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Nale Tasih 2: journey of a Middle Palaeolithic raft

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Introduction

Current archaeological knowledge implies that humans may have first occupied Australia perhaps 60 ka ago. The Pleistocene evidence of the human occupation of Australia includes: skeletal remains of about 200 individuals; a series of sites with dated occupation remains, particularly stone tools; and rock art demonstrated to be of the Pleistocene (but excluding the infamous Jinmium site). The widespread belief that the initial colonization of Australia was by *Homo sapiens sapiens*, soon after arrival from Africa to South-east Asia (Bellwood, 1987; Jones, 1989; Bunney, 1990; Allen, 1991; Bartstra *et al*., 1991; Gamble, 1993; Noble & Davidson, 1996) contrasts sharply with the evidence that seafaring began in that region probably about a million years ago (Koenigswald & Gosh, 1973; Sondaar *et al*., 1994; Bednarik, 1995, 1997), and that its introduction has no more to do with the advent of anatomically modern humans than the introduction of palaeoart (Bednarik, 1994), advanced wooden tools, efficient hunting (Thieme, 1996) and fishing with harpoons (Yellen *et al*., 1995), or any other 'modern behaviour' supposedly introduced by the progeny of the 'African Eve'.

Seafaring has been developed in the islands of Indonesia for many hundreds of millennia, and even in Europe the earliest evidence dates from the Late Middle Pleistocene (Bednarik, 1999*a*). Since many of the earliest human fossils from Australia, such as WLH 50 or the Kow Swamp specimens, resemble archaic *Homo sapiens* individuals from Java, as long ago noted by Larnach and Macintosh (1974) and Thorne and Wolpoff (1981), and since the first human settlers in Australia had a Middle Palaeolithic technology, the involvement of a genocidal African 'super-race' can be safely excluded from all considerations, both of Australian colonization and of the issue of Pleistocene seafaring generally.

The evidence of hominid occupation of the Wallacean islands of Flores (Verhoeven, 1958; Maringer & Verhoeven, 1970; Sondaar *et al*., 1994; Bednarik, 1995, 1997; Morwood *et al*., 1998; Bednarik & Kuckenburg, 1999), Timor (Bednarik, 1999*a*) and Roti (Bednarik, 1999*b*) renders the southernmost of Birdsell's (1957) three routes to Australia the most likely. Moreover, the Late Pleistocene stone tool inventories in Timor show considerable similarities with the earliest lithic industries of Australia (Bednarik, 1999*a*; Bednarik & Kuckenburg, 1999). The longest of the many sea crossings needed to reach Australia from Java was the last, namely the journey from Timor to Australia. In contrast with all previous crossings, the target land (Sahul) could in this instance not be sighted at any Pleistocene sea level. In fact because of the flatness of the continental shelf and the hinterland it remained beyond the horizon for most of

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the journey. It is reasonable to assume that this factor delayed human settlement of Australia by several hundred thousand years, suggesting that during this period, maritime technology and confidence remained below the threshold required to venture on a determined colonization attempt of an unseen land.

Maritime colonization probably began at Lombok Strait, when *Homo erectus* had developed adequate seafaring skills to embark on a deliberate attempt to reach Lombok from Bali, with an adequate number of females to found a new population. After later crossing to Sumbawa he was ready to reach Flores, which took place well before 800 ka ago. Nevertheless, there is no physical evidence whatsoever of Pleistocene watercraft anywhere in the world, be it in the form of material remains or as depictions in rock art (Bednarik, 1997). While there are reasonable hypotheses about the approximate times of various landfalls, until now there have been only vague speculations about how the mariners of the Ice Ages accomplished their great achievements. The sea level fluctuations of the Pleistocene are one of the most radical taphonomic factors in archaeology, having eliminated most coastal evidence from that period. This presents the Pleistocene archaeologist with a massively truncated record, a record that refers essentially to inland economies. Consequently, there is practically no knowledge of Pleistocene marine economies. It is against this enormous hiatus that all claims about the human history of the Pleistocene need to be viewed: an indication of their inadequacy.

