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Human maritime subsistence strategies in the Lesser Sunda Islands during the terminal Pleistocene–early Holocene: New evidence from Alor, Indonesia

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ABSTRACT

The islands of Wallacea are remarkable on a world scale as settlement occurred by at least 43,000 cal BP and must have involved the use of watercraft. The majority of the islands are depauperate in terrestrial fauna and human subsistence must have focused on the marine environment. Although few islands have been archaeologically explored, some such as Timor have yielded abundant remains of pelagic and reef fishes, as well as the earliest evidence of fishhook manufacture, demonstrating that modern humans in this region were well equipped to undertake complex exploitation of the marine environment. However, a holistic understanding of human subsistence strategies on these islands from initial colonisation in the late Pleistocene through to the Recent remains elusive. Here, we present survey and excavation data from the site of Tron Bon Lei on the small island of Alor in Nusa Tenggara Timur, Indonesia. This study focuses on the terminal Pleistocene – early Holocene human fishing behaviour in the region, and specifically the zooarchaeological sequence from Tron Bon Lei dated to this period. The Holocene preference for reef fish relative to pelagic fish, observed in mid-to late Holocene occupation levels in East Timor, occurred earlier in Tron Bon Lei, suggesting a shift from the larger abundance of carnivore taxa observed in the late Pleistocene deposits. Comparisons with other archaeological deposits in Wallacea indicates that fishing was an important subsistence activity in Nusa Tenggara Timur, unlike more northern Wallacean islands where shellfish make up almost all zooarchaeological records. Tron Bon Lei confirms that the faunally limited nature of Alor spans the Holocene, and we find no evidence that terrestrial fauna made up a significant component of the subsistence activities undertaken at this site.

1. Introduction

The importance of insular environments for providing unique insights into a species' diversity and distribution (i.e. biogeography) was highlighted by pioneer studies in evolutionary biology, and exemplified by research conducted by Darwin and Wallace in the 19th century (Darwin, 1838; Wallace, 1859, 1869). Defining human adaptations and subsistence strategies in such environments has since been the focus of many studies (Erlandson and Fitzpatrick, 2006; Keegan et al., 2008; Fitzpatrick and Erlandson, 2009; LeFebvre and Giovas, 2009). In archaeology, the principles of island biogeography (MacArthur and Wilson, 1963) have been widely used to explain prehistoric settlements, although some researchers have proposed new conceptual approaches related to human actions in these environments (Fox and Fox, 2000; Lomolino, 2000a, 2000b; Drake et al., 2002).

During the glacial phases of the Pleistocene, lower sea levels in Southeast Asia exposed the Sunda shelf, such that Peninsular Malaysia, Sumatra, Java, Bali and Borneo were connected and formed a single landmass, commonly referred to as Sundaland. At the same time, New Guinea, Australia and the Aru Islands were joined forming an area referred to as Sahuland. Despite generally lower sea levels during the late Pleistocene and Holocene, the islands of Wallacea have never been connected to either landmass; rather the ocean in Wallacea ensured a maritime barrier existed between both continental shelves, albeit one with many thousands of dispersed islands (Voris, 2000; Sathiamurthy and Voris, 2006).

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Hence, human migration to any of the Wallacean islands resulting in sustainable populations would have required the use of watercraft (Birdsell, 1977; O'Connor and Veth, 2000; Allen and O'Connell, 2008). Sustaining populations on the small and generally faunally impoverished islands of Wallacea would have required continued exploitation of marine resources, perhaps supplemented by consumption of the limited terrestrial fauna and flora. Within this framework, the Wallacean islands of Nusa Tenggara Timur (the Lesser Sunda Islands: Fig. 1) are crucial for understanding human behaviour en route to Australia.

Despite the minimal land-based fauna identified on most Wallacean islands, stegodons, large rodents, marsupials, birds, large reptiles, and bats were or are still present on several islands, including Sumba, Sumbawa, Sangihe, Flores, Timor, and Sulawesi, and could have potentially been exploited by early modern humans (Hooijer, 1965; Glover, 1986; Van den Bergh et al., 2001; O'Connor and Aplin, 2007; Van den Bergh et al., 2009). Of these, only Sulawesi still supports a diverse faunal community (Dennell et al., 2014). Meanwhile, existing archaeological deposits from Timor strongly indicate the importance of marine-based subsistence strategies during the late Quaternary (O'Connor and Veth, 2005; O'Connor, 2007; O'Connor and Aplin, 2007; O'Connor et al., 2011). Even earlier than this, research conducted on the middle Pleistocene deposits of Trinil, geographically situated outside Wallacea, suggests that Southeast Asian *Homo erectus* subsistence strategies, despite being mainly focused on terrestrial resources, may have included aquatic resources and even the use of shells for tool production and engraving (Joordens et al., 2009, 2014; Storm, 2012), challenging the idea that exploitation of aquatic resources was restricted to *Homo sapiens* and had an African origin (McBrearty and Brooks, 2000; Marean et al., 2007). In Wallacea, the early to mid-Pleistocene record from Flores has yet to produce any evidence of early hominin marine resource use; instead it has been suggested that *Homo floresiensis* (and presumably earlier hominins) subsisted exclusively on terrestrial resources (van den Bergh et al., 2009). Evidence for marine exploitation in Flores begins only in levels associated with modern humans at the terminal Pleistocene, and is largely restricted to molluscs.

