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Examining the Origin of Fortifications in East Timor: Social and Environmental Factors

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ABSTRACT

The remains of fortified archaeological sites abound in hilltop locations on the island of East Timor (Timor-Leste). Archaeologists have linked the emergence of these fortified settlements with environmental change. Some point to a period of reduced rainfall and increased environmental fluctuations beginning about AD 1000, while others cite relatively large-scale climate change during the post-AD 1300 transition from the Medieval Warm Period to the Little Ice Age. Both groups link environmental change to resource unpredictability which in turn leads to inter-group conflict. Of course environmental change is not the only possible trigger for conflict; a variety of social or economic factors could also be responsible. Here we present data on three fortified sites in East Timor, two of which have been dated, and combine these new data with previous work to develop a new chronology for fortifications in eastern East Timor. We then evaluate potential environmental and social factors against this chronology and other archaeological, historical, and ethnohistoric evidence. This assessment indicates that social factors, particularly the impact of increased sandalwood trade, were likely more important drivers of fortification and conflict in East Timor than environmental change.

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The remains of fortified archaeological sites abound in hilltop locations across the island of East Timor (Timor-Leste). Similar stone-walled fortifications are a common feature in the archaeological landscape of Indo-Pacific islands from Island Southeast Asia to New Zealand (Field 2008; Field and Lape 2010). While traditionally archaeologists have viewed these structures as a response to intergroup conflict and have linked the emergence of conflict with population pressure, leading to status rivalry, over-intensification, and competition for control over scarce resources (e.g., Earle 1991), the last decade has seen a proliferation of studies investigating the social impacts of climate change in prehistory (Allen 2006; Caviedes 2001; Fagan 2000; Hunter-Anderson 1998; Nunn 2007; Nunn et al. 2007). Archaeologists and geographers have proposed that significant climatic change in the Indo-Pacific region over the last thousand years had far-reaching and traumatic environmental impacts with commensurate social consequences, including an increase in inter-group conflict promoting the wide-scale construction of fortified settlements across the Indo-Pacific region (Field 2008; Field and Lape 2010; Nunn 2007).

Within East Timor, Lape (2006) and Lape and Chao (2008) identified and excavated a number of fortified settlements in eastern East Timor (Figure 1). They propose that fort building began circa AD 1000 and was the direct result of climate-induced resource stress and a subsequent development of inter-group conflict. Nunn (2007) instead incorporates the East Timor region into a larger analysis that attributes fortifications to resource impacts arising from climate change associated with the post-AD 1300 transition from the Medieval Warm Period to the Little Ice Age. These two hypotheses thus propose different time frames for the start of fortifications.

In addition to environmentally based causes, social and economic factors can also lead to conflict. Population pressure, trade

imbalances which favor certain groups over others, and raids or colonization by outside groups can lead to endemic conflict and the development of defensive fortifications. In this article, we present data on three fortified sites in East Timor, two of which have been dated, and combine this new data with previous work to develop a new chronology for fortifications in eastern East Timor. We then evaluate environmental and social hypotheses for the origin of fortifications against this chronology and other archaeological, historical, and ethnohistoric evidence. We begin with a discussion of the characteristics of fortified and defensive prehistoric sites in East Timor.

FORTIFICATIONS IN EAST TIMOR

Field and Lape (2010) note that while many thousands of fortifications are known throughout the Indo-Pacific region, dated examples number less than 200, and most of these are in New Zealand and Hawaii. Similarly, fortifications are abundant in East Timor but only a handful have been dated; dates for two additional sites are presented below. Moreover, not all walled enclosures in the contemporary landscape of East Timor should be classed as fortifications. Walled enclosures come in a range of shapes and constructed forms as well as a variety of locations and degrees of integrity and completeness. Former settlement sites are generally identified with the phrase *lata irrata* or *lata paru* by local people and all refer to ancestral residential places of named groups (*ratu*). Fortified *lata* are called *pa'amakolo*, which is a composite construction of *pa'a* (to pile up) and *makolo* (dense or wide walls).

Places known as *pa'amakolo* tend to share a number of common structural features which indicate that they are true fortification sites (see also Lape 2006). They are often built on hill tops and cliff-edge locations sometimes hundreds of meters above

Figure 1. Location map of East Timor showing Macapainara, Vasino, Masui, and fortifications discussed by Lape and Chau.

sea level. Most are enclosed by massive stone walls around the periphery with un-walled sections utilizing the defensive protection afforded by the steep drop of a cliff face. The enclosing walls commonly comprise double rows of dry-stacked limestone (1 to 4 m in height and 1 to 2 m wide at the base) which are infilled with irregular limestone rubble, known as *boro*, which litters much of the karstic limestone forest floor in the region (Figure 2). Those with the more massive walls usually have gateways and narrow meandering passageway entrances. These entrances/exits may have been guarded from above. The walls on the larger structures are sometimes slitted, indicating that weaponry was used in their defense. Defense against artillery (cannon) has been indicated by oral narratives, but there is currently no archaeological evidence of artillery attack. Planting of cacti outside, atop

and perhaps on the inside of the perimeter walls provided an additional defensive barrier. On a visit to the former settlement of Locami, informants identified five different species of cacti (*latu*)—*latu irinu*, *latu uku*, *latu pokala*, *latu lépenu*, and *latu sériku*—growing along the perimeter walls of the fortification (Pannell and O'Connor 2010:124).