However, the principal reason for the importance of navigational capability is that it provides the most reliable measure of maximum technological sophistication at a particular point in hominid history. These maritime achievements involved matters of survival. Therefore it may be assumed that they relate to the cutting edge of technology at the time in question—much in the same way as today's journeys into space. Even though the subsistence of many of present day societies is acquired by essentially Bronze Age, Neolithic or even Palaeolithic means, nobody claims that this is a valid indicator of human technological capability in the 20th century. In the same sense, the technological capability of, say, *Homo erectus* cannot be ascertained from the contents of his refuse deposits, as archaeologists are prone to do. For this self-evident reason, traditional archaeological pronouncements about technical levels are to be regarded as minimalist. If they are used in reconstructing the cultural, cognitive and even intellectual level of the people concerned, they are likely to lead to grossly misleading paradigms. Maritime capability and non-utilitarian artefacts and practices provide a much more valid measure of such levels, but until now they have hardly been consulted. Hence the picture archaeology has presented so far of human sophistication in the Pleistocene is likely to be substantially false.

The *Nale Tasih* project

In the absence of any direct physical evidence of the means hominids employed in their navigational exploits it is necessary to resort to replicative archaeology, a scientific method that does not necessarily generate valid interpretations or factual accounts of the human past, but if applied rigorously can create realistic scenarios to test hypotheses. In the case of Pleistocene seafaring, its methods involve the construction, using essentially Palaeolithic technology, of seagoing vessels and their experimental sailing. It also includes replicative studies concerning numerous aspects of Palaeolithic life relating to maritime technology, such as fishing, wood and bamboo working, the preparation of provisions, methods of transporting drinking water, making and using fire on board, and the production and use of the relevant stone implements.

The *Nale Tasih* project, begun in 1996 (Bednarik, 1997), has succeeded in sailing a primitive bamboo raft from Timor to Australia. This journey was first undertaken by archaic *Homo sapiens*, presumably about 60 ka ago, using Middle Palaeolithic tools and technology. One of the two specific principal objectives of the project was to determine the minimum conditions necessary to cross to Australia in a reasonable time. The other, to repeat a very much earlier maritime voyage, is yet to be accomplished. This is the first crossing of Lombok Strait, between Bali and Lombok, which is thought to have been achieved by *Homo erectus*, probably between 1,000,000 years and 850 ka ago. This endeavour represents the largest project ever undertaken in replicative archaeology.

The first replication of a Pleistocene vessel, built in part with the help of stone tools in late 1997 and early 1998, was launched in Roti on 14 February 1998. Sea trials were commenced on 6 March and showed a number of design shortcomings and material defects, and in combination with unfavourable wind and current conditions caused by the El Niño phenomenon, this led to the abandonment of the attempt to sail the 15-tonne raft with a crew of 11 to Australia (Bednarik, 1998; Bednarik & Hobman, 1998). The 23 m *Nale Tasih 1* was returned to Roti and beached at Oeseli for examination and destructive testing on 9 March. It was dismantled into every single component. Material samples were tested, and one pontoon was sectioned by chainsaw to remove a 30 cm sample in order to check the performance of various bamboo species and the effects of water penetration. As a result of infestation by bamboo beetles, and to a lesser degree through cracking, 93% of the air chambers were found to contain some water. The tensile strength of some of the plant fibres used as cordage was found to have been severely reduced by seawater.

On the basis of these findings and the experience so gained, a radically different, simpler design was adopted for *Nale Tasih 2*, an 18 m bamboo raft of only 2·8 tonnes, exclusive of equipment and supplies (Fig. 1). In contrast to the *Nale Tasih 1*, whose design was based on the recommendations of leading marine designers, the second raft reflects the ideas of its captain, Bob Hobman, and the experience of indigenous and traditional boatbuilders of Indonesia. In its simpler design, the separation of structural from buoyancy components was eliminated, and the two problems of raising the deck sufficiently above the water and of meeting the impact of waves arriving from the sides were solved by curving the sides of the raft upwards (Fig. 2). Apart from this one factor, the *Nale Tasih 2* was as basic as a bamboo raft can possibly be: 87 bamboo stalks arranged flat in three layers were held in place by eight cross timbers made from naturally curved tree trunks.

