Examining pre-colonial Southeast Asian boatbuilding: An archaeological study of the Butuan Boats and the use of edge-joined planking in local and regional construction techniques

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Abstract

While the earliest descriptions of Southeast Asian watercraft written by Chinese and European observers were generally brief, many noted that they were constructed without using a single metal nail. Another trait mentioned in only the most detailed historical accounts, but recognisable in the material evidence, is the series of drilled lugs protruding from the insides of the boats' planks. The lugs functioned to secure frames and thwarts to the hull by means of lashing rope or rattan strands through the lugs' holes. Published research provides confirmation that edge-joined and lashed-lug boats are the oldest plank-built watercraft in the region's archaeological record. The earliest is the Pontian Boat found in Peninsular Malaysia, dating to between the third and fifth centuries A.D. Contemporary sources suggest such boats may still be in use today by a community on the remote island of Lembata, Indonesia.

In 1976, looters unearthed the incomplete remains of what is now referred to as Butuan Boat 1 buried under approximately 1.5 m of flood deposits in Barangay Libertad, Butuan City, Philippines. According to various reports, looters have since that time come across between nine and 11 Butuan Boat remains in an area less than 1 km in radius. Archaeologists from the National Museum of the Philippines examined the remains of seven of these boats and recovered three. Excavations revealed that construction features of the Butuan Boats were characteristically Southeast Asian, as described in historical documents. The planks were edge-fastened with wooden dowels, and carved along the length of the planks of all but one of the boats were a series of rectangular lugs drilled with holes, some which still bore fragments of rope. Unfortunately, much of the early reporting of the Butuan Boat sites and related archaeological activities was unclear, and details such as locations, dimensions, and wood identification, were presented inconsistently. Construction features were only discussed in general terms, and early attempts to radiocarbon date the first three recovered boats in the 1970s and 1980s resulted in widely disparate results of fourth, thirteenth, and tenth centuries A.D., respectively.

The research undertaken for this dissertation involved recording the Butuan Boats, identifying the timbers used, and obtaining more reliable radiocarbon dating results. In examining the construction of each Butuan Boat more closely, atypical features that were previously unreported or downplayed began to emerge. Using this data, along with other

archaeological, historic, and ethnographic evidence from throughout Southeast Asia, broadens our understanding of lashed-lug boat construction, a practice that survived more than 1,500 years. This study aids in revealing possible reasons for the loss, persistence, or development of certain aspects of boat construction and adds significantly to the knowledge of Philippine and Southeast Asian boatbuilding technology and practices.

Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signed,

Ligaya Lacsina
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Abbreviations and acronyms

AINSE	Australian Institute of Nuclear Science and Engineering
ANSTO	Australian Nuclear Science and Technology Organisation
ANU	Australian National University; radiocarbon laboratory code
ASEAN	Association of Southeast Asian Nations
BB	Butuan Boats
BBx	'x' denotes specific Butuan Boat by number
BM	British Museum radiocarbon laboratory code
BP	Before present, refers to uncalibrated radiocarbon date before 1950 AD
Beta	Beta Analytic (USA) radiocarbon laboratory code
cal.	Calibrated radiocarbon date, presented as a range
COCI	ASEAN's Committee for Culture and Information
DOST	Department of Science and Technology (Philippines)
FEFNA	Far Eastern Foundation for Nautical Archaeology
FPRDI	Forest Products Research and Development Institute
GaK	Gakushuin University (Japan) radiocarbon laboratory code
Gif	Gif sur Yvette (France); radiocarbon laboratory code
I	Teledyne Isotopes (USA) radiocarbon laboratory code
KP	Keel plank
Lx(-x)	Denotes specific lug along a strake (STRx) or keel plank (KP). May also denote a row of lugs along the whole vessel. Numbered sequentially from one end of the boat, or the intact end of the keel plank, if present. Lugs composed of more than one protrusion are further labelled by an additional number, e.g. KP-L4-2 refers to the second protrusion of the fourth lug on the keel plank.
NM	National Museum (Philippines)
OXQ	ANSTO radiocarbon laboratory code
OED	Oxford English Dictionary
PEG	Polyethylene glycol; used for the preservation of waterlogged wood
Phils.	Philippines
SEAMEO	Southeast Asian Ministers of Education Organization

SPAFA	Special Project in Archaeology and Fine Arts (project of SEAMEO); Southeast Asian Regional Centre for Archaeology and Fine Arts
STR-Ax/Bx	Strake A or B, to designate strakes either side of the keel or keel plank where port and starboard sides are unknown; with x denoting the outboard position of the strake from the keel or keel plank
SUA	Sydney University radiocarbon laboratory code
TAMU	Texas A&M University
UCH	Underwater cultural heritage

Chapter 1 Introduction

Hundreds of years prior to sixteenth century European colonisation, boatbuilders of Southeast Asia constructed shell-based, plank-built watercraft without metal fastenings (Horridge 1985:5–6; Manguin 1993:262; Scott 1981:5–6). The vessels were built up from a keel timber with planks that were edge-fastened by lacing and/or dowelling. Alongside this method of plank edge-joining, was a particular technical practice that evidence has shown to have persisted for at least 15 centuries. This involved the use of a series of drilled, projecting blocks, referred to as lugs, that were carved out from the inner side of the planks to which frames were secured by tying rope or strands of rattan. These watercraft are commonly identified as lashed-lug boats (Clark et al. 1993:143; Green et al. 1995:178; Hornell 1920:59; Horridge 1982:1; Manguin 1993:256; Ronquillo 1987:4). The earliest archaeological evidence of a lashed-lug boat was excavated in Malaysia and dates to approximately A.D. 260–430 (Manguin 1993:256–257). The wooden remains of more lashed-lug boats were also located throughout Southeast Asia in archaeological contexts in Indonesia, the Philippines and Vietnam (Horridge 1982; Manguin 1993, 2009; McGrail 2001; Nishino et al. 2014; Peralta ca. 1978; Priyanto 2011).

Lashed-lug boats were still in relatively wide use in some areas of Southeast Asia up to the late nineteenth century based on evidence from written accounts, drawings and collected boat models (Horridge 1982; Wallace 2014 [1869]:ch. 9, para 29). Today, few boatbuilders in the region continue to use similar construction techniques, and their numbers are decreasing. In today's "traditional" boatyards, lugs have almost completely disappeared as frames, i.e. floors timbers, half frames and top timbers, or any combination thereof, are generally fastened directly to planks by treenails (Horridge 1985: colored plate Q). The use of wooden edge-joinery continues in some places, however, metal rods, in particular iron rebar may be used in their place. Despite the known archaeological, historic and ethnographic evidence of lashed-lug boats throughout the region, there have been few attempts at analysing their construction in detail.

This dissertation seeks to clarify aspects of Philippine pre-colonial boatbuilding practices by compiling and examining the archaeological, historic, and ethnographic evidence from throughout Southeast Asia, and from this, undertake a thorough study of these boats within the context of the Southeast Asian maritime region.

Significance: The study of pre-colonial planked watercraft of Southeast Asia

Until recently, the value of studying ship and boat construction in the Philippines has been generally overlooked throughout the country's history. The obvious ubiquitousness and importance of watercraft in an archipelago such as the Philippines appears to have been taken for granted. Because of this, there is a large gap in the recording of the variety, innovations and lost practices in Philippine watercraft construction.

Studies in Philippine and Southeast Asian underwater archaeology have thus far focused on international trade networks wherein a much greater the emphasis was placed on preserved cargo than on any other aspect of a shipwreck site. Unsurprisingly, most of the analyses have focused on ceramic studies. In modest examples, shipwrecks carried thousands of pieces of ceramics, while in more spectacular cases, the ceramics numbered in the tens of thousands (Orillaneda and Ronquillo 2011; Sudaryadi 2011). In one extreme, unprecedented example, more than 600,000 ceramic pieces were recovered from a single ninth-century lashed-lug shipwreck (Liebner 2014:243).

It should also be noted that archaeologists and cultural heritage advocates consider many shipwreck excavations in Southeast Asia to be controversial and incompatible with modern-day archaeological ethical standards (Green 2004; Kimura 2015; Prott 2006). Most projects have involved some degree of commercial exploitation by private companies that applied varying degrees of academic rigour in their activities, if any. Until recently some countries in the region did not consider the protection of underwater cultural heritage (UCH) among government priorities. At the same time, these governments were indifferent to, or powerless in controlling the looting of the sites, usually by poor fisher folk. As such, the responsibility for funding shipwreck exploration and excavation often fell to private companies that in exchange received some form of remuneration, usually a share of the recovered materials (Flecker 2002; Green 2004; Liebner 2014; Orillaneda and Ronquillo 2011; Pope 2007). Such companies were not always willing to invest in the substantial dive time or conservation work necessary for uncovering and comprehensively studying ship structure. At most, work undertaken included a general assessment of construction features that would help in classifying the ship's origin e.g. Southeast Asian, Chinese or European. One unfortunate consequence of this system is that shipwrecks that had already been significantly looted, or shipwrecks that held no valuable cargo received only cursory examination, and were essentially ignored. Throughout the western Philippines private companies working in collaboration with the National Museum have explored and excavated several shipwreck sites, but the emphasis was very obviously placed on the ceramic and other inorganic artefacts (Dizon 1992; Orillaneda and Ronquillo 2011; Ronquillo 1990).

The case of the Butuan Boats in the Philippines, to be discussed more thoroughly throughout this dissertation, differs slightly. These are not shipwrecks; their remains, likely abandoned, were found buried in waterlogged flood plains, with only a small number of associated artefacts. When the first excavations of the Butuan Boats took place in the 1970s, there were no formally-trained Philippine maritime archaeologists, nor had any shipwreck excavation taken place in the country up to that point. In the 1980s the Butuan excavations continued but showed only a marginal improvement in terms of academic rigour and archaeological method.

As the Southeast Asian region is generally tropical, organic materials such as wood rarely survive in an archaeological context. It is then puzzling that despite the presence of the identified Philippine archaeological resource, little research has been conducted with the aim of comprehensively investigating and characterising boat and ship remains, much less Philippine plank-built watercraft.

The study of ship and boat technology from archaeological sites in the Philippines is obviously a topic that can benefit from more thorough study. The research on the dowelled and lashed-lug Butuan Boats in the 1970s and 1980s, for example, were preliminary in nature (Clark et al. 1993; Green et al. 1995; Peralta 1980a; Ronquillo 1989), with more comprehensive studies only now beginning to take place. Philippine shipwrecks from underwater sites were not suitably utilised in enriching knowledge of the region's maritime culture. These underwater archaeological sites, and especially those located before the 1990s, were inadequately assessed with regards to the wooden boat and ship remains (Cuevas et al. 2004:5–6; Santiago 1997:n.p.). The data presented in this dissertation sets out to provide a more in-depth study that will add significantly to the knowledge of Philippine and Southeast Asian boatbuilding technology. It will broaden our understanding of the region's maritime history when synthesised with other studies related to Southeast Asian boatbuilding technology and practices.