Gateways to fortified sites typically open onto an internal walled space (*laca*) which is said to be the area where visitors were inspected or greeted. These tend to be semi-circular in plan. Fortified sites in East Timor always include stone structures identified by local informants as graves. They are said to house the remains of ancestors and are extremely venerated (Figure 3).

Oral accounts, together with the mapping of the internal features of the fortifications, indicate that they also contained circumscribed ceremonial spaces called *sepu*

Figure 2. Section of stone wall showing large outer rocks and rubble infill.

where dancing and communal feasting took place and where ancestral graves (*calu lutur* or *narunu*) may be located. The forts also include distinctive sacrificial platforms that are marked with upright stone or wooden posts (*ete uru ba'a* or *sikua*). These remain sites of sacrificial veneration for customary owners of the former settlements. The wooden or stone posts represent material markers of guardian beings (*mua ocawa*) and are sites of ritual power (*tei*).

As well as the large fortified settlements (*pa'amakolo*) there are many smaller walled structures that may be no more than 15 to 20 m in diameter. Locals sometimes ascribe them status as early villages, but they do not have visible remains of house structures or graves within the walls. They are also not constructed in naturally defensible locations. It is possible that the walled spaces in

these smaller circular structures were used to enclose animals rather than people, and that the villages were adjacent to the animal corrals but were not themselves enclosed. Buffalo corrals known as *lobo* are still widely used in this region of East Timor. There are also a variety of intermediate sized structures with low narrow walls; many of these have been subject to processes of reclamation and use in the construction of subsequent cycles of swidden garden walls. These small and intermediate-size settlements are not considered to be fortified sites in the present analysis.

ARCHAEOLOGICAL EXCAVATIONS

In 2008 a team of archaeologists and local people excavated the hilltop fort of

Figure 3. Grave at Macapainara showing Batu Makassar dressed fine sandstone upper level overlying rough cut limestone blocks.

Macapainara, near the port and village of Com. In 2009, Vasino, a hilltop fort near the modern village of Moro-Parlamento was mapped and excavated and Masui, a cliffside fort at Ira Ara, was mapped (Figure 1). The material recovered from the excavated sites was consistent with Lape and Chao's (2008; see also Chao 2008; Lape 2006) excavations in East Timor in that it included abundant earthenware pottery sherds, as well as animal bones, marine shells and a few stone artifacts. The excavations at Macapainara also recovered imported trade ceramics and glass. A brief overview of each of these sites is presented below, followed by an extended discussion of site chronology as it relates to the emergence of fortified sites in East Timor. For more detailed discussion of Macapainara and Vasino excavation results see

O'Connor et al. (in prep.) and Brockwell et al. (in prep.).

The site *Macapainara* is part of a two-level fortified complex located 175 m above sea level and approximately 2 km in a straight line distance from the coast (Figure 1). The upper level is known as Ili Vali and references the large rocky bluff on which the complex is located. Ili Vali has a narrow stone entranceway, several graves made of dressed stone and several large flat circular dressed disks made of fine grained sedimentary rock, identified locally as *batu Makassar*. The lower level, known as Macapainara, is surrounded by massive encircling stone walls to the north and south which are up to 3 m high and 2 m thick at the base. This area is a natural sediment trap and was selected for excavation as the part of the site most likely

to have some depth of deposit. Macapainara has several stone structures identified by local informants as graves, including one very large structure facing east-west identified as a double grave containing the remains of the former ruler of Ili Vali / Macapainara and his close political ally (Figure 3). This grave measures 3 m in length and 2.2 m in width. The base of the grave is constructed from shaped limestone blocks while the upper section is made from flat dressed pieces of fine-grained sandstone. At the time of our field visit it had a Chinese blue and white tradeware bowl on the surface.

Excavations in three 1 m by 1 m test pits (pits A, C, and D) reached a depth of circa 1.5 m and contained a variety of wild and domesticated terrestrial faunal remains,

fish, shellfish, sea urchin, earthenware pottery, glass (including beads and bottle fragments), ceramics, charcoal, and occasional seeds (*Celtis* sp.). Small quantities of worked shell and bone were also recovered, demonstrating that decorative items were made at the site.