Construction of the *Nale Tasih 2* began in August 1998 near Kupang, West Timor, involving the work of eight boatbuilders for 3 months. The primitive raft was launched in mid-November and left Kupang harbour with a crew of five on 17 December. It was constructed entirely from materials available to Middle Palaeolithic people of Indonesia, but in contrast to *Nale Tasih 1*, critical rope bindings consisted of full rattan vines. In particular, most mast guy-ropes were rattan, and the individually lashed bamboo lengths were collectively tied to the thwart timbers by rattan forest vines. These are more difficult to terminate than ropes, but they are of extraordinary tensile strength.

Crossing the Timor Sea by raft

On board were two mangrove logs, hollowed out by termites and sealed off

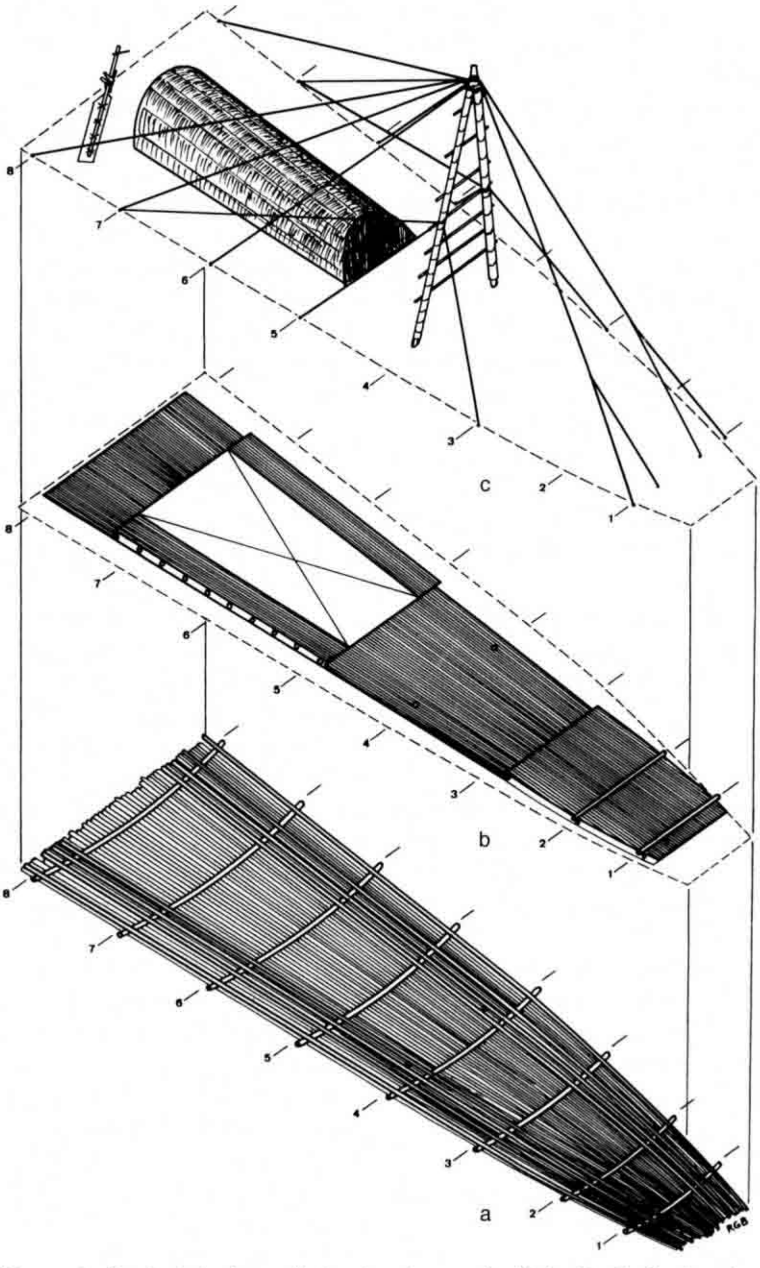

Figure 1. Exploded view of the bamboo raft *Nale Tasih 2*, showing the arrangements of raft structure (a), deck (b) and superstructures (c) (Drawing: R. G. Bednarik).

with wood, beeswax, bark and tree resin, and containing 350 litres of drinking water. The one A-frame mast bore a 24 m^2 sail woven from palm leaf (Fig. 3). A single steering-oar on the stern was effective at reasonable velocity, augmented by six steering boards. The latter were not found to improve steering ability greatly. The

Figure 4. R. G. Bednarik steering the *Nale Tasih 2*, seated on the dugout strapped across the stern. The two hollow mangrove trunks containing drinking water are visible, also a raised steering board (Photo: P. Rogers).

