sunde site, Motutapu Is	open site, stratified	important faunal & artefact record	Scott 1970
North Is	Washpool, Palliser Bay	open site, stratified	sedentary settlement & burial site	Leach & Leach 1979
North Is	Black Rocks, Palliser Bay	open sites	important sequence of faunal change	Leach & Leach 1979
North Is	Mayor Island	obsidian quarry	large obsidian source	Davidson 1984
North Is	Tahanga Quarry complex	multiple open sites	large basalt source	Turner 1992
North Is	Mercury Is	varied sites	complete cultural sequence; well preserved locality	Green 1963
South Is	Shag River Mouth	dune, stratified	stratified sequence of artefacts & fauna; settlement	Anderson <i>et al.</i> 1996; Nagaoka 2002
South Is	Wairau Bar	open site, stratified	settlement & burial site	Duff 1977; Higham <i>et al.</i> 1999
South Is	Rakaia River Mouth	open site, stratified	very large moa processing site	Anderson 1989: 129-130

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Auckland Is	Sandy Bay	open site	short-term occupation; subantarctic adaptation	Anderson & O'Regan 2000
<hr/>				
Chatham Is				
Chatham Is	Owenga	eroding burial site	temperate adaptation; distinctive burial goods	Sutton 1980, 1982
Chatham Is	Kaingaroa	open site?	adaptation to cool temperate climate	Sutton 1980, 1982
Pitt Is	Waipaua	not known	adaptation to cool temperate climate	Sutton 1980, 1982

Table 2. Early East Polynesian Sites (see text for details on site inclusion)

Conclusion:
The path ahead



Conclusion: The path ahead

Ian Lilley

This chapter reviews issues that have emerged in the course of compiling this Thematic Study, considers the management, conservation and protection needs of sites relating to early human expansion and innovation in the Pacific, and recommends further action to support Tentative Listing and World Heritage nomination of these sorts of sites in the Pacific Region.

Findings of the study

As discussed at the beginning of this volume, in Port Vila in 2005, representatives of Pacific Island countries and territories agreed on three themes that were a priority for thematic studies in the region. These were:

- Associative cultural landscapes of stories that explain the origin and development of social structures in the Pacific;
- Cultural landscapes related to cultivation in the Pacific;
- Lapita Expansion.

Throughout the present Thematic Study a larger vision of the last of these themes has been presented. Lapita sites are important, but must be contextualised against the background of Pacific colonisation more broadly.

This study does not identify particular sites for tentative listing. Rather the aim has been to discuss the background to early colonisation and innovation in the Pacific and identify and discuss various kinds of tangible archaeological evidence that are likely to reflect this in relevant sites across the region.

The study area represents over a quarter of the globe, and the temporal framework extends back some 50,000 years, so the study has had to be selective and general. Nonetheless, the work does offer substantial detail in relation to critical issues and so should be a valuable point of departure for more detailed studies. These studies could be thematic, such as “pre-glacial occupation”, typological, such as “Early Lapita sites”, or geographical, such as “Near Oceania” or “Vanuatu” or “Eastern Polynesia”. However, an appropriate framework or basis for comparative analysis should begin by considering precisely what Outstanding Universal Value any Tentative Listing or World Heritage nomination was intended to capture. This is something only a State Party can do.

This study has been a desktop project. This means not only that it lacks original archaeological research, but also that it has had no first-hand input from Pacific Island people about the archaeological sites in question, how Pacific Island communities perceive these sites and what if anything they think is significant about them, either specifically or in general. These questions are crucial, because sites related to remote antiquity – even if ‘only’ 3000 rather than 50,000 years ago – are not necessarily valued at all by local people or non-archaeologists more generally, or at least are not valued for the sorts of characteristics the archaeologists find interesting and important. This contemporary information must be documented in relation to individual places as well as broader themes and types of property if we are to understand and assess fully the cultural significance of archaeological sites concerning early human expansion and innovation in the Pacific. Significance ascribed by contemporary communities might also contribute to the Outstanding Universal Value of the different sites.

Another limitation of this study – and of Pacific archaeology more generally – is that vast areas of the region remain completely unstudied or only patchily covered by modern scientific archaeological research. This is particularly noticeable in New Guinea as a whole (western and eastern), but also in Papua New Guinea’s island provinces. More focused and detailed studies of particular kinds of sites

in specific localities will require a great deal of basic field recording through scientific survey and excavation. This should be a priority for future work and will enable a more balanced and representative picture of the colonisation of the Pacific Islands to emerge.