Vasino is located on a hill top about 2 km inland from the north coast of East Timor (Figure 1). Like Macapainara, Vasino was built on two levels. The lower level has a nearly flat surface that encompasses an area of about 1,950 m² at an elevation of about 240 m. It is bordered on the west by a high, steep cliff, while stone walls and shorter cliffs line its north and south edges (Figure 4). This level contains two stone structures with standing stone markers which local

Figure 4. Plan of Vasino fortifications and features.

informants identified as graves, as well as a carved wood pole (*ete uru ha'a*) of current sacred significance. Its eastern boundary is a 3- to 5-meter high cliff which also forms the western boundary of the upper level. The upper level is fairly even and covers about 2740 m², and has for its eastern boundary a 2- to 4-meter deep natural gully with sharp edges. The gully is about 5 meters wide along the northern portion of the upper level, and widens considerably as it continues south. To the east of the gully is a rising slope that eventually crests on a hill that overlooks the site; Vasino would be highly vulnerable to artillery attack from that hill but it is probably too distant when using traditional weapons. The northern boundary of the upper level is protected by a slope with a series of stone walls which we have termed the Back Entrance. The upper level has one stone structure identified as a grave and a 15 m diameter circular structure which local informants identified as a water buffalo coral (*lobo*). This seems unlikely since there is no gap in the large stone walls of the structure for an animal gate. Vasino's two levels are joined on the south side by a stone wall-lined *laca*. A grave structure is located within the *laca* at a pinchpoint between natural stone cliffs about midway along the slope between the two levels. Outside the *laca*, the ground slopes gently down to the south and east.

Eight 1 m by 1 m test pits were excavated in four locations within the walled enclosure, but the sediment deposition of only 50 to 80 cm was much shallower than at Macapainara. Local informants estimate that the site has been abandoned for the last 200 years. The archaeology appears to endorse this as the top layers were virtually sterile of artifacts and dominated by land snail. The range of finds was similar to Macapainara and included pottery, wild and domesticated terrestrial fauna, shellfish, land snail, and charcoal. However, foreign imported wares such as glass and trade ceramics were entirely absent from Vasino excavation pits.

Masui is a cliff top fortification site near the modern village of Ira Ara and 500 m from the coast at an elevation of 80 m (Figure 1).

It forms a large semi-circular open site covering 13,830 m² with massive stone walls constructed on the curved side, and a seaward-facing side formed by a sheer cliff drop off (Figure 5). The surface is fairly even, with a gentle slope from the cliff edge down to the southwest. There are two entrances; one in the northwest corner which is guarded by a protruding stone wall, a *laca*, and the cliff slope, and the other in the easternmost corner. This latter entrance includes an opening in the stone wall configured as a rudimentary gateway, with the ground outside the entrance sloping steeply down to the northeast.

Like Vasino, Macapainara and other clearly fortified settlements, Masui contains stone structures with upright markers that local informants identify as graves. There are eight such graves at Masui, all of which have one or more upright wooden or stone markers. There is also a 13 m diameter circular stone walled structure again identified by local informants as a buffalo pen (*lobo*); as at Vasino, it does not have a gap in the stone for an animal gate. In addition, Masui has a number of stone fences made of a single row of piled stone which are much less sturdy than the stone walls and have unknown function. Unfortunately, we did not receive permission to excavate at Masui so its subsurface archaeology and occupation dates remain unknown.

FORTIFIED SITE CHRONOLOGY

The chronology of fort building will be used in our assessment of competing environmental and social hypotheses of fortification causes. Unfortunately dating of the forts is complicated by the uncertainty of radiocarbon date estimation and calibration. In particular, radiocarbon dates from the period after AD 1500 tend to produce relatively large calibrated age ranges due to fluctuations in the radiocarbon calibration curve during this period. Within a calibrated date range, furthermore, specific dates are not uniformly likely but instead the date ranges have probability distributions whose irregular shapes are determined by the uncertainties

Figure 5. Plan of Masui fortifications and features.

involved in measuring and calibrating each date. It can thus be unclear how to combine multiple calibrated radiocarbon dates so as to assess specific questions related to multi-site occupation start dates. This latter problem is addressed through the use of Bayesian analysis to combine the calibrated

probability distributions of multiple related dates and produce an overall probability distribution. Specifically, we used the BCal online Bayesian radiocarbon analysis tool (Buck et al. 1999, <http://bcal.shef.ac.uk>) to produce a probability distribution that represents the start of fortified occupations in

eastern East Timor. The radiocarbon dates used in our Bayesian analysis are described below; more details on the Bayesian analysis and this chronology assessment are available elsewhere (Fenner et al. in prep.). Only terrestrially based radiocarbon dates are included because the carbon reservoir offset for marine organisms (ΔR) is unknown for this area, preventing the use of marine dates in the high-precision analyses required for our purposes.