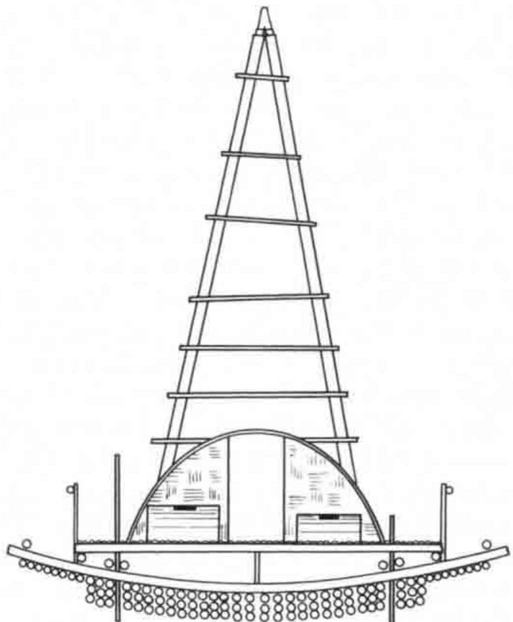

Figure 2. Cross-section of the stern of the *Nale Tasih 2* (between thwart timbers 7 and 8), looking forward. One steering board is raised, one lowered. The two hollow mangrove trunks containing water are visible at the aft cabin wall (Drawing: R. G. Bednarik).

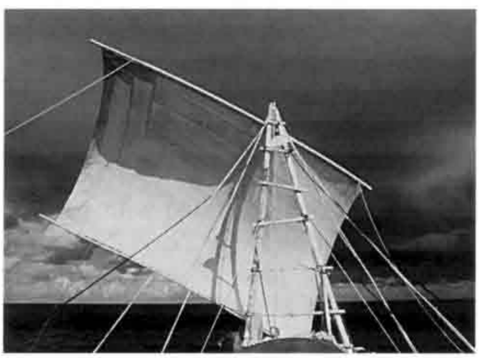

Figure 3. The square sail of the *Nale Tasih 2* consisted of woven palm leaf fibres, the rigging is of forest vines (Photo: R. G. Bednarik).

Nale Tasih 2 was well equipped with spare parts, including two sails, a steering-oar, vines, ropes and other cordage, and to effect repairs at sea it carried 65 stone artefacts, replicas of Middle Palaeolithic types made from black sedimentary silica stone. A large stone mortar and pestle was used in food preparation. A wooden anchor, weighted down with a limestone block, was on board, also a fire box, a quantity of firewood and coconut husks, used as fuel and tinder. Finally, the raft carried an old dugout of 4·77 m length strapped across the stern (Fig. 4), for the purpose of permitting the camera man to film the vessel from some distance during the journey. It was only used on one occasion as it would have been unsuitable under rough conditions.

Food provisions included 30 coconuts, several bundles of bananas, a basket of mangoes, some melons and cassava, salted meat, a basket of native millet, about seven litres of palm sugar, some salt, and a few limes, carrots and cucumbers. However, these were supplementary supplies; it was intended to derive most food from the sea. For this purpose the raft was equipped with several harpoons and fish spears. Utensils were made from coconut shells, and buckets from folded lontar palm leaves. Food was cooked in such containers.

Figure 5. J. Zakawerus roasts a yellow fin tuna on the fire box. The palm leaf-covered shelter hut is in the background, on the right is the anchor and a bundle of spare rattan bindings (Photo: R. G. Bednarik).

Fish up to 1·5 m length were harpooned or speared on the journey, including dorado, yellow fin tuna and angel fish. They were immediately gutted and filleted with stone knives (which were found to be as effective as steel knives) and roasted on the fire (Fig. 5). Sharks followed the raft persistently but their hard skin proved a good defence against harpoons. A sea turtle tried to board the *Nale Tasih 2* but was not killed for food. Two poisonous sea snakes were encountered, and various marine birds were sighted daily, as well as butterflies.