Edge-joined and lashed-lug watercraft

The available evidence for plank-built Southeast Asian vessels (all discussed in greater detail in Chapter 5) demonstrates the use of a shell-based construction technique (Manguin 1993:258–260). Shipbuilders erected and aligned hull planking to create the shell of the vessel by edge-joining strakes using dowels and lacing ligatures through pre-drilled holes in the planks, or solely by dowels, that were sometimes locked in place by wooden pegs inserted through the thickness of the planks (Manguin 1993:258–260). After the shell was assembled, it was strengthened transversely with frames lashed to perforated lugs carved on the interior surfaces of the hull planking.

Unlike their Chinese counterparts from roughly the same period, builders of lashed-lug boats did not use metal nails for fastenings but instead used materials such as wooden dowels, treenails, wooden pegs, rattan strands and rope. Explanations for this type of construction vary, the most far-fetched explaining that the region's magnetic geological features would cause iron nails to be pulled out of the wood (Anon, in Alcina 1960 [1668]:151; Alcina 2005 [1668]:181–183). More reasonable justifications offered that iron was known to corrode easily in the Southeast Asian tropical environment; it was a limited commodity, and not readily available locally (Alcina 1960 [1668]:150–152; 2005 [1668]:181–183; Reid 1988).

The seventeenth-century account by Francisco Alcina (2005 [1668]:159–213), describes how contemporary boatbuilders in the central and southern Philippines utilised a shell-based construction technique in which planks were edge-joined to one another with wooden dowels. He describes how they lashed frames to the protruding lugs on the interior surfaces of each strake. Boat remains located in Philippine, Malaysian, Indonesian, Thai, and Vietnamese sites are consistent with the construction technique described in Alcina's account, and they demonstrate that this particular practice prevailed in the region hundreds of years prior to European contact (Horridge 1995; Liebner 2014; Manguin 2012; McGrail 2001; Peralta 1980a). Other first-hand accounts confirm that similar construction techniques continued to be used by boatbuilders in the Indonesian and Philippine archipelagos until much later (Barnes 1996; Dwyer and Akerman 1998; Hornell 1920; Horridge 1985; Rebello 1569; Wallace 2014 [1869]). The construction of similar vessels outside of Southeast Asia, in places such as southern Taiwan, the Maldives, and the Solomon Islands, have also been documented (Hornell 1936:145; Kano and Segawa 1956; Millar 1993). In some regions of Indonesia and the

Philippines, wooden boatbuilding practices, including some of the aforementioned traits, still persists despite the presence of modern boatbuilding technologies and the availability of modern materials. Traditional boatbuilders in the region still apply shell-based construction methods and use dowels to edge-join strakes, though lashing frames to lugs has almost completely disappeared. The Indonesian town of Lamalera is the only notable example in which, at least into the late twentieth century, boatbuilders continued to lash frames to lugs (Barnes 1996; Dwyer and Akerman 1998). In all other examples, frames are now directly fastened to planks with wooden treenails or metal spikes (Horridge 1982:50–53; 1985:51–54).

Southeast Asian boatbuilding

Several authors have proposed that the development of construction techniques in Southeast Asia came with the appearance and the development of metal tools. Pierre-Yves Manguin (1993:260) posits that plank lacing was an earlier technology that was eventually reinforced, then replaced by the development of dowel edge-joining. Adrian Horridge (1982:1, 32–33, 56–58) further asserts that metal tools were required to drill the deeper holes needed for dowels, but not for drilling the holes through which ligatures were laced or lashed, as stone, shell or bone tools would have sufficed. He points to the Pacific Island boatbuilders who did not have access to metal tools in prehistoric times, but built watercraft such as the *mon* of the Solomon islands—a vessel with its planking exclusively edge-joined by ligatures (Hornell 1944:51). A 1767 passage by Samuel Wallis describing plank-built canoes in the Society Islands in the South Pacific supports this theory. He writes:

> To fasten these planks together, holes are bored with a piece of bone that is fixed into a stick for that purpose, a use to which our nails were afterwards applied with great advantage, and through these holes a kind of plaited cordage is passed, so as to hold the planks strongly together (Wallis 2004 [1773]:487)

Seán McGrail (2001) further states that in a number of regions where sewn boats are constructed, such as Atlantic Europe, Sri Lanka and the Bay of Bengal, the use of treenails is "unknown" (McGrail 2001:436). Manguin, Horridge and McGrail thus believe that doweling being used as a primary plank fastening was a later development that came with the appearance of metal. However, in several instances plank lacing still persisted long after the time the practice of dowelling was well established (Cuevas et al. 2004:8, 12). Looking at the archaeological evidence of lashed-lug boats in island Southeast Asia, dowels are always present, even if only as reinforcement to primary ligature fastenings, as seen in the Pontian, Medan, Sambirejo and Kolam Pinisi boats (McGrail 2001:298). Thus, the matter of dowelling evolving from lacing cannot be determined without additional evidence of much earlier plank-built boats.

Manguin and McGrail have both attempted crafting chronologies based on the available, though limited evidence. These aimed to clarify the emergence or disappearance of certain boatbuilding traits such as plank-lacing, plank-doweling, lashed-lugs, outriggers, multiple planking layers, and bulkheads. Their hypotheses are discussed further in Chapter 2.

What appears to be evident from a cursory survey of the available literature is the rapidly evolving character of traditional Southeast Asian boatbuilding in the last century. The evidence so far shows that lashed-lugs were in use for no less than 1,500 years, only to decline at some point between the late nineteenth and twentieth centuries. It may be argued that lugs were finally discarded due to the impracticality of their production; only two planks could be hewn from a single tree, and carving the lugs from the planks was time-consuming and labour-intensive. How can the persistence of lugs, and even in some cases vestigial lugs, through more than three hundred years of European colonization then be explained? On the other hand, the use of wooden fastenings persisted after lugs were abandoned, even with the emergence of metal fastenings. How does tradition compel stasis but still allow change? These are questions that this dissertation hopes to address.

Terminology used for Southeast Asian watercraft

Attempts at using consistent and standard terminology for ship and boat components from all regions of the world and throughout history has been problematic. This is true even within one language when referring to different objects that have subtle variations in form and function. McGrail (2001:433) illustrates the point with an example that is of particular relevance to this research, citing the English words "peg", "dowel", and "treenail" as often used interchangeably. In his illustrated glossary, John Richard Steffy defines a dowel as:

> a cylindrical piece of wood (of constant diameter) used to align two members by being sunk into each. A cylindrical coak. Unlike treenails and pegs, dowels served an alignment function only, additional fastenings being necessary to prevent separation of the joint (Steffy 2012:270).

For reference, Steffy defines a coak as a "rectangular or cylindrical pin let into the ends or seam of timbers about to be joined in order to align or *strengthen* [emphasis added] the union" (Steffy 2012:269). Steffy later defined tenons "that are unpegged and contribute *no structural strength* [emphasis added] are essentially *coak joints* [emphasis in original]" (Steffy 2012:276).

The International Maritime Dictionary defines a dowel as a "cylindrical piece of hardwood of suitable diameter and length, used for additional security in joining two pieces of timber together to prevent them from slipping. Also called cog, coak" (de Kerchove 1961:238). Peg is not defined in the dictionary. A peg is defined by Steffy as:

> a tapered wooden pin, driven into a pre-drilled hole to fasten two members or lock a joint. Pegs came in a variety of sizes and tapers; they could have square, round, or multi-sided cross-sections. The important difference between dowels and pegs in ancient construction was that the former were of constant diameter and lightly set, while the latter were tapered and driven with appreciable force. The most common use of pegs in ancient construction was the locking of mortise-and-tenon joints (Steffy 2012:277).

Finally, Steffy defines a treenail as:

> a round or multi-sided piece of hardwood, driven through planks and timbers to connect them. Treenails were employed most frequently in attaching planking to frames, attaching knees to ceiling or beams, and in the scarfing of timbers. They were used in a variety of forms: with expanding wedges or nails in their ends, with tapered or square heads on their exterior ends, or completely unwedged and unheaded. When immersed, treenails swelled to make a tight fit (Steffy 2012:281).

The International Maritime Dictionary defines a treenail as "a cylindrical pin of hardwood used for fastening planks or timbers…. They are driven from the outside through the ceiling, and are wedged at both ends" (de Kerchove 1961:860).

In cases such as the Butuan Boats, Steffy's definitions are not entirely helpful, as attributes of each were found in one object-type, that most authors refer to as a dowel: the cylindrical wooden component that may have tapered ends, is used both for aligning and joining planks together, and may or may not be locked into pre-drilled holes in the plank edges (Clark et al. 1993; Green et al. 1995; Horridge 1978; Manguin 2009). This dissertation will follow the most common usage and will refer to this component as a dowel. The distinction noted in the Maritime Dictionary that treenails are driven inwards from the outside, will also be used.

Terminology used for ligature fastenings are also often confused, being interchangeably referred to as "laced", "lashed", "sewn", or "stitched". As comprehensive as Steffy's glossary is, it does not include any of these words. They are, however, included in the glossary provided by Frederick Hocker and Cheryl Ward (2004), which incidentally, does not include dowel, coak, peg, or treenail.

According to Hocker and Ward's glossary, to lace means "to fasten elements together by passing a cord or strap through a series of holes along the joint line, much as a shoe is laced" (Hocker and Ward 2004:165). To lash means:

> to fasten elements together by multiple passes of the cord or strap through a set of holes either side of the joint line. In some Egyptian vessels, lashings were continuous through a series of channels set in line" (Hocker and Ward 2004:165).

To sew is "to fasten major elements of a hull together with cord or fibre. Such craft are normally called 'sewn boats'"(Hocker and Ward 2004:166). Finally, to stitch is to "fasten elements together with individual ligatures of cord or strap, each passed through a single pair of holes and tied off" (Hocker and Ward 2004:166). Some nautical archaeologists find these definitions unsatisfactory, and prefer to limit the terms stitching and sewing to the construction of hide or bark boats where implements analogous to a needle and thread are used (McGrail and Kentley 1985). As defined by the Oxford English Dictionary (OED), to sew is:

> To fasten, attach, or join (pieces of textile material, leather, etc.) by passing a thread in alternate directions through a series of punctures made either with

a needle carrying the thread, or with an awl (OED Online 2016).

To stitch is "to make the seams of (a garment, etc.); To fasten or attach (something) by sewing". Some archaeologists advocate using the terms "lacing," "lashing," "tying," and "binding" as these are more appropriate when referring to wooden vessels where holes must be bored before builders can pass ligatures through (McCarthy 2005; McGrail and Kentley 1985; Polzer 2009). This dissertation uses the term "lacing" to refer to the joining of planks by ligatures. "Lashing" refers to the use of ligatures to bind frames and other components to lugs.