We obtained AMS radiocarbon dates from apparently intact stratigraphic levels within Vasino. As discussed in Brockwell et al. (in prep.), pit D was stratigraphically mixed so its dates cannot be used for the present analysis. In addition, one date from pit A is out of sequence and anomalously early (indicating a probable old wood problem) and two near-surface spits returned post-AD 1950 dates which are not included here. This leaves a total of 12 valid radiocarbon dates from Vasino (Table 1). Nine AMS data were obtained from Macapainara (Table 1). These dates are combined with a total of ten published radiocarbon dates from five other fortified sites in the area: Bukit Aiteas, Ira Ara, Lekpaturen, Lorilata, and Malarahun Lama (Table 1) (Chao 2008; Lape 2006; Lape and Chao 2008). Thus a total of 31 radiocarbon dates from seven fortified sites were used in assessing the start of fortified settlements in eastern East Timor. Bayesian analysis was performed which computes the posterior probability distribution of a hypothetical event which immediately pre-dated the start of fortified occupations as represented by the radiocarbon data in Table 1. The area under the curve of this distribution was then summed up to a particular year. This was repeated for a sequence of years to produce the curves in Figure 6, which represent the probability that fortified occupations started after a specific year (Fenner et al. in prep.).

We use the curves in Figure 6 to assess the most likely starting date range for fortified occupations in eastern East Timor. It is critical to define specifically what is meant by "most likely". In Bayesian analyses the actual probability of interest is estimated rather

than the probability that a condition is the result of chance sample selection (as is the case in frequentist statistical approaches such as *t* tests). It is therefore inappropriate here to use the typical 5 percent probability cut-off common in archaeological frequentist analyses. We prefer to use two measures of what is meant by "most likely": the 80 to 20 percent interval probability interval and the 50 percent probability year. The 80:20 interval assesses the most likely period during which fortified occupations began, while the 50:50 date identifies when it is equally likely that fortified occupations began either earlier or later.

The 80:20 interval for the start of fortified site occupation when all seven dated sites are included is AD 1334 to 1373, and the 50:50 date is 1358. To evaluate how sensitive the analysis is to particular dates, we sequentially removed the earliest sites and redid the analysis (Figure 6). Removing the earliest site, Bukit Aiteas, only shifts the probability curve forward by about 25 years. Removing the next earliest site, Vasino, produces a less steep curve and shifts the start of occupation from 50 to more than 200 years. In particular, the 50:50 date increases by 232 years (compared to the full seven-site set) to AD 1590. Removing two more sites shifts the dates by another 150 to 200 years, with a midpoint at AD 1776. This sensitivity analysis points out several interesting characteristics of our data set. First, there are two sites that drive the earliest date of fortified site occupation: Bukit Aiteas and Vasino. These two sites in effect reinforce each other, suggesting that the early dates from neither site are likely to be purely an artefact of the dating process or samples selected. Note, however, that it remains possible that the early dates from these sites represent unfortified occupation of the hill-top locations, with walls and other fortifications being constructed later in time. The only radiocarbon date taken from directly beneath a fortified site wall is Vasino G7 wall, and it has a relatively late calibrated date range of AD 1658 to 1805 (Table 1). There is currently insufficient data directly related to fortification construction to assess whether

Table 1. East Timor fortified sites radiocarbon dates.

Site	Sample ID	Lab ID	Radiocarbon date (RCYBP)	Calibrated range (year AD)	Ref.
Bukit Aiteas	1	NTU-4669	410 ± 40	1450 to 1519, 1538 to 1625	1
Bukit Aiteas	3	NTU-4656	780 ± 55	1244 to 1254, 1256 to 1322, 1339 to 1398	1
Ira Ara	Burial 2	Beta-214264	80 ± 40	1692 to 1727, 1806 to 1927	1
Ira Ara	Burial 3	Beta-214266	310 ± 40	1497 to 1671, 1782 to 1795	1
Lekpaturen	L4a	NTU-4746	250 ± 55	1508 to 1682, 1622 to 1712, 1716 to 1817, 1828 to 1893	3
Lekpaturen	L4b	Beta-232525	360 ± 55	1455 to 1650	3
Lekpaturen	L5	Beta-196470	310 ± 40	1496 to 1671, 1781 to 1796	1
Lekpaturen	L7	NTU-4475	300 ± 55	1479 to 1682, 1731 to 1802	1
Lorilata	4	Beta-184711	240 ± 30	1642 to 1686, 1729 to 1803	2
Macapainara	A2c	WK24947	54 ± 30	1809 to 1837, 1845 to 1858, 1880 to 1922	5
Macapainara	A8c	WK24948	83 ± 30	1806 to 1840, 1842 to 1867, 1876 to 1923	5
Macapainara	A13c	WK24949	221 ± 30	1666 to 1683, 1725 to 1814, 1836 to 1849, 1855 to 1879	5
Macapainara	C2c	WK24950	107 ± 30	1804 to 1923	5
Macapainara	C7c	WK24951	72 ± 30	1808 to 1839, 1844 to 1866, 1878 to 1923	5
Macapainara	C13c	WK24952	282 ± 30	1644 to 1665, 1739 to 1801	5
Macapainara	D2c	WK24953	49 ± 30	1809 to 1838, 1880 to 1922	5
Macapainara	D8c	WK24954	193 ± 37	1721 to 1897, 1920 to 1932	5
Macapainara	D15c	WK24955	93 ± 30	1806 to 1870, 1876 to 1924	5
Malarahun	4	NTU-4674	410 ± 60	1446 to 1637	1
Lama					
Vasino	A2	ANU12626	510 ± 20	1420 to 1452	4
Vasino	A3	ANU12627	590 ± 20	1327 to 1337, 1391 to 1428	4