The *Nale Tasih 2* travelled without an escort boat, and the crew's only contact with the outside world was via a satellite telephone, reporting its position twice a day to a contact in Darwin. With the exception of this item, and equipment for navigation, recording and scientific purposes, all equipment on the vessel would probably have been available to sailors 50–60 ka ago.

The experimental raft reached the continental shelf of Australia, which formed the continent's shore during most of the Late Pleistocene, on the sixth day of the voyage, thus having completed its primary objective. To gain more knowledge in the handling of the craft, the crew continued on towards Darwin (Fig. 6). On the eleventh day, the seas became rough and the raft was sailed under extreme conditions for 2 days. The steering-oar broke, a yard broke in two, and at one stage, all guy ropes forward of the mast snapped in unison. However, all repairs were effected successfully in heavy seas. On the thirteenth day, waves of 4–5 m forced the raft towards Melville Island, north of Darwin, the coast of which is heavily populated by saltwater crocodiles. The Australian coastguard insisted that, as a precaution, the crew be taken off 3 hours before the raft was expected to reach the shore. The crew of the *Nale Tasih 2* transferred to the oil tender *Pacific Spear* on the evening of 29 December 1998. Three days later, the raft was recovered in calmer seas from where it was beached on the south coast of Melville Island and towed to Darwin. It had survived without significant structural damage and was in fact in better condition than when it left Timor, having been improved at sea. After fumigation by Australian quarantine it was released for public exhibition.

Discussion

While it would be premature to present here conclusions of a project that is still continuing, preliminary findings need to be made available because of the far-reaching effects they have on our concepts of Pleistocene hominids.

As already demonstrated with the *Nale Tasih 1* expedition, *Nale Tasih 2* has again shown that the idea of an 'involuntary colonization' is absurd in the history of hominid expansion in Indonesia: 'the knowledge and technological skills required to sail the open sea are significantly greater than most archaeologists are capable of imagining' (Bednarik, 1998). The long history of maritime colonization is itself an indication of the technical and cognitive competence of the hominids concerned, of their long-term forward

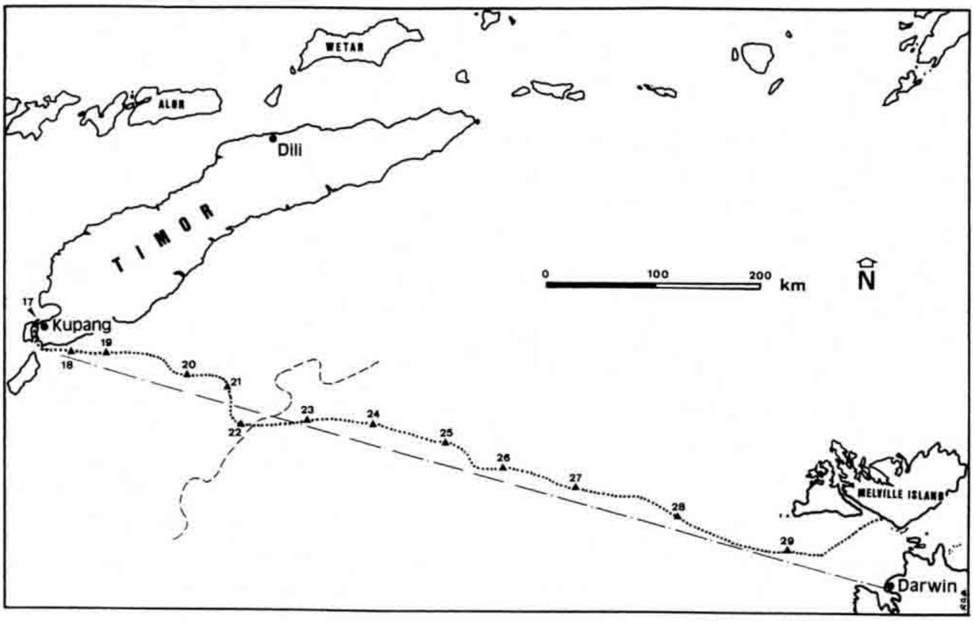

Figure 6. The route taken by the *Nale Tasih 2*, from the southernmost tip of Timor to the southern coast of Melville Island. The numbers refer to the days of December 1998, 08.00 a.m. of each day; the broken line crossed on 22 December is the edge of the Sahul (Australian) continental shelf, the continent's former coast line (Drawing: R. G. Bednarik).