The International Maritime Dictionary defines to lace as "to draw together with a lacing passed through eyelet holes such as an awning, a bonnet, and so on" (de Kerchove 1961:428). To lash means "to secure by binding closely with a rope or small stuff" while lashing is "a general term given to any rope or small stuff used for binding or making fast one thing to another, such as an eye to a spar, a spar to another, and so on" (de Kerchove 1961:434). While De Kerchove does not define a "stitch", he defines sewn planking as:

> a method of planking dispensing with seam battens and caulking and used for the construction of high-speed boats, canoes and so on. It consists of layers of thin mahogany sewed together with copper wire passing through holes bored in the ribs. It is said to give great strength and flexibility. Its inventors are Messrs S.E. Saunders, Cowes (de Kerchove 1961:710).

The perforated projecting block carved from the inner side of planks in Southeast Asian watercraft have at times been referred to as a "cleat" (Hornell 1920; McGrail 2001). In the International Maritime Dictionary, a cleat is defined as: "a short transverse piece of wood nailed to a sloping gangway to give sure footing" (de Kerchove 1961:151). While Hocker and Ward (2004:164) define it as "a small block of wood nailed to the surface of another timber either to fasten it to the timber or to act as a stop". These definitions do not match the component found on Southeast Asian vessels which are carved from the same timber, rather than nailed one to another. The much more commonly-used term for this is "lug" (Clark et al. 1993; Green et al. 1995; Hornell 1920; Horridge 1978; Manguin 2009; Peralta 1980a). James Hornell was the first to refer to these blocks carved from the planks as lugs, using the term interchangeably with "cleats" in his publication, *The Outrigger Canoes of Indonesia* (Hornell 1920:59).

The use of illustrated technical glossaries, as McGrail (2001:433) proposes, is helpful, but is also limited when attempting to apply English terms used for European and Mediterranean watercraft to watercraft from other regions—there are not necessarily exact equivalents. Some Asian and Pacific island watercraft are stemless (Burningham 1990), meaning they are not constructed with stems or sternposts that are usually considered fundamental structural elements of European and Mediterranean wooden boats and ships. In other cases, the ends of watercraft were closed using a V-shaped end piece that are decidedly not stem- or post-shaped. This piece has been referred to as a "wing stem" or "winged stem" (Clark et al. 1993; Green et al. 1995; Horridge 1985), regardless of whether it is known to come from the bow or stern of the vessel. This dissertation uses the term "wing end" to refer to this component.

Some authors, especially in reporting first-hand observations or specific ethnographic cases, cite the local names in the boatbuilder's language (Burningham 1990; Liebner 2014). This approach is problematic in a region such as Southeast Asia, where hundreds of languages and dialects are spoken in the Philippine and Indonesian archipelagos alone. For this reason, English terms, despite their limitations, will be used here.

Research aims and questions

This dissertation aims to closely examine and synthesise new and existing historical and archaeological data on the construction of Philippine and Southeast Asian plank-built watercraft. In doing so, technical and cultural aspects of the region's pre-colonial boatbuilding practices will be identified and possibly defined as constituting a regional plank-built boatbuilding tradition. This study will attempt to identify typical construction features, such as the use of lashed-lugs and wooden fastenings, and investigate possible atypical features.

By studying these and other elements of Southeast Asian watercraft, it is hoped that the possible reasons for the loss, persistence, or development of certain aspects of their construction over time may be learned. In order to accomplish this, the role of the Philippines within the wider region of Southeast Asian maritime culture is examined. The possible economic and cultural influence of regional contact and trade on Philippine wooden boatbuilding is explored. The research seeks to answer or clarify the following research questions:

1. Can the archaeological and historical study of pre-colonial Southeast Asian plank-built boats confirm the existence or non-existence of a regional boatbuilding tradition?
2. Can typical or atypical construction features of pre-colonial Philippine plank-built boat technology be identified?
3. What was the character of the maritime contact/trade during the pre-colonial period in the Philippine and Southeast Asian region and how did this influence local boatbuilding practices?

Methods

In undertaking this research, archaeological and archival sources related to wooden boatbuilding within the context of pre-colonial and colonial Southeast Asia were examined. The sources include primary and secondary archaeological data, historical documents, and ethnographic studies. To supplement these, experimental wood model construction was used in order to gain insights and better understanding of lashed-lug construction.

Archaeological data

The archaeological research included the examination of previous studies, and more importantly, the examination of original archaeological objects, where available. The Philippine data studied were comprised of:

- Timbers of Butuan Boats 1, 2, and 5 that had been excavated and retrieved in the 1970s and 1980s, and are now on exhibit or in storage at the National Museum of the Philippines, in Manila, and the Butuan Regional Museum and the Balanghai Shrine, both in Butuan City;
- Butuan Boats 4 and 9 that were the subject of ongoing but as of yet uncompleted, archaeological excavation;
- Timbers from the Gujangan shipwreck, which had been looted in the 1990s; and
- The report of the San Isidro shipwreck excavated in the 1990s.

<u>Previous studies</u>

Archaeological documents, including reports, manuscripts, and photographs filed at the Records Section of the Archaeology Division in the National Museum of the

Philippines were an important source of information in shaping this research. These documents outlined the activities undertaken and results produced, in relation to the excavation and retrieval of Butuan Boats 1, 2 and 5, and the Gujangan and San Isidro shipwrecks. Syntheses and summaries of previous Southeast Asian plank-built boat research from the region, some of which also contain primary data were consulted.

Museum visits were made to Western Australia and the Northern Territory. The Shipwreck Galleries of the Western Australian Museum holds a comprehensive maritime library including field notes, reports and hundreds of photographs produced from their staff's research in the Philippines. Twentieth-century Indonesian boats make up an important part of the collection at The Museum and Art Galleries of the Northern Territory, Australia.

Archaeological objects

The examination and recording of watercraft remains from Philippine archaeological sites, primarily of the Butuan Boats, was undertaken in collaboration with the National Museum. The previously excavated Butuan Boats 1, 2, and 5, that are on display or in storage at National Museum branches in Manila and Butuan, as well as Butuan Boats 4 and 9 that were in the process of being excavated, were documented in their current state. Boat 3, excavated ca. 1978, but not recovered, is inaccessible and thus remains unexamined. Boat 7 was excavated in 1989 with its planks too far degraded to be recovered. Smaller wood samples were collected for identification and dating.

The remains of Butuan Boat 1 are on display at the *Balangay* Shrine, a site museum overseen by the National Museum's Butuan regional office. Its timbers are arranged on top of a metal stand in an unsealed glass enclosure (Figure 1-1).

When it was recorded, most of the timbers of Butuan Boat 2 were on display and partially reconstructed with additional fabricated planks and frames (Figure 1-2) at the *Pinagmulan* Gallery at the National Museum's Museum of the Filipino People (now the National Museum of Anthropology, in Manila). Because the display could not be dismantled, many dowel holes and lashing holes were obscured from sight and their general locations and dimensions could only be approximated. In February 2016, the Butuan Boat 2 display was disassembled to give way to new exhibits. Its timbers are currently undergoing conservation work (National Museum of the Philippines Facebook update, 17 February 2016).

Figure 1-1. Butuan Boat 1 as displayed in 2011 at the *Balangay* Shrine, Butuan City. Photograph by author.

The disarticulated and deteriorated timbers of Butuan Boat 5 were placed on two tables while in storage at the Balangay Shrine (Figure 1-3). The planks, which were divided into smaller pieces during their retrieval (ASEAN 1986:141), have shrunk and warped considerably since their recovery. The fragments of the keel plank are recognisable due to a distinctive ridge that runs along its centre. The frames and especially wing ends seem much better preserved than the planks. Soon after the author's visit, the timbers of Boat 5 were moved to the Butuan City Regional Museum for storage and subsequent display (Mary Jane Louise A. Bolunia, personal communication 2015).

The excavations of Butuan Boats 4 and 9 took place over four field seasons commencing in mid-2012, and remain uncompleted (Figure 1-4). The drawings show approximately 50 per cent of Boat 4, and 60 percent of Boat 9.

Timber recording

Using the baseline-offset method and direct measurements, the author, with the assistance of others, produced 1-to-10 scaled drawings of the Butuan Boat timbers of Boats 1, 2 and 5, while National Museum illustrators drew preliminary drawings of Boats

Figure 1-2. Butuan Boat 2 as displayed in 2013 at the *Pinagmulan* Gallery, National Museum, Manila. Photograph by author.

4 and 9, in 1-to-40 scale. In addition, the curvatures of the keel planks of Boats 1 and 2 were taken with the use of a digital goniometer, with readings taken in the space between the lugs. Photographs were taken of specific construction features.

Several badly degraded timbers from the Gujangan shipwreck were also examined, photographed, and because of their small sizes and number, were traced to actual size.

Timber sampling

Wood samples from each of the available Butuan Boats were collected for the purposes of wood species identification and AMS ^{14}C analysis. The samples, measuring approximately 2 cm^3, were collected using various tools e.g. a pipe saw blade, a rotary tool, a chisel, and a *tara-tara*, which is a local digging implement. A total of 58 samples were collected for wood identification, while 11 samples were taken for radiocarbon analysis. The locations from which the wood samples were collected were then recorded on the drawings of the timbers.

Wood identification

The samples used for identification were collected from all major identifiable components of each of the boats, i.e., the keel planks, planks, wing ends, frames and a

Figure 1-3. Butuan Boat 5 timbers as stored in 2013 at the Balangay Shrine, Butuan City. Photograph by author.

quarter rudder. The exception was Boat 9, which at the time of sampling had not been adequately exposed. Only two samples were collected from Boat 9, one from the wing end and the other from the keel plank. Due to funding constraints, only two dowel samples were collected—one from Boat 1 and the other from Boat 5. In the case of the disarticulated planks of Boat 5, 10 representative samples were collected from plank fragments. The samples were taken to the Department of Science and Technology's (DOST) Forest Products Research and Development Institute (FPRDI) in Laguna, Philippines. By viewing the samples under 20x magnification, and comparing with their comprehensive reference collection, FPRDI staff identified 57 samples. One sample from Boat 9's wing end could not be identified because its deterioration was too far advanced.

Radiocarbon analysis

Radiocarbon analysis was performed on the wood samples, which gives rise to issues regarding the resulting ages. It should be noted that as the radioactive clock begins when the sample is formed, a timber sample from an inner tree ring will result in an older date than a sample from an outer ring of the same tree (Aitken 1994:58). In long-lived trees, this means the archaeological context of the sample could be significantly younger

Figure 1-4. Exposed portions of Butuan Boats 4 (background portion) and 9 (foreground portion) as of 2013. Photograph by author.

than the sample age.

The samples used for radiocarbon analysis were collected from the keel plank and wing end of each boat. Radiocarbon analysis, as well as sample pre-treatment, took place at the Australian Nuclear Science and Technology Organisation (ANSTO) in Lucas Heights, New South Wales. In the case of Boat 4, where no wing end was present, a sample from one of the planks was used instead. An additional strake sample was also taken from Boat 1.