(Continued on next page)

Table 1. East Timor fortified sites radiocarbon dates. (Continued)

Site	Sample ID	Lab ID	Radiocarbon date (RCYBP)	Calibrated range (year AD)	Ref.
Vasino	C2	ANU12635	410 ± 30	1454 to 1511, 1573 to 1621	4
Vasino	C3	ANU12636	430 ± 20	1450 to 1502, 1591 to 1614	4
Vasino	C4	ANU12637	420 ± 20	1452 to 1506, 1586 to 1618	4
Vasino	E6	ANU12631	380 ± 20	1477 to 1627	4
Vasino	F2	ANU12633	90 ± 20	1701 to 1722, 1810 to 1837, 1880 to 1921	4
Vasino	F4	ANU12619	400 ± 20	1457 to 1512, 1547 to 1566, 1568 to 1622	4
Vasino	G7nut	ANU12625	360 ± 30	1484 to 1638	4
Vasino	G7wall	ANU12621	210 ± 20	1658 to 1693, 1727 to 1805	4
Vasino	H1	ANU12623	320 ± 20	1508 to 1583, 1619 to 1649	4
Vasino	H4	ANU12624	170 ± 20	1672 to 1743, 1798 to 1819, 1825 to 1893, 1922 to 1933	4

The calibrated ranges are the 95 percent highest probability density regions computed by BCal using the SHCal04 calibration curve (McCormac et al. 2004). The Vasino G7nut sample was a *Celtis* sp. nutcase; all others were charcoal samples of undetermined species. References: (1) Lape and Chao 2008 (2) Lape 2006 (3) Chao 2008 (4) Brockwell et al. in prep. (5) Fenner et al. in prep. For Vasino and Macapainara, sample ID shows the pit identifier and the spit that the sample was taken from.

Figure 6. Probability that radiocarbon dates at fortified sites in eastern East Timor date later than specific years. The radiocarbon dates are from Table 1. The six-site curve omits the Bukit Aiteas site, the five-site curve also omits Vasino, and the three-site curve also omits Lekpaturen and Malarabun Lama.

fortifications substantially postdate site occupation, but the fairly inaccessible nature of both site locations does imply that protection from attack was a consideration during the initial occupation period. Of course, it is also possible that sometime after initial occupation fortifications became unnecessary but the sites nevertheless continued to be occupied. This would not affect our analysis of the initiation of fortification.

A second implication of the sensitivity analysis is that fortified site construction continued for hundreds of years after an initial impetus that led people to fortify their positions. In other words, not only were fortified sites occupied over long periods of time (which could be the case even if fortification was no longer needed), but new sites were continually being established in defensive locations and fortified with stone walls. Any hypothesis regarding the cause of fortifications in East Timor must take this into account.

In sum, the current radiocarbon data set indicates that fortified occupation sites may have been initiated as early as AD 1300, but continued to be constructed and developed for centuries and become widespread at least by the period between AD 1550 and 1750. We will now turn to evaluating a variety of potential environmental and social drivers of fortification against this chronology. This will allow us to reduce the range of potential causation agents by eliminating those which do not match the chronology, leaving one or more working hypotheses relating environmental and/or social changes to the onset of fortifications.

POTENTIAL ENVIRONMENTAL DRIVERS OF FORTIFICATION

Lape and Chao (2008) hypothesize that fort building commenced in East Timor as a direct result of climate induced resource stress

and subsequent development of inter-group conflict. They argue that droughts associated with heightened ENSO events which started around AD 1100, peaked around AD 1300 and ended by AD1600, had uneven effects across the landscape, favoring some groups and stressing others. In their view, fortifications were built by the favored groups for protection from attacks by stressed groups. Lape and Chao (2008:19) acknowledge that there is a significant disjunction between their predictions and their archaeological findings, with fortifications starting well after the start of heightened ENSOs and the majority of their dated sites post-dating the peak ENSO period. Our chronology reinforces this, with fortifications not starting until sometime after AD 1300 and most post-dating the end of the heightened ENSO period at AD 1600. As discussed below, there is also no clear reason to assume that droughts were common in East Timor during this period.