Protection, conservation and management

This study is about specific archaeological places, but all heritage sites everywhere exist in evolving cultural and associative landscapes that are continually being shaped and re-shaped by interactions between people and their environment. Such interactions and their physical results are what give landscapes and the sites in them their significances and sometimes their Outstanding Universal Value. It is thus crucial that these landscapes and the processes that produce them are sustained in ways that help maintain the heritage values of specific sites and the landscapes that contextualise them. This does not mean that these landscapes will not change, but that any change should respect the significances of the landscapes and the sites they contain. Many Pacific sites and landscapes are managed in accordance with customary practices. These practices are crucial to sustaining their heritage values, as the case of the Kuk site in Papua New Guinea shows. Yet it is also generally true that customary practices need to be underpinned by protective statutes and policies. Successful long-term management and protection will thus frequently bring together traditional and legal instruments. At Kuk, for example, continuing traditional management of the site and its surroundings will be bolstered by protection from local, provincial and national laws.

Customary land management in the Pacific can be defined as contemporary land management which has evolved out of traditional practices without reference to central government laws or systems of land administration. Central or national governments have existed in the Pacific for over a hundred years. Although central governments and some earlier colonial governments have usually not played a direct role in customary land management, there are systems of private title/ownership in places such as the Federated States of Micronesia, there dating to the German and Japanese colonies, and New Zealand, where they date to the 1840s. There are also other forms of land rights such as the Tongan system where all land is owned by the Crown but allocated on a permanent basis to users. In these countries and others there is an ongoing negotiation between the central government and the people and their leaders who have a customary interest in the use of land and the conservation of its values.

The *Operational Guidelines for the implementation of the World Heritage Convention* acknowledge that customary land management can provide appropriate sustained conservation management, but only where there is a “thorough shared understanding of the property by all stakeholders” (*Operational Guidelines* 2008 s. 111 (a)). In addition, the guidelines require “a cycle of planning, implementation, monitoring, evaluation and feedback” (s. 111 (b)) and “an accountable, transparent description of how the management system functions” (s. 111 (f)). As noted by Smith and Jones (2007: 120), “conservation-focused” customary land management permits economic (commercial or subsistence) use of the land, but the World Heritage system requires that:

- customary guardians are aware of the World Heritage values and actively support them;
- reliance is placed on the good judgement of customary guardians about protection;
- relatively informal monitoring and reporting protocols are in place, e.g., new finds are reported to the national museum or other research agency;
- harmful effects beyond the control of the local community are reported promptly so that corrective action can be taken;
- part of the negotiation between national governments and local communities must involve the resourcing of local protection of World Heritage value(s).

Customary land management is therefore of primary importance in maintaining archaeological sites of the sorts identified in this thematic study. Partnerships between local communities and national

governments will be needed to sustain customary management and ensure its continuity over the long term.

When a property is nominated for the World Heritage List, it must demonstrate that it has a management system in place and that it is adequately protected. To provide structured monitoring and feedback, it may be necessary to develop some sort of formalisation of customary management and partnerships between local communities and the national government that has the responsibility for ensuring the protection of World Heritage sites. In the face of potential development, State Parties will have to demonstrate that properties have adequate legal protection of both the nominated property/site and its buffer zone.

A key issue is the need for Pacific Island countries to build their capacity to manage cultural places and landscapes so that they continue to have a strong prospect of World Heritage inscription. Both *authenticity* and *integrity* have to be satisfied as part of the assessment of Outstanding Universal Value (*Operational Guidelines* 2008 ss 79-95). *Authenticity* means that cultural value is “truthfully and credibly expressed through a variety of attributes” such as materials, use, traditions and setting (s. 82). *Integrity* means that the nominated property must be whole or be large enough to give expression to its Outstanding Universal Value and is not overwhelmed by ancillary or neighbouring development (s. 88) which might impact on its setting.

Recording and documentation

World Heritage listing requires a record of what has been nominated, to justify its Outstanding Universal Value and to provide a basis for continued long-term monitoring. As has been emphasised throughout this study, an appropriate level of documentation does not yet exist for many of the significant archaeological sites related to early human expansion and innovation in the Pacific.