The Australian Institute of Nuclear Science and Engineering (AINSE) grant that was applied for and obtained for this research, subsequent to the collection of samples, provided enough funds for the pre-treatment and AMS analysis of seven samples. This meant that each boat could be dated, and two of the boats could be dated twice. Boats 1 and 2 were selected to have both of their samples analysed because of the noted discrepancy of the results from previous radiocarbon analysis, as will be discussed later in chapters. The keel samples of Boats 4 and 5 were selected, while the Boat 9 keel sample was observed to have developed mould growth while in storage and was discarded; the wing end of Boat 9 was used instead. The remaining unused samples have been kept for additional analyses if needed.

The pre-treatment of the wood samples, using the acid-alkali-acid (AAA) method, involved the removal of any contaminants that would affect dating results such as waxes, fats, oils, and other compounds, including chemicals used for wood preservation. The process comprised of first cutting the wood into small pieces with a scalpel. The samples were cleaned with cyclohexane and ethanol in a Soxhlet extractor, then with ultrapure water in a sonic cleaner. They were bleached in order to remove lignin as well as to isolate holocellulose and alpha-cellulose. The samples were converted to carbon dioxide, then graphite. The graphitised sample then underwent AMS analysis for the determination of radiocarbon ages. The results were calibrated with OxCal 4.2 using the IntCal13 dataset.

Archival data

The archival data examined for this dissertation largely consists of historical texts that discuss, to varying degrees, Southeast Asian watercraft. The most important are the first-hand accounts and descriptions of watercraft construction in the Philippines and Indonesia by Spanish, Portuguese and British witnesses. Other accounts containing only brief descriptions by European and Chinese writers were also examined, along with illustrations and paintings.

Experimental model construction

Scaled research models based on the recording and documentation of the Butuan Boats were constructed during the author's visit to the Texas A&M University's (TAMU) Nautical Archaeology Program. The process of model-making has provided greater insight in analysing aspects of the Butuan Boats' construction, and allowed certain concepts to be better visualised than occurs with technical drawings alone.

Prior to their construction, decisions were made to facilitate the completion of the models within the limited timeframe. The builders of the Butuan Boats, and all other lashed-lug boats, carved lugs from the plank timbers. Replicating this process for the plank models was considered to be both time consuming and wasteful of wood. The models were instead constructed by forming the lugs separately and later gluing them to the planks. Poplar wood (*Poplus* sp.) was used because it is easy to work. To prepare the planks, the wood was sawn and planed to the maximum thickness of the individual members, then manually carved with a wood-working kit to correspond with lesser plank thicknesses.

Research models of Boats 1 and 2, constructed to 1:10 scale, were made because of the more complete timbers and recording available for these vessels. Models of both wing end portions of Boat 5 were also produced at this scale. Several “composite” models, demonstrating dowel edge-joining and lashed-lug technique were also produced, in approximately 1:5 scale.

The procedures used in constructing the 1:10 models of Boats 1 and 2 are outlined below:

- Photocopy 1:10 scaled drawings of Butuan Boats 1 and 2
- Cut out individual planks from the photocopies
- Prepare poplar wood planks using bandsaw and electric planer to appropriate thicknesses (the maximum of thickness of each plank)
- Glue paper strips of plank outlines to the poplar using rubber cement
- Cut the wood to shape of plank with band saw (Figure 1-5)
- Smooth shaped plank edges with ceramic sanding belt
- Mark with a pencil the thickness of the planks to be further reduced
- Reduce thickness of wood with hand chisels according to pencil marks
- Cut the lug outlines from the paper strips
- Glue paper lugs shapes to planks with rubber cement
- Cut the lug shapes with band saw
- Glue the lugs to the planks with wood glue, clamping them for at least 30 minutes
- Chisel down the thickness of the lugs
- Drill dowel holes into the plank and lashing holes into the lugs. The smallest drill bit available, 1.6 mm (1/16 in) was used for both holes
- Shape dowels from bamboo skewers with a craft knife
- Insert dowels into dowel holes in planks (Figure 1-6)

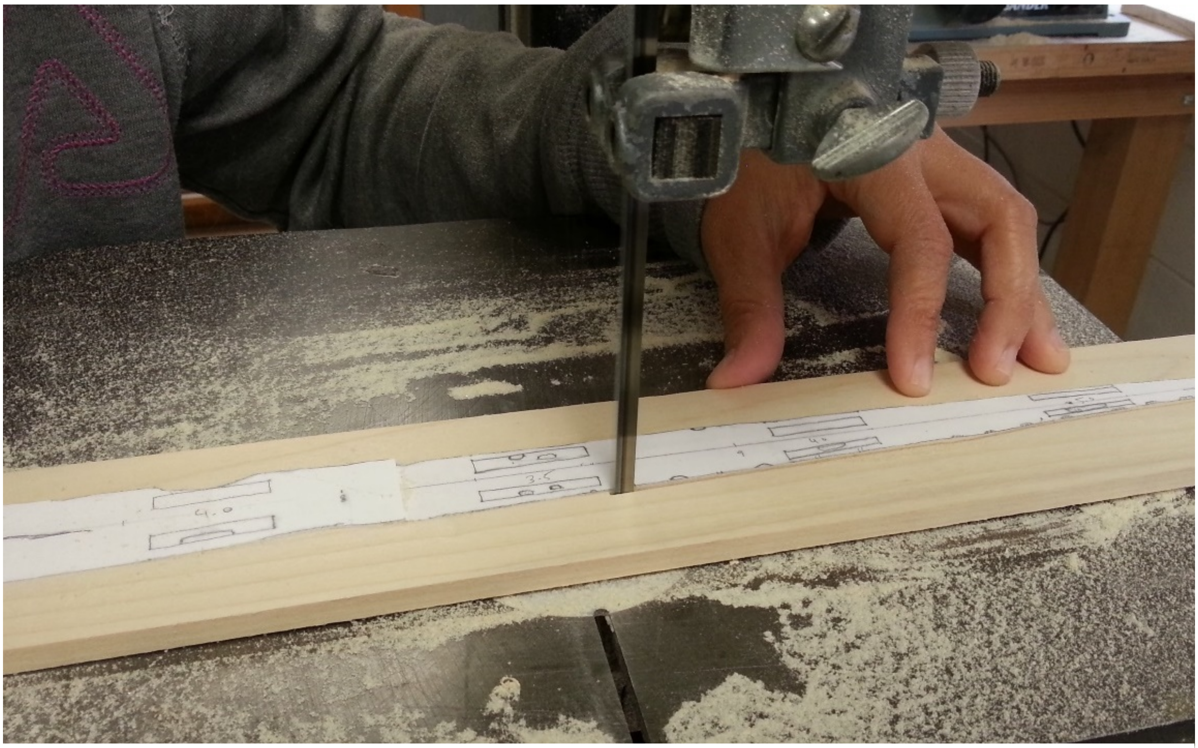

Figure 1-5. Cutting the wood to shape with a band saw. Photograph by Wendy Van Duivenvoorde.

- Thread string into lashing holes, attempting to replicate the lashing shown in drawn and photographed examples; experiment with own lashing

Additional plank sections were produced at a roughly 1-to-5 scale. These sections were used to better understand dowelling and lashing techniques and allow easier experimentation at a more manageable size. The research model construction undertaken at TAMU provided a valuable resource for better understanding the processes of dowelled and lashed-lug boatbuilding. It also served to complement the recording and drawing of the Butuan Boats.

Limitations

While this study benefited from inspecting the original lashed-lug boat remains,

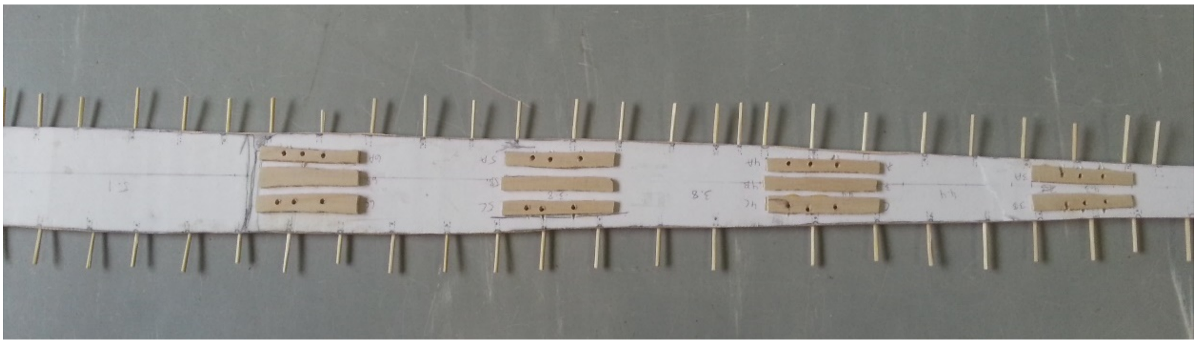

Figure 1-6. Dowels inserted into plank edges. Photograph by author.

several limitations were identified in the overall data set. In all Philippine cases of lashed-lug boat excavations, the corresponding archaeological reports, drawings and photos lacked detail, clarity and at times, accuracy.

This deficiency in the data is especially critical in the cases of Butuan Boat 5 and the Gujangan shipwreck, as their timbers are now badly degraded. Butuan Boats 1 and 2 were exhibited at museum galleries in Butuan and Manila, respectively, and the manner in which they were displayed made taking certain measurements impossible.

Primary data is likewise lacking from most sites in Southeast Asia. Often, more information was found from secondary sources such as regional synopses and summaries. Historical texts must also be considered cautiously. They may contain biases, as well as inaccuracies, that may be exacerbated by translators. These issues emphasise the importance of revisiting the archaeological material in future work.

Chapter outline

This dissertation is divided into eight chapters. This chapter presented a brief summary of the current state of boat and ship archaeology in the Philippines and Southeast Asia, an introduction to evidence of the region's plank-built and lashed-lug boats, and discussed the significance of undertaking more thorough research on these boats, particularly the Butuan Boats of the Philippines. The research questions were defined, the methods used in gathering the data to answer these questions were outlined, and the limitations were disclosed.

Chapter 2 is a literature review that briefly discusses historical sources, previous archaeological work and ethnographic studies related to Southeast Asian plank-built boat construction. Perspectives and theoretical approaches to the study of boatbuilding traditions and technologies, as well as ideas on tradition, innovation and particularism are explored and reviewed for their relevance and usefulness in interpreting the data used in this study.

To set the context for this study, the history and culture of Southeast Asia and then more specifically, of the Philippines, is presented in Chapter 3. It includes a brief description of the region's natural history and environment, early peoples, societies, and maritime interactions, while providing a background to its political and economic conditions through time.

A summary of archival and ethnographic accounts related to Philippine and

Southeast Asian watercraft is provided in Chapter 4. Many of these are comprised of brief, and often vague descriptions provided by non-Southeast Asians, particularly Chinese and Europeans, of Southeast Asian watercraft. There are a few exceptions that are highly detailed first-hand accounts of Southeast Asian boatbuilding. These accounts that span about 500 years, are paid particular attention.