Nunn (2007) explains the rise of fortification building in the wider Pacific region as a consequence of rapid environmental change associated with the transition from the Medieval Warm Period to the Little Ice Age (LIA) from circa AD 1250 to 1350. These climate period designations are based on northern hemisphere data, but Nunn (2007) uses a variety of data from the Pacific rim and Oceanic islands to argue that the southern Pacific region also became colder during that transition period. Allen (2006) also assessed environmental data related to Oceania and found a significant change during the period, but in the opposite direction, becoming warmer. Nonetheless, because the Nunn assessment is more relevant to the East Timor region, we will review its applicability to fortification building in East Timor.

The last few decades of the time period proposed for the onset of widespread climate change coincide with the dates in our chronology for the onset of fortifications in East Timor. To better assess whether this climate change incited conflict and therefore fortifications, we must consider the probable effect in East Timor of each of the spe-

cific environmental changes during the period. Nunn (2007) does not identify specific climate changes for East Timor, but does discuss particular changes for the broader region. Unfortunately, no paleoclimate work has been done for East Timor itself (Barnett et al. 2007) so climate change assessments in East Timor necessarily must be fairly general.

Nunn (2007:93–97) proposes that the western Pacific suffered extended droughts related to changes in monsoon patterns during and after the transition to the Little Ice Age. However, this is largely based on drought data from China. Recent climate investigations indicate that the monsoon changes during this period were related to southward movement of the Intertropical Convergence Zone (ITCZ—the area where the northern and southern hemisphere winds meet) (Sachs et al. 2009). This brought drought to areas north of the current ITCZ position, but likely increased rainfall and decreased the impact of ENSO events on East Timor and other areas within the southern IndoPacific Warm Pool (Tierney et al. 2010). On this evidence drought due to monsoon change is unlikely to have been a significant driver of fortification in East Timor. Another impact of the LIA cited by Nunn (2007:103–112) is sea-level drop. While this could impact low islands, East Timor is mountainous with steep coastal dropoffs so sea level change would not change the coasts substantially. As evidence of this, marine shells are found in East Timor throughout archaeological sites spanning the much greater sea level changes around the last glacial maximum (O'Connor 2007; O'Connor et al. 2010). They are also found in all occupied levels of Macapainara and Vasino.

The most obvious impact of the LIA was cooler temperatures. While this doubtless had an impact on temperate regions, East Timor has a tropical climate with less than 3 C seasonal change in temperature (Barnett et al. 2007). It is difficult to see how a slight cooling would cause substantial changes in East Timor, especially prior to maize cultivation on mountain ridges (see below for more on maize cultivation).

POTENTIAL SOCIAL AND ECONOMIC DRIVERS OF FORTIFICATION

Thus no strong environmental driver for circa AD 1300 climate change has been identified for East Timor. Until paleoclimate data focused on East Timor itself is available, there remains the possibility that some unknown environmental change associated with the transition to the LIA drove resource unpredictability and then conflict, but we will now turn to considering possible social drivers of conflict.

Population Growth

Population growth leading to resource scarcity can be a cause of conflict. However, unlike Oceanic islands where crowding is often proposed as both a source of conflict and the development of hierarchical societies, East Timor has been occupied for at least 42,000 years (O'Connor 2007). It must have long since reached and adjusted to carrying capacity, so a technological or social innovation would be required to increase population substantially. The only such innovation known for the timeframe of interest is the arrival of maize. While there is no clear evidence when maize was introduced to East Timor, it is reported to have been established in neighboring Maluku by the 1540s from whence it could have easily been transported to Timor. By 1658 it was reported as the main crop in western Timor (Hägerdal 2009:30; Reid 1993:19). The introduction of maize probably allowed for substantial food surpluses and higher populations among the scattered Timorese settlements. According to Fox, for example, maize probably replaced a multi-crop swidden system based around millet with some rice, legumes and tubers which would have supported a population of less than 10 to 14 persons per sq km. Maize, by contrast 'provided the Timorese with the potential to support a population several times that density' (1988:268). Such demographic shifts are hinted at by the expansion of *Tetum* speakers from their settlements in south-central Timor, northwards and along the south coast, and the aggressive historical expansion of *Meto* speakers through-

out west Timor (Fox 2000:21; McWilliam 2002). Nevertheless, under our fortification chronology the post-AD 1500 date for maize arrival (along with other New World crops and technologies such as gunpowder) is too late to account for the start of fortifications in East Timor. Maize and guns may, however, have played a role in the continuation of fortification building in subsequent centuries.