Since 2000, several archaeological sites excavated in East Timor have produced evidence of occupation and marine resource exploitation dating to before and through the Last Glacial Maximum (LGM). Excavations at Lene Hara (basal dates between ~42,000 and 39,000 cal BP) have produced shell beads and a fish hook dated to the early Holocene (O'Connor et al., 2002; O'Connor and Veth, 2005), with evidence of heavy reliance on marine resources, especially in the Pleistocene levels (O'Connor and Aplin, 2007; O'Connor et al., 2010). Matja Kuru 2 currently has a basal date of ~36,000 cal BP, although it is likely older as bedrock was not reached in the initial excavation. Three main phases of occupations are recognised as occurring between 36,000 and 30,000 cal BP; 13,000–9500 cal BP and finally from 4000 cal BP (O'Connor et al., 2014a). The late Holocene fauna included a variety of introduced species such as the marsupial cuscus *Phalanger orientalis* and dog (O'Connor, in press). The dog occurred as a burial and was directly dated to 2867 ± 26 B P Wk-34931 (2921–3075 cal BP) (Gonzalez et al., 2013). Shell beads and a bone projectile point were also recovered *in situ* in archaeological units dated to ~10 ka BP and 35,000 cal BP, respectively (O'Connor and Aplin, 2007). It was suggested that the bone projectile point was hafted and was likely used in the marine environment for spearing large fishes, dugongs, or sea turtles (O'Connor et al., 2014a).

Jerimalai rock shelter (basal dates ~42,000 cal BP) has yielded pelagic (Scombridae and Selachimorpha) fish remains as well as the earliest fish hook (dated between ~23 and 16 ka), which demonstrates that early modern humans in this region were well equipped to undertake complex exploitation of the marine environment (O'Connor et al., 2011). Differential exploitation of marine resources was evident in the different occupation phases of Jerimalai. Phases I and II, dated to 42–38 cal BP and 17–9 cal BP respectively, showed roughly equivalent fishing focus on pelagic and inshore species. This contrasted markedly with the later occupation phases, dated to the mid-to late Holocene (6.5 cal BP to present), where the proportion of inshore species far outstripped that of pelagic fishes. O'Connor et al. (2011) attributed this change to the stabilisation of sea level, warmer temperatures, and the establishment of reef habitats associated with the introduction of the climatic conditions of MIS 1.

Shellfish, bony fish, and marine turtles dominate the faunal compositions of Lene Hara and Jerimalai, both of which are situated close to a steep shoreline, with only a small terrestrial contribution from rodents, reptiles and bats. In contrast, Uai Bobo 2 at 600 m altitude and over 80 km inland was first occupied ca. 16,000 cal BP and contained exclusively murids and bats in the Pleistocene and early Holocene horizons (Glover, 1986). Matja Kuru 2, situated about 10 km inland but close to the largest freshwater lake in East Timor, has yielded abundant remains of giant and small murids and reptiles (mostly freshwater turtles), although also producing some marine remains (shellfish and fish) mostly from the layer dating between *ca.* 36–30,000 cal BP (O'Connor and Aplin, 2007). While there is evidence of shellfish exploitation on other Wallacean

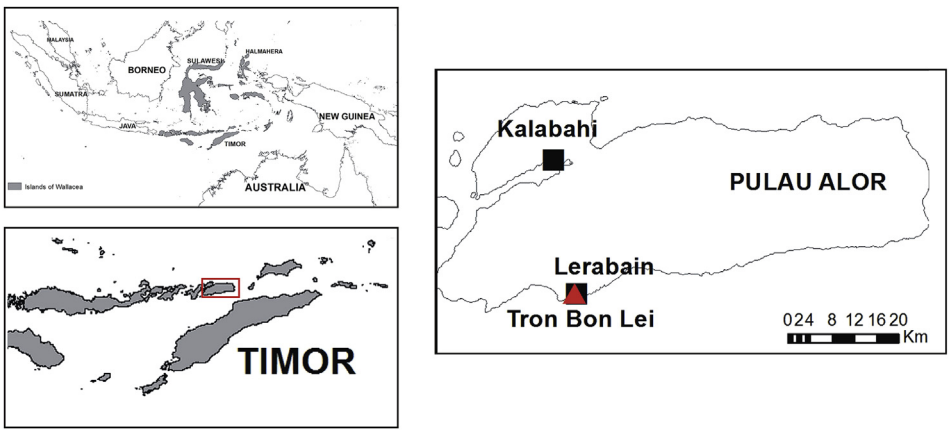

Fig. 1. Map of Lesser Sunda Islands showing the location of several Wallacean Islands (upper left), Alor Island location north of Timor (rectangle, lower left) and Tron Bon Lei in Alor Island (right).

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