planning ability, sophisticated communication ability and social complexity. However, to fully appreciate these factors, replication experiments are more instructive than armchair archaeology. They can provide us with an inkling of the numerous skills involved in such accomplishments, and the command of cultural systems these demand. These skills are in no way related to genetically imparted 'construction skills', such as those of a spider, a beaver or a bird. They were acquired by learning, that is by non-genetic means. The scientific definition of culture is 'the transference of practice by non-genetic means' (Handwerker, 1989; Bednarik, 1990). Thus the skills required to prepare and execute maritime colonization are all cultural. They would provide a superb measure of cultural sophistication, if only data survived to define technical limits on the basis of specific known maritime achievements. The *Nale Tasih* expeditions have begun to provide such data.

The *Nale Tasih 2* was found to perform outstandingly well at sea. It behaved like a raft at speeds under 1·5–2 knots. In other words it drifted with wind and current, but at speeds exceeding 2 knots it sailed rather like a boat, and was perfectly steerable. However, its most economical velocity over the ground was at the relatively low speed of between 2 and 3 knots. Above that, any increase in wind velocity prompted only a modest increase in travel speed, and even a strong following gale of over 30 knots would only result in a maximum speed of 4·5 knots at most. The swell of several metres under such conditions merely buffeted the raft, demanding flexibility in excess of the vessel's natural elasticity. This strained bindings and rigging, without a corresponding gain in speed. The main function of the steering boards was their ability to provide the raft with a 'pseudo-keel' at reasonable speed, and they were probably not used 60 ka ago.

The opportunity to sail the raft under very rough conditions was an important aspect of the *Nale Tasih 2* expedition. It facilitated the determination of the vessel's weakest aspects, their correction, and the testing of the improvements made. Additional forward guy ropes were installed aft of the sail, and cross timber No. 2 was reinforced above deck. It was due to the crew's acceptance of this 'destructive testing approach' that the most important information on this journey was secured. It concerns aspects of fundamental design, limits of material strengths, and limits of human endurance. Most importantly, it was discovered through this approach that in any seagoing bamboo raft constructed with full-length stalks (as almost certainly would have been used in Pleistocene vessels), the greatest tensile stress is in the forward section and in the forward guy ropes. In the design of a very simple raft such as the *Nale Tasih 2* it is therefore essential to reinforce the forward thwart timbers, particularly those serving as guy-rope anchors, by alleviating the tension created by longitudinal flexing. It seems possible to overcome the structural problem by omitting the forward section altogether, replacing it with some projecting poles to serve as guy-rope anchors. This possibility may be investigated in a further experiment.

On the basis of current knowledge, the vessel used in first landfall in Australia had a windsail area sufficient to provide at least some steering capability. Whether this was an actual 'sail' of some type remains to be clarified. The sea crossing was not possible without at least rudimentary steering. Moreover, it was totally impossible without a number of indirect factors. To begin with, it would have involved several months of concerted efforts by a social group, directed towards one entirely abstract goal: reaching land that remained invisible for up to nine-tenths of the journey. Consequently, language of sufficient complexity to convey abstract concepts, to motivate construction crews, to convince others to participate and to organize the work was clearly essential. Moreover, any hominids capable of seafaring also possessed the ability of forward planning. Culturally-based teamwork was essential for any major sea crossing, and it may reasonably be assumed that a group of hominids working together for several months to assemble a raft would have developed not just team spirit, but a strong sense of common purpose which would have been further honed by their maritime experience. Finally, a particular emphasis must be placed on the importance of the cultural (learned) understanding of material properties that was undoubtedly extremely sophisticated; in the authors' view none of the Pleistocene colonizing sea crossings would have been possible without it.

Conclusion

Any archaeological model of hominid capabilities that cannot accommodate such 'modern behaviour' as demanded by these observations up to a million years ago has now been effectively superseded, essentially through replicative nautical archaeology.

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