Chapter 5 presents a detailed synopsis of previous archaeological research and reported findings on Southeast Asian watercraft in the region. This chapter is divided into two parts: the first deals with the preliminary results of earlier Philippine archaeological work, mainly on the Butuan Boats, but also other sites. The second part focuses on the material evidence of Southeast Asian watercraft throughout the region.

The data collected from the renewed examination of the Butuan Boats is described in Chapter 6. These include the rerecording of Butuan Boats 1, 2 and 5, as well as the preliminary observations of Boats 4 and 9, the results of timber identification of all the Butuan Boats' main components, and the results of AMS ^{14}C analysis.

Chapter 7 analyses and discusses the historical, ethnographic and material evidence presented. It characterises aspects of traditional Southeast Asian watercraft construction, examines typical and atypical features, and attempts to place these within the wider context of the region's maritime history.

Chapter 8 is the concluding chapter that reviews work outlined in preceding chapters and provides a summary of the research undertaken for this PhD dissertation. Present issues are addressed and avenues for future research are considered.

Chapter 2 Literature review

Introduction

This chapter presents the prevailing knowledge of Southeast Asian watercraft from material remains and written sources, and places this within local, regional and global perspectives. It provides a brief summary and assessment of available historical, ethnographic and archaeological sources, with regards to the scope and quality of the material. In particular, it explores how researchers from the region have approached the study of watercraft from a technological perspective, and how this may have been used to further understand the region's cultural past. Specific examples of Southeast Asian plank-built watercraft studies are presented, with a particular focus on edge-joined and lashed-lug craft. Following this is a review of literature pertaining to the study of traditional watercraft construction worldwide, where broader frameworks in maritime and nautical archaeology are discussed; specifically the use of particularistic approaches by maritime archaeologists, and the responses to this by generalist and relativist theoreticians. The concepts of tradition, human agency and innovation are explored for their relevance in interpreting boatbuilding practices and a theoretical framework for this research is outlined.

Plank-built watercraft with non-metal fastenings

Though no direct evidence survives, human movements from at least 60,000 years ago, but possibly hundreds of thousands of years earlier and predating modern humans, could not have been possible without sea-crossings using some sort of watercraft (Bednarik 2003; Mijares et al. 2010; Simmons 2012; Sutikna et al. 2016). Hornell's (1946) influential hypothesis on the development of the earliest types of watercraft—floats, rafts, and boats, is still recognised and referred to today (McGrail 2014:46). Plank-built boats are considered to be a fairly advanced technological achievement requiring specialized tools to be able to cut planks and prepare them to take fastenings. It is believed that the earliest wooden boats were constructed prior to the development of metal nails, and indeed, metal tools (McGrail 2014:10–11; Ward 2004:14). This stance is disputed by Cunliffe (2010:268–269), who argues that copper or bronze axes and adzes were the minimum tools necessary. Ethnographic evidence, however, supports the possibility of wooden boat construction prior to the metal ages as boatbuilders in various regions of the world were observed to use nothing more than stone, bone or shell tools (McGrail 2014:10–11). On the basis of known technological phases, McGrail theorises that the first plank-built boats could have been constructed prior to the Bronze Age but not earlier than the Neolithic Period (McGrail 2014:46–47). The oldest archaeological evidence of plank-built vessels are from the third millennium B.C. in Egypt (Polzer 2011; Tristant 2012; Ward 2004:14). In some regions, this manner of watercraft construction persisted long after the development of metal nails, though metal tools would have been utilised to facilitate builders' work. In the Mediterranean, for example, the use of non-metal fastenings persisted in the region up to the eleventh century A.D. (McGrail 2014:83), much later than when metal nails were confirmed to have been used in the construction of the sixth-century B.C. Jules-Verne 7 shipwreck (Pomey 1997; Van Duivenvoorde 2014). In many remote coastal and island areas, including parts of Southeast Asia, boatbuilders continued to produce watercraft with non-metal fastenings well into the modern era (Barnes 1996; Green 1996; McGrail et al. 2003).

Accounts of Southeast Asian watercraft and their construction

While Southeast Asian cultures were known to be literate from at least the first millennium, little physical evidence of writing has survived, especially in the archipelagos. Philippine syllabic scripts, thought to derive from Sanskrit, were often etched on perishable materials such as bamboo, leaves and tree bark (Scott 1984, 1992, 1994). Detailed record-keeping, such as those kept in Chinese dynastic annals, was not practiced. Instead, island Southeast Asians passed down knowledge through oral traditions. Southeast Asian historiography has necessarily shown a reliance by historians on written accounts by non-Southeast Asian sources.

Most of the written accounts of Southeast Asian boats or ships are brief, as their authors often focused on outward appearance and size, with only a small number of them offering any insights regarding construction (Blair and Roberston 1903–1905; Manguin 1993; Pigafetta et al. 1962 [1525]; Scott 1982). Such accounts were usually tangential, and placed within a larger narrative that was usually of a political, economic or religious theme (Blair and Roberston 1903–1905; Pigafetta et al. 1962 [1525]).

As most of the texts were originally written in non-English languages, this study relied on translations and secondary sources by historians that may be unfamiliar or less knowledgeable in regards to local watercraft. In some cases, scholars translated selected passages relevant to a specific topic of research (Horridge 1982; Manguin 2012; Scott 1982, 1989). These might include a brief mention of watercraft that in turn were likely to be superficial (Blair and Roberston 1903–1905; Pigafetta et al. 1962 [1525]). In certain instances, however, they can be extremely revealing (Horridge 1982; Manguin 1993, 2012; Scott 1982). Whatever the case, it is likely that materials referring to Southeast Asian watercraft, including those originally written in various Chinese and European languages, remain untranslated and unavailable for this work.

Sudjoko (1981:23) opined that Indonesian historians ignored descriptions of technological and craft skills in favour of political and religious issues, even though technological ability played a significant role in that society. Overall, he laments western- and especially Euro-centric views of Indonesian historians (Sudjoko 1981:23). As a specific example, he cites the tendency of mid-twentieth century historians to down play iron work and metallurgy in Indonesia, and of further ignoring the evidence that Indonesians throughout the archipelago smithed knives, swords and firearms, an activity that practically all the earliest Europeans to the region reported (Sudjoko 1981:23). Instead, European technological superiority was emphasised as the reason for the successful colonisation of Indonesia — even though it took some 300 years for the colonisation to succeed (Sudjoko 1981:23).

Regardless, the scattered historical information can still be drawn upon to create a composite image of the Southeast Asian boat. The accounts, including drawings and paintings, also suggest that there were a variety of different watercraft, of various sizes. They were called various names depending on type and/or on the language or dialect of the local speaker. While form and function varied, evidence shows that specific concepts of construction were commonly shared in parts of Southeast Asia, especially in the archipelagic regions.

The exceptions that describe local watercraft construction are remarkable in their level of detail. Historical accounts dating to the sixteenth, seventeenth and nineteenth centuries detail characteristics of lashed-lug watercraft that complement more contemporary accounts from the twentieth century (Alcina 1960 [1668], 2005 [1668]; Barnes 1985, 1996; Hornell 1920; Horridge 1982, 1985, 1986; Rebello 1569; Wallace 2014 [1869]). These sources are discussed in detail in Chapter 4.

Archaeological examples

There are a relatively small number of available scholarly materials published on Southeast Asian boats and boatbuilding from an archaeological standpoint. Horridge (1982, 1985, 1986, 1995), McGrail (2001), and especially Manguin (1980, 1984, 1985, 1989, 1993, 1996, 2009, 2012) have produced the most in-depth research into the region's boatbuilding integrating archaeological data with historical evidence. The latter two have each produced compilations of watercraft remains based on scant data; both were constrained by the lack of detail offered in the available archaeological reports. Regardless, these authors have provided much of the data that is available to date.

The Butuan Boats

Since 1976, remains of plank-built boats, referred to as the Butuan Boats, were excavated from underneath about two metres of waterlogged alluvial sediment within about a one-kilometre radius in Barangay Libertad, Butuan City, Philippines. The first Butuan Boat was partially unearthed in 1976 by looters searching for buried coffins that contained valuable grave goods such as Chinese ceramics and gold ornaments. Using long metal rods to probe through the earth for the wooden coffins, they came upon the timbers of what is now referred to as Butuan Boat 1. The find was reported to local government officials, who in turn alerted the leadership of the National Museum. Personnel from the National Museum's Archaeology Section investigated the boat's remains (Peralta 1980a). After several months, looters found the remains of Boats 2 and 3, about one kilometre south of Boat 1. Excavations were undertaken on all three sites, though work on Boat 3, described as a smaller vessel, was abandoned (Peralta 1980a). The remains of Boats 1 and 2 were subsequently recovered and displayed in exhibits managed and operated by the National Museum, though Boat 2 is currently undergoing conservation work. Boat 5 was excavated in 1986 as part of a course on archaeological excavation and conservation organised by the Association of Southeast Asian Nations (ASEAN) and hosted by the Philippines' National Museum (ASEAN 1986). It was located approximately one kilometre southwest of Boat 1 and less than 400 metres northwest of Boats 2 and 3. Boat 5 was also recovered and its planks are now stored in the Butuan City branch of the National Museum. In 1989, a team led by Angel Bautista carried out a series of excavations in the area to determine the distribution and extent of archaeological sites. During this project, the remains of Boat 7 were unearthed and found to be in a poor state of preservation; its planks could not be recovered, but smaller wooden pieces such as dowels were collected

(Bautista 1989b:3–4, 6–10, 15). The excavation of Boats 4 and 9, which are adjoining one another, commenced in 2012 and is still ongoing. The remains of these two boats were located just several metres east of the Boat 2 excavation trench, which remains unfilled.

Various authors set the total number of excavated and unexcavated boats at eight (Ronquillo 1997:79; Salcedo 1998:208), nine (Clark et al. 1993:143; Green 1996:95; Green et al. 1995:182) or 11 (Cembrano 1998:4; Galpo 2002:2). A site map frequently reproduced in National Museum site reports and other publications up to 1995 illustrates the approximate locations of eight boats (ASEAN 1986:49–50; Bautista 1988:42; Clark et al. 1993:144; Green et al. 1995:182). This map is problematic as it does not match the geographic features of the area depicted (Figures 2-1, 2-2, and 2-3). Another map attached to a survey report includes a ninth boat which appears to have been drawn by hand after the map had been finalized (Galpo 2002). The boats in this map were not drawn to scale, but Boat 9 is depicted to be west of Boats 2, 3 and 4, southeast of Boat 5 and north of the National Highway (Figure 2-3). None of the sources cite how or when the locations of the unexcavated boats were confirmed.