Recommendations for future work

- Future studies of Pacific cultural heritage places should entail fieldwork to record and assess the tangible evidence, values and current state of conservation of places considered for inclusion in Tentative Lists. The present study has stressed that there are insufficient current, relevant, and reliable data about the extent, condition, authenticity and integrity of Pacific cultural heritage places. While recognising this has resource implications, a field-recording component which involves Pacific Island people as well as scientific survey and excavation would be highly desirable for further studies at the local and sub-regional level.
- The development and review of future studies should include detailed and on-going consultation with representatives of Pacific State Parties. Pacific Island people should also be involved in the writing of these studies. There are few Pacific Island people with training in cultural heritage, and involvement in the development and writing of cultural heritage studies could help build this capacity in the region.
- There are natural heritage initiatives under way in various parts of the Pacific. The current UNESCO-sponsored reports on these projects contain only passing reference to the cultural values of these places, which are potentially very important. All such natural areas need careful review for their cultural values. Work should be conducted to set a cultural context for all natural-heritage nominations.
- The cultural values of mixed properties presently on Pacific Tentative Lists, such as the Huon Terraces in Papua New Guinea, and the Solomon Islands’ Marovo-Tetpare Complex, need substantially more attention, with regard to archaeological as well as contemporary cultural matters.

- Pacific Island countries should consider the potential for archaeological sites to be on their Tentative Lists and to be nominated for World Heritage inscription. Some or all of the sites discussed in this thematic study may have potential to be considered as World Heritage sites but it would require far more detailed field research to determine if this were the case. The sites included in this study are only indicative examples and represent some of the many places worthy of further investigation.
- Melanesian and Micronesian nations are under-represented on the World Heritage List. While there is a great wealth of anthropological data from these sub-regions, archaeological sites are still only rarely the focus. The great diversity of cultures and environments in Melanesia does not readily lend itself to comparative frameworks beyond the most general. To address this, a future study should specifically investigate how the cultural and linguistic diversity of Melanesia is reflected in archaeological sites across the region. Micronesia is characterised by very small land areas and great expanses of ocean. It would be appropriate for future thematic studies in the sub-region to focus on the ways in which Micronesian societies and their heritage places reflect the constraints and opportunities offered by this environment.
- A study should be undertaken across all three subregions of Oceania – Micronesia, Melanesia and Polynesia – concerning the traditions relating to discovery and voyaging to complement the present study and especially Irwin’s chapter. Such a study would identify places that, like Taputapuātea in French Polynesia for example, are representative of the origin and interconnectedness and shared history of Pacific communities. Single subregional studies should be avoided, as they will make it hard if not impossible to deal with past and continuing strong connections that span the three areas. There is a very strong link, for instance, between the revival of voyaging in Polynesia and traditional skills in Micronesia. Modern Hawaiian navigators learned many of their skills from Micronesian master-mariners specifically invited to Hawai’i for training purposes.
- Associations between local people and ancient archaeological sites have not been dealt with in this study. This question should be the subject for future study that would recognise that the associations people have with their landscapes and the archaeological sites they contain are commonly part of traditional knowledge systems, and community cultural rights and ownership of this knowledge will need to be respected in the investigation of these associations. Such a study should take a holistic approach to understanding traditional (including spiritual) links with sites and their landscapes.
- Managing archaeological sites in their dynamic, evolving cultural landscapes presents many challenges in the 21st century. In this context, customary management often needs to be supported by a protective legal framework and strong local community and national government partnerships if it is to be practicable. Although the World Heritage Committee strongly supports customary management where this sustains Outstanding Universal Value, such management needs to be formalised to the extent that a desired state of conservation can be sustained, that effective monitoring and feedback systems are in place and functioning, and that adequate legal protection can be demonstrated.
- There is a clear and present need to build capacity across the Pacific to achieve a satisfactory level of management and protection that optimises the success of future nominations.
- A lack of capacity at national level could be partly overcome by regional inter-governmental co-operation and additional resourcing of regional heritage agencies.

- The material presented in this thematic study suggests the potential for serial nominations but current Tentative Lists do not indicate support for serial listings from State Parties.
- Regional co-operation in capacity building could support national and transnational serial nominations.