Slave Raids

Slavery has a long history in eastern Indonesia where control over labor was always a critical component of local power relationships and a measure of political status. Forms of debt bondage within hierarchical patron client relationships were therefore common features of island societies and bonded individuals (slaves) became a widely defined strata of social status. As Anthony Reid has noted, the system of bonding based on debt was one where loyalties between owner and slave were strong and intimate, but also became transferable and saleable (1988:129). It is unknown how far into the past this trade extended.

Slaves as a tradeable commodity are mentioned in the earliest accounts of European records of contact with Timor. Barbosa's account from 1518 identifies 'sanders-wood, honey, wax, slaves and also a certain amount of silver' as traded items from the island (Dames 1921:195-196). Slavery in eastern Indonesia flourished following both the adoption of Islam across the Indonesian archipelago and the rise of European colonialism in Southeast Asia. As Reid has noted, with the Islamization of Java and the extension of *Shari'a* law forbidding enslavement, the major Muslim cities from the late sixteenth century were supplied with slaves from beyond the frontier of Islam. The destruction of Banda by the Dutch in 1621 saw the extermination or exile of the local population and a subsequent dramatically increased demand for slaves to work the expanding plantations. Timorese slaves were taken to the island of Kisar off the northeast coast of Timor from where they were transhipped to Maluku to work on the Banda nutmeg plantations (Rodenwaldt 1927:19).

The demand for slaves from the area increased when the VOC in 1689 forbade 'the use of slaves from Butung, the Malay areas, Makassar, Bali and Java' (Andaya 1991:83). The slave trade continued across the eastern Indonesian archipelago for centuries. Earl for example in a commentary on the 'quasi-Papuan tribes' of southeast Timor observes that these people are wary of strangers and have good reason to be so because the 'great slave mart of the Bughis and Macassar traders, Kapalla Tanah, or the Land's-end, is in their immediate neighbourhood' (Earl 1853:182). 'Kapalla Tanah' [*Kepala Tanah* or 'Head of the Land'] is the name that appears on maps from this period for the most eastern point on the island of Timor (Weber 1902). Furthermore, oral histories of the senior clans of the old Com port adjacent to Macapainara recall an enthusiastic and successful engagement in slaving.

Timorese slaves were thus important to Islamic and European traders, and doubtless slave raids caused untold conflict within Timor. However our historic records do not document extensive slaving prior to circa AD 1500, and no direct archaeological evidence of early slaving has yet been found. Therefore, based on current evidence, slaving post-dated the start of fortifications in our chronology. It should be remembered however that Malaccan and Javanese slave raids may have occurred much earlier than currently documented.

Beeswax Trade

Beeswax was one of the most important Timorese trade items during the European period. Gunn (1999:115) reports that as late as the early nineteenth century, more than 20,000 *piculs* [with 137 lbs per picul, according to Echols and Shadily (1990:428)] of beeswax were exported annually from Portuguese ports in Timor. Alfred Russell Wallace reports from his visit to East Timor in 1861, that "almost the only exports of Timor are sandalwood and bees'-wax" (1872:199). As previously noted, Barbosa listed wax as a Timorese export in 1518. Beeswax was probably important to Timor trade prior to European arrival (Meitzner Yoder 2011). As with

slaving, the beeswax trade evidence does not extend as early as the start of fortifications on East Timor, but there is some reason to believe that it occurred prior to the start of our records. Beeswax collection and trade would likely not be visible archaeologically, so the lack of archaeological evidence is unsurprising.

Sandalwood Trade

Historical accounts indicate that the export of sandalwood—for which the island of Timor was famous—was established by the Chinese from perhaps as early as 900 years ago. In his circa AD 1225 discussion of trade, Chau Ju-Kua notes that Timor was a source of sandalwood for the Chinese (Hirth and Rockhill 1911:208). Wang Ta-yuan, in a work published around AD 1350, describes what appears to be a fairly robust trade in Timorese sandalwood for Chinese silver, iron, ceramics and cloth. He indicates that the Chinese visited twelve ports, and that the Timorese had local chiefdoms. The trade involved in at least one case a visit to Timor by a Chinese junk carrying over 100 men (Ptak 1983).