As the remains of Boats 1, 2 and 5 were recovered, they have been the most documented and closely studied. The excavation of Boat 3 was suspended soon after it was unearthed in the 1970s, and little information on it exists, except that it is similar to the others and composed of only three surviving planks (Peralta 1980a:47). The excavations of Boats 4 and 9 are yet to be completed, and any observations about them should be considered preliminary.

Boats 1, 2, 4, 5 and possibly 3 are all dowelled and lashed-lugged boats. Boat 7 was dowelled but far too deteriorated to judge if it was also lashed-lugged. Similarly, initial research indicates that Boat 9 is edge-joined with dowels, but the presence of lugs in this boat cannot be confirmed at this time. It also appears that Boat 9 measures at least twice the size of the other Butuan Boats (see below and Chapters 5 and 6). Any other technical information is absent from the official reports of the earliest Butuan Boat studies. The National Museum excavations of Boats 1, 2, and 3 took place over several field seasons between December 1976 and December 1977 (Alegre 1976, 1977a, 1977b, 1977c, 1977d, 1977e). The excavation reports for this period only provide a poorly delineated outline of accomplishments and activities across these sites. Site mapping was a listed activity

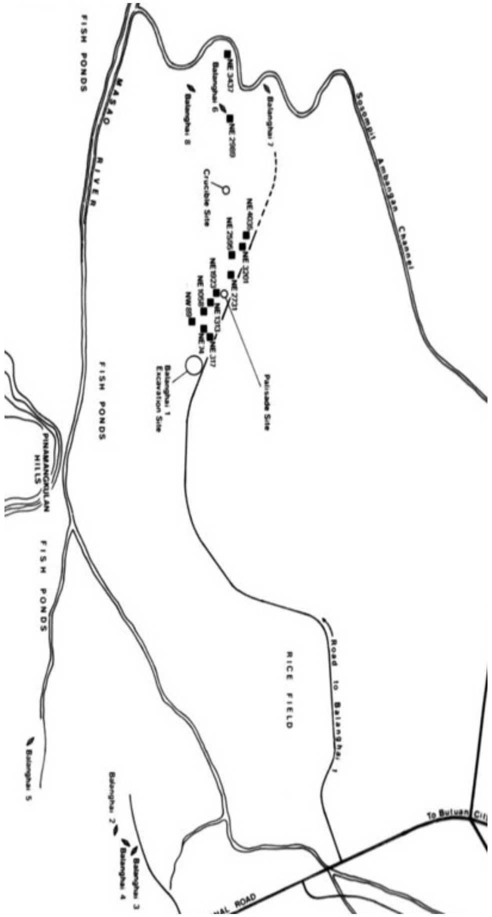

Figure 2-1. Map of Butuan Boat sites. Compare northern river bends with Figures 2-2 and 2-3. Courtesy National Museum of the Philippines.

Figure 2-2. Satellite view of Butuan Boat sites. Compare northern river bends with Figure 2.1 Image from Google Maps, 2014.

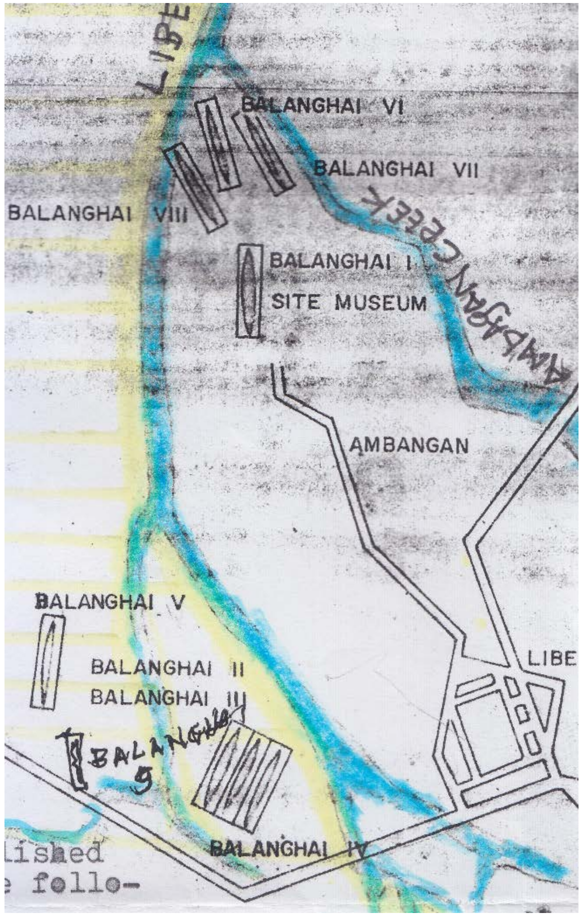

Figure 2-3. Map of Butuan Boat sites with location of Boat 9 hand-drawn after the map was finalised. Also compare northern river bend with Figure 2-1 (after Galpo 2002).

but no maps were attached to the submitted reports. It is possible that these were filed separately, or attached to another copy filed elsewhere. Whatever the case, these have not been located. The *Butuan Balanghai Project: Preliminary Report on the Archaeology of Butuan City* was produced by Peralta (ca. 1977–1978), who had minimal, if any personal involvement in the Butuan archaeological activities; he would have proceeded based on discussions with the excavator, Leonardo Alegre, and others involved. Also lacking from the reports are photographs and timber recordings. Photographs from the excavations of

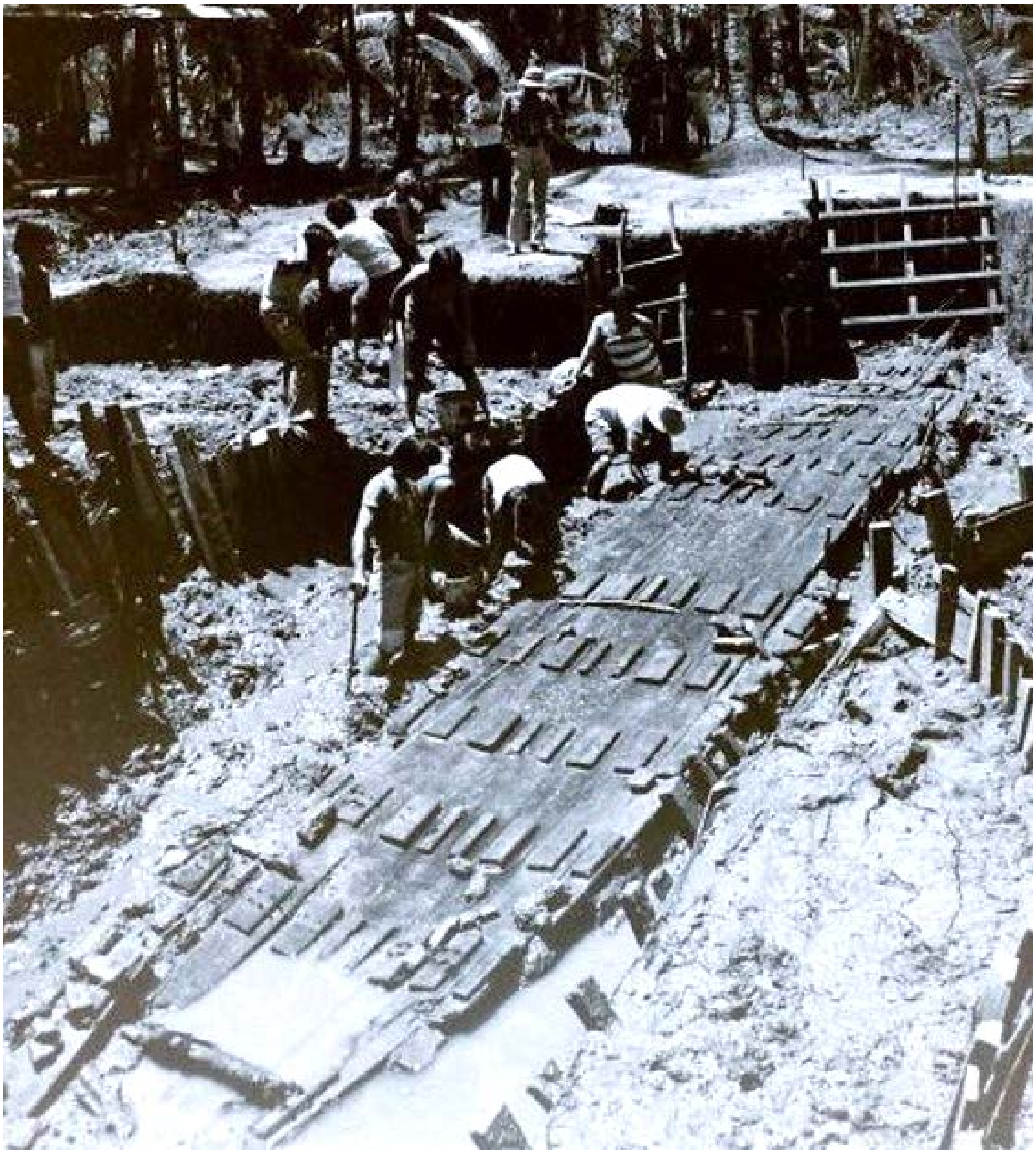

Figure 2-4. Butuan Boat 2 excavation. Photograph courtesy of the National Museum of the Philippines.

Boats 1 and 7 are currently missing and it is unknown if any even exist. Photography was undertaken during the excavations of Boats 2 (Figure 2-4) and 5 (Figure 2-5), and possibly of Boat 3; unlabelled photographs of unearthed timbers that fit the brief descriptions (Peralta 1980a:47) provided for Boat 3 (Figure 2-6) have been located. Even so, few detailed photographs were taken of a standard useful for archaeological analysis. Drawings of Boats 1, 2 and 5 were produced but likewise show little detail that is useful for analysis, and upon closer inspection, contain some errors. The drawing of Boat 1 appears improperly scaled (Figure 2-7), and the drawing of Boat 2 is only a rough sketch showing an inaccurate number of lugs (Figure 2-8). The in situ drawing of Boat 5 appears

Figure 2-5. Butuan Boat 5 excavation. Photograph courtesy of the National Museum of the Philippines and the Western Australian Museum.

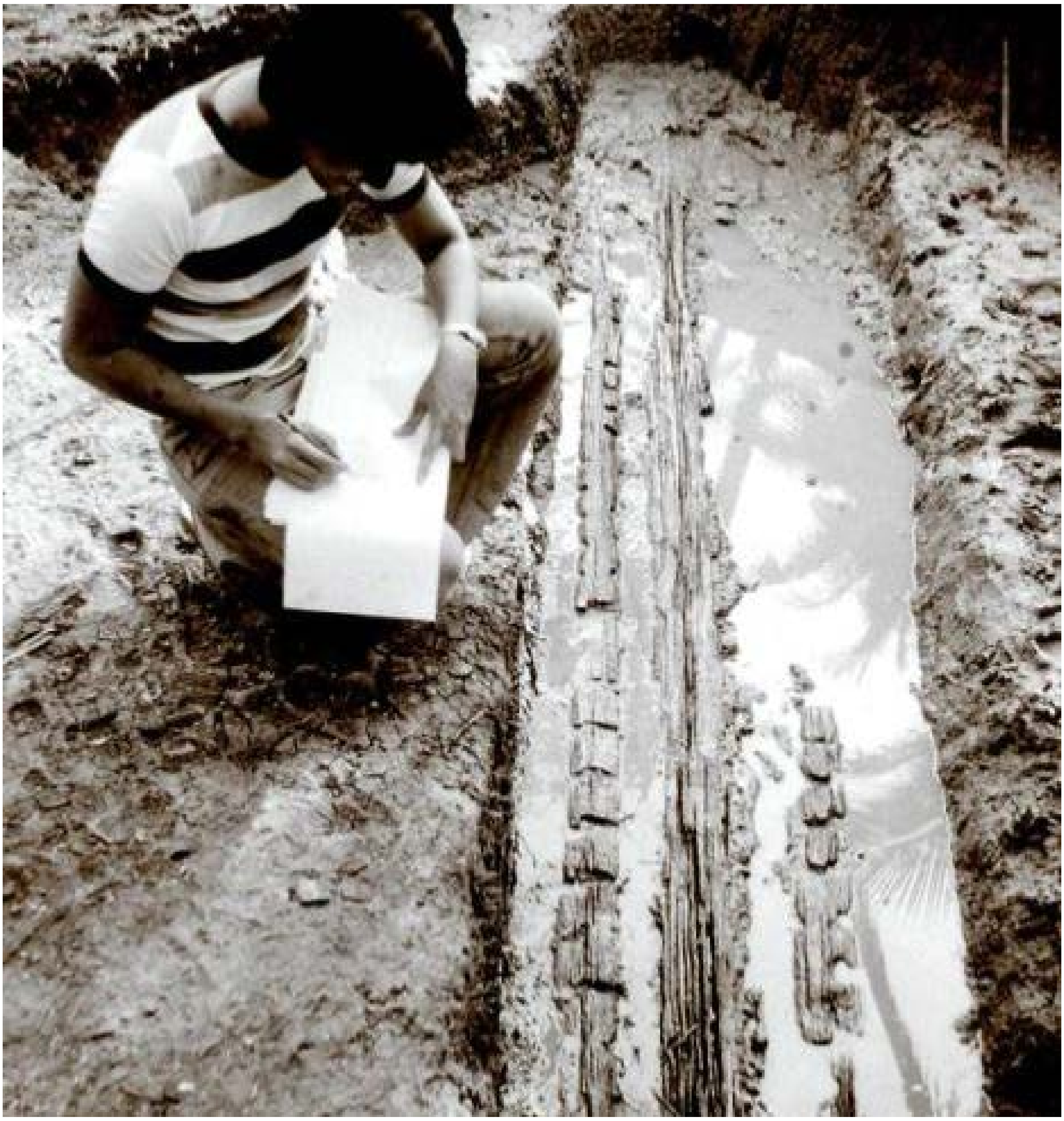

Figure 2-6. Unlabelled excavation photograph of what may be the timbers of Boat 3. Courtesy of the National Museum of the Philippines.

to be accurate, but does not show the locations of seven frames recovered from the site, nor the sampling and plank sectioning made at the time of recovery (Figure 2-9). The original drawing is missing, and the available copies are in a relatively large scale precluding close examination.

While the official archaeological reports provide little information, bits of data eventually emerged in subsequent papers published by several authors (Cembrano 1998; Peralta 1980a; Ronquillo 1989, 1997; Salcedo 1998). Most of these writings, however, still lacked detailed information, perpetuated earlier mistakes, and in several cases

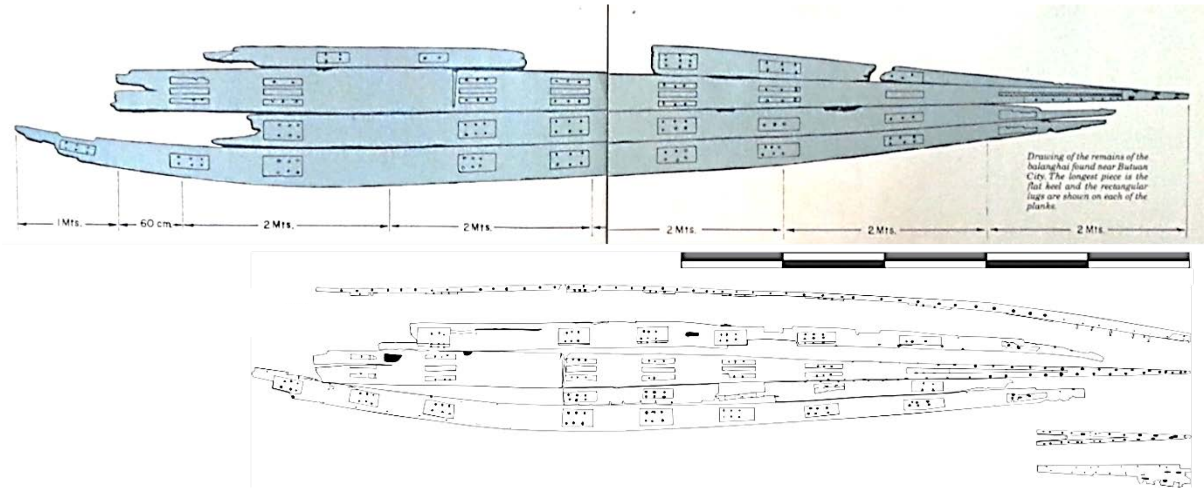

Figure 2-7. Top: Timber drawing of Butuan Boat 1 that appeared in *Archaeology Magazine* (Peralta 1980a:44–45). Compare to bottom drawing by author, made in 2013 adjusted to the same scale. Planks were also rearranged at some point after the first drawing was was produced.

further confused matters by providing vague or conflicting information without addressing inconsistencies. That this occurred is hardly surprising, considering the paucity of first-hand documentation and recording.

The similarities of the Butuan Boats to Alcina's descriptions were remarkable, though overstated. The unreserved statement that "in every feature, the hull remnants seemed to come directly from the seventeenth century manuscript" (Peralta 1980a:44), was taken at face value. With some exceptions, writers on the Butuan Boats have treated their construction as basically identical to each other, to other Southeast Asian lashed-lug boats, and especially to what has been described in historical documents (Peralta 1980a; Ronquillo 1989, 1997; Salcedo 1998). Because their construction appeared to have come from the same boatbuilding tradition, their similarities were emphasised while the differences were glossed over. They were rarely discussed as individual watercraft, and instead treated as a set of vessels indistinct from one another. In the earliest written works, the Butuan Boats were commonly described as "edge-pegged" (later amended to the more accurate, "dowelled") and/or "lashed-lug" (sometimes, "cleated") vessels that were constructed without metal fasteners (Horridge 1982; Manguin 1993; McGrail 2001; Peralta 1980a; Ronquillo 1989, 1997; Salcedo 1998). Their original size was estimated to have measured 14 to 15 meters in length and 2.5 to 4 metres in width (Cuevas et al. 2004:5; Peralta 1980a:45; Ronquillo 1989:62; 1997:79; Salcedo 1998:208). Also, Peralta noted that Boat 2 shared with Boat 1 "the same characteristic edge-pegging, raised rectangular lugs, and other essential *balanghai* features: the flexible bulkhead, the

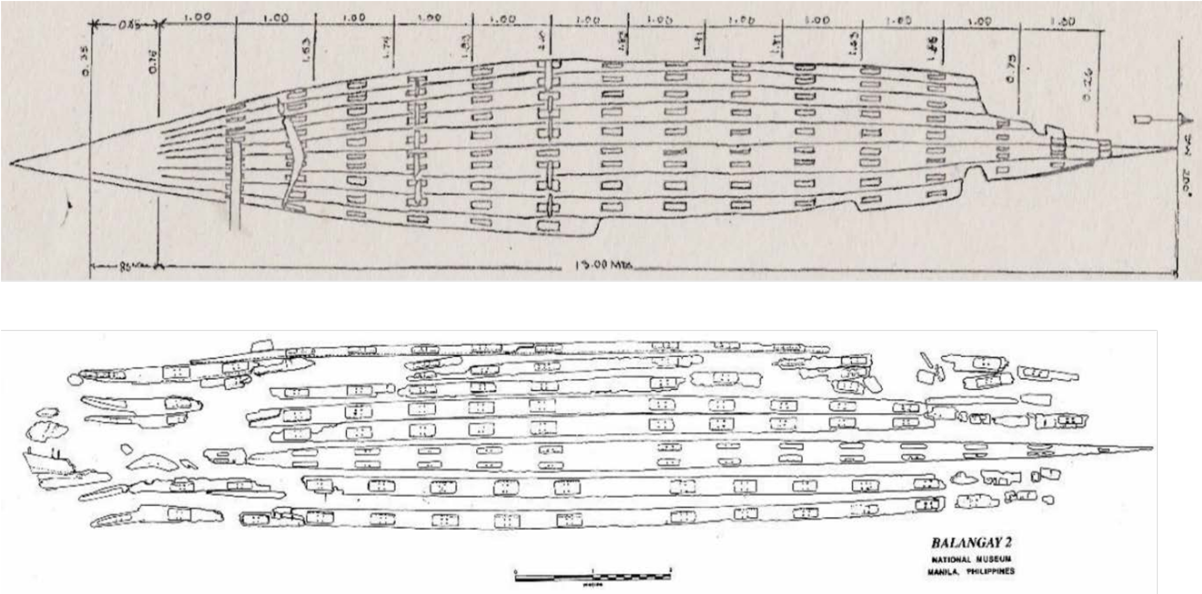

Figure 2-8. (Top) Timber drawing of Butuan Boat 2 that appeared in a conservation report showing an additional row of lugs (Abinion 1978:5). Compare to bottom drawing from a tracing of a photomosaic (Clark et al. 1993:45).

collapsible mast, and the counter-pegging of the planking pegs," (Peralta 1980a:45). Furthermore, he refers to the: "base of a spar found amidships [that] suggest[s] a collapsible mast" (Peralta 1980a:45). In describing Boat 1 earlier in the same paper, however, no mention was made of "flexible bulkheads" or what may be taken to mean flexible frames; but a frame fragment was found lashed to a lug on Boat 2 (Figure 2-10). He only reported that some ligatures were still found in some of the lashing holes of Boat 1. Neither this, nor subsequent papers report evidence of a collapsible mast on Boat 1. The "spar" found on Boat 2 was also not reported by other authors. Peralta refers to "counter-pegging of the planking pegs" on Boat 2; but as others later remarked, the dowels of Boat 2 were not locked in to the planks unlike Boats 1 and 5 (Clark et al. 1993:154; Green 1996:96–97).