Securing access to the trade in high quality white sandalwood (*Santalum album*) was one of the influential factors that brought early Portuguese traders to Timor's shores. It is not known exactly when European-controlled sandalwood trading began in East Timor, but by 1516 Jorge Fogasa was able to secure and successfully ship lucrative amounts of sandalwood to the Portuguese base in Malacca (Gunn 1999:55). Sandalwood and beeswax are also mentioned as two of the products of Timor recorded by Pigafetta in 1522, and sandalwood is the first export product mentioned by Barbosa in 1518. From the mid-sixteenth century and over the ensuing century Portuguese efforts to secure the sandalwood trade from Timor for the lucrative Chinese market saw a major increase in exports. While Timorese sandalwood production was never efficiently managed by the Portuguese (Villiers 1994), by the end of the sixteenth century Timorese sandalwood ended up in India and China on an unprecedented scale. The scented wood was obtained both through treaty with coastal

Timorese politics and more coercive means including raiding and subjugation. Antonio Bocarro writing in 1635 highlighted the importance of the sandalwood trade and noted that “in fact sandalwood became so popular that it was used as a kind of currency in the Solor-Timor area” (cited in Ptak 1999:105).

The high point of sandalwood exports was reached towards the end of the seventeenth century before the impact of overcutting and plunder of mature stocks began a long term decline in the revenue potential of the scented wood. Nevertheless it continued to play an important role as a lucrative export from Timor, particularly for well placed Timorese suppliers.

The material wealth gained through the sandalwood trade undoubtedly contributed to a degree of competition and possible resource conflicts between rival Timorese groups (Fox 1988:263–264; McWilliam 2005:290–291). Control over sandalwood production and trade brought prosperity and enhanced status to well placed political communities while limiting benefits to others outside the sphere of trade. Marked differences in material wealth likely made the trade-controlling communities potential targets of avarice among neighboring groups and also may have given them the resources to expand their territories at the expense of their neighbors.

Sandalwood trade is thus documented both at the start of East Timor fortification building and throughout the following centuries when fortifications continued. As with other trade products, the harvesting and exporting of sandalwood is unlikely to leave archaeological remains, so the lack of archaeological evidence is expected. Sandalwood trading is thus a plausible cause of resource inequity, conflict and fortification building.

Autochthonous Social Developments

It may be that conflict arose internally within East Timor without any external influence. Perhaps a coalition of clans decided to expand their territory, which led to war and the construction of defensive occupation sites. This is pure speculation, because we simply have no historical or archaeo-

logical evidence related to internal developments during the timeframe of interest. It is possible that one day enough archaeological work will have been performed in East Timor to chart the development of internal social organizations, but until then we must consider this to be a plausible but untestable hypothesis.

CONCLUSIONS

Our excavation and survey results indicate that the fortified structures in eastern East Timor operated as domestic living spaces as well as ritual and symbolic sites. The settlements served as loci from which a variety of subsistence pursuits were carried out across a broad geographic area encompassing forest food gardens and grazing lands, marine reefs, and rock platforms and extensive forested hinterlands. All areas excavated contained abundant earthenware pottery, animal bones, and a wide variety of marine shellfish. While some of the shellfish were clearly transported for reduction into decorative items, the larger proportion seems to have been for subsistence. This is particularly so at Vasino, where with the exception of a few extremely reduced *Nautilus* and *Tridacna* (clam) shells, the remains appear to be food residues. Domestic species predominate in the fauna and include buffalo, dog, and pig; however, some wild animals such as monkey and cuscus are represented. Fish remains are sparse at both sites.

On the basis of the chronology, we have argued that certain social drivers rather than climate change provide a more compelling driver of fort building in East Timor. Analysis of fortified site radiocarbon dates suggests that in two cases, the sites of Bukit Aiteas and Vasino, settlement activity is most likely to have been initiated in the mid-fourteenth century. This is later than the ENSO-driven drought hypothesized by Lape and Chao (2008) but compatible with the post-AD 1300 climate transition proposed by Nunn (2007). However, none of the climate-based mechanisms for societal impact discussed by Nunn appear to be applicable to the East Timor case. Similarly, there is no known

mechanism which would have caused significant population growth and resource scarcity during the time frame of interest.

Our chronology is largely based upon radiocarbon analyses of charcoal derived from unknown species. It may therefore incorporate an old wood effect in some cases. Furthermore, it is assumed, but questionable, that the start of a fortified site's occupation marks also the start of fortifications at that site. If the earliest dates in our chronology are affected by either of these potential problems, it would mean that the actual beginning of fortification is somewhat later in time than our current assessment. This would make fortification post-date potential environmental changes associated with ENSO droughts or a post-AD 1300 climate transition by an even greater duration than in the current assessment. It might however, depending on the amount of time change, make certain social drivers more likely to be involved. In particular, should the true start date of fortification be pushed out to the mid-sixteenth century then European-influenced social changes, including the introduction of maize, potentially become important.

Based on current evidence, the most likely cause of conflict and subsequent fort building in East Timor was resource imbalances caused by trading with outside agencies; the sandalwood trade in particular but possibly also beeswax and slave trading both began early and continued throughout subsequent centuries. In fact European colonization is known to have reinforced all these trading practices (in addition to causing direct conflict during the imposition and maintenance of colonialism). It also remains possible that conflict arose spontaneously without external influence.

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