Almost a decade later, researchers realised the necessity of detailed recording of the Butuan Boat remains (cf. Clark et al. 1993; Green et al. 1995). The first attempts at thoroughly recording the boats came years later, in 1988 for Boat 2 in Manila, and in 1992 for Boats 1 and 5 in Butuan City (Clark et al. 1993:154; Green 1996:96–97). This came about through a collaboration between researchers from Australia's Northern Territory Museum of Arts and Sciences, the Western Australian Maritime Museum and the Philippines' National Museum. They confirmed that up to that point, no accurate construction drawings of any of the Butuan Boats had been produced (Clark et al.

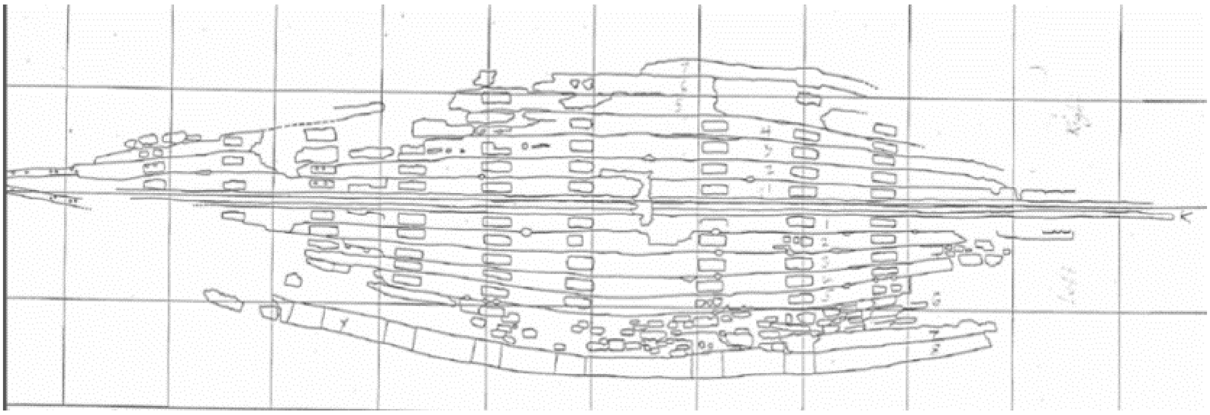

Figure 2-9. Excavation plan of Butuan Boat 5. From ASEAN 1986.

1993:143). The team carried out comprehensive documentation through proper artefact photography and drawing (Clark et al. 1993:143; Green 1996:95–97; Green et al. 1995:182–183). Their recording was easily the most comprehensive to date, making use of photo mosaics and full-scale timber tracings.

The Butuan Boat site nomenclature has caused a good deal of confusion, especially with the lack of excavation photographs of the earliest archaeological activities and publication of results. Butuan Boat 1 was first referred to as a *balanghai*, in line with the spelling used by Antonio Pigafetta (1962 [1525]:137) of what the first Philippine people he encountered called their larger vessels. When the succeeding Butuan Boats were unearthed, the boats and the sites in which they were found were referred to as *Balanghai* I (or 1), *Balanghai* II (or 2), and so on in the order that they were reported, but not in the order they were archaeologically excavated (Alegre 1976, 1977b; Galpo 1981; Peralta ca. 1980). This posed problems in recent years with new Butuan Boat excavations taking place—how to number new finds in light of reports that cite Boats 4, 6, 8, 9, 10 and 11, as unexcavated, with their precise locations unknown. National Museum researchers elected in 2012 to refer to the first newly excavated boat as 4, as this was within the same plot of land shown in old site maps, and the second newly excavated boat as 9, as finalised maps only depicted the locations of the first eight boats (Mary-Jane Louise O. Bolunia, personal communication 2012).

In some instances, the alternate Philippine spelling *balangay* was used (Bautista 1989a; Cembrano 1988; de Vera 1988a). Other archaeological work that was undertaken near the boat sites was also placed under the umbrella project called '*Butuan Balanghai Project*', the objectives of which included surveys for habitation and burial sites that fell within a range of at least four cultural sequences (de Vera 1988b; Peralta 1980b). The

Figure 2-10. Frame fragment still lashed to Butuan Boat 2 lug. Photograph courtesy of National Museum of the Philippines.

sites under this project were sometimes named after the property owners, such as Burdeos, Fortun, Luna, Plaza, Sanches-Buque, and Torralba (Alegre 1978; ASEAN 1986; Bautista 1989a). Subsequent reports divided the area into seven localities, some of which encompass several sites. Locality 1 is the Sanches-Buque property where a burial site containing Yue-type materials was found and excavated in 1977; Locality 2 is the *Balanghai* 1 excavation site; Locality 3 is the Torralba property site containing wooden palisades; Locality 4 is the Plaza property site where 20 earthenware crucibles were retrieved; Locality 5 is the Luna property site where *Balanghai* 6, 7, and 8 were reported; Locality 6 is the Fortun property site containing *Balanghai* 2, 3, and 4; and Locality 7 is the site of *Balanghai* 5 (ASEAN 1986; Galpo 1982). Later, most researchers discarded the use of *balanghai*/*balangay*, and the vessels became known as the Butuan Boats (Cembrano 1989; Clark et al. 1993; Green et al. 1995; Manguin 1993; Ronquillo 1997; Salcedo 1998).

In several papers Boats 1 and 2 are mistaken for the other. William Henry Scott (1981:2) published a photo of the Boat 2 excavation erroneously labelled Boat 1. Manguin

(1985:334; 2012: Fig. 2) and McGrail (2001:297) used a drawing of the lug configuration of Boat 1 and either labelled it as Boat 2, or used it to represent all the Butuan Boats. An *Archaeology Magazine* article published in 1980 features two photographs shown side-by-side of the same excavation of Boat 2 taken from slightly different angles (Figure 2-11). The accompanying caption implies that the photographs are of two different boats:

> (Left) The discovery of this *balanghai* has firmly placed boat travel in the Philippines to some time before the tenth century after Christ. Archaeologists work to save this wooden artefact. (Right) The second *balanghai* is uncovered by Philippine archaeologists (Peralta 1980a:46).

The same paper provided the A.D. 320 date for Boat 1 and A.D. 1250 date for Boat 2, and so the caption for the photograph on the left referred to Boat 1. The error was likely unintentional, as the paper clearly noted the differences in the number of strakes that each boat consisted of, and also included a drawing of Boat 1, so that anyone reading the paper carefully would have caught the error. Even so, it is easy to see how the pictures and their captions could cause confusion to readers.

Figure 2-11. Published photographs of Butuan Boat 2 with a caption suggesting left photo is of Butuan Boat 1, as shown in *Archaeology Magazine* (Peralta 1980a:46)

As seen from the examples above, a considerable amount of confusion has arisen in the decades following the Butuan Boats' excavations. One of the main aims of this thesis is to provide clarity on their construction features, the wood used, and their dates. Even so, early work should not be entirely disregarded, but must be carefully considered. While this study re-examined the previously excavated and recovered boats, the new results can still be used in conjunction with earlier findings. These will be presented in Chapters 5 and 6.

Other evidence from the Philippines: the San Isidro and Gujangan shipwrecks

An unpublished paper prepared for the ASEAN Committee for Culture and Information (ASEAN-COCI) reports two boats from archaeological sites that share similarities in construction to the Butuan Boats (Cuevas et al. 2004). The first is the Gujangan shipwreck located in the southern Philippines, which was heavily looted. The site yielded materials including Chinese ceramics dating to the fifteenth century. National Museum archaeologists collected several boat timbers which are now in storage. The planks exhibit lugs and dowel holes similar to the Butuan Boat planks (Cuevas et al. 2004:5).

The San Isidro shipwreck was located in 1996 at a depth of 42 to 44 meters under about 50 cm of deposits (Cuevas et al. 2004; FEFNA 1996). The vessel, measuring approximately 15 meters in length, was carrying iron bars, cooking implements and Chinese porcelain dating to the sixteenth century (Cuevas et al. 2004; FEFNA 1996). The report submitted to the National Museum by the Far Eastern Foundation for Nautical Archaeology (FEFNA) states that several of the boat timbers were dismantled and raised for top side documentation then returned to the site (FEFNA 1996). The authors reported that the San Isidro planks exhibited shallow lugs and dowels, and in addition, evidence of stitching with rattan was observed near the edges of the planks. National Museum archaeologist Rey Santiago included in the FEFNA report an observation that the planks were clinker-built, which is inconsistent with edge-joinery, unless both planking methods were used in this particular vessel.

Other lashed-lug boats from Southeast Asia

Other Southeast Asian watercraft remains, to be discussed in greater detail in Chapter 5, that have been documented from throughout the region number at least 20 (Manguin 1993, 2012; McGrail 2001). Anecdotal accounts indicate that several more may have been found but have not been published. Unfortunately, little information on these boats other than general descriptions is available, much like the early documentation of the Butuan Boats. Similarly, the information included here is from secondary sources (Manguin 1985, 1989, 1993, 2012; McGrail 2001).

The oldest known lashed-lug vessel, dating to between the third and fifth centuries, is the Pontian Boat found in Peninsular Malaysia in the 1920s. So far, the most intact and best-preserved lashed-lug boat is the Punjulharjo Boat found in Central Java, Indonesia. The boat, which dates to between the seventh and eighth centuries (Manguin 2012), was exposed along an ancient beach ridge in 2008. A detailed report on the Punjulharjo boat was published in Indonesian (Abbas 2010), while an English version is currently being prepared (Pierre-Yves Manguin, personal communication 2015). The largest lashed-lug vessel is the Cirebon shipwreck, which was excavated by commercial salvors. It carried various types of tradeware numbering in the hundreds of thousands dating to the early first millennium (Liebner 2014).

Assessment of Philippine and Southeast Asian sources

The available archaeological and historical evidence indicates that the use of lashed-lug boats was widespread for at least 1,500 years. Archaeological studies of boats and ships in Southeast Asia, however, have for many years been overlooked. While archaeological material is available, researchers from within the region have until recently neglected the thorough and precise recording of these boats and ship remains, or otherwise have not made such documentation easily available. What is known is therefore mostly fragmentary, lacking in detail and possibly incorrect. There also appeared to be an over-reliance on historical descriptions in favour of examining the archaeological material as primary evidence. The Butuan Boats were used to confirm old texts rather than as a way to learn about what may have not been mentioned in, or differed from, the accounts. As has been lamented by several maritime archaeologists (Adams 2013:48; Corbishley 2011:83; Muckelroy 1978:6), the archaeology was used to illustrate the written history while the potential for new interpretations based on the archaeological data was ignored. The archaeological evidence should also be used to fill in ambiguous parts of the texts. The "diagonal" lug holes of the Butuan Boats, which were of three pairs per lug in Boat 1, and of two pairs per lug in Boat 2, were said to be identical to Alcina's descriptions (Peralta 1980a:43). In fact, Alcina (1960 [1668]:149; 2005

[1668]:179; Horridge 1982:14) simply wrote that two holes were made on each lug, and did not refer to their orientation. Furthermore, the Butuan Boat lug holes are predominantly and generally L-shaped, not diagonal. This study uses both written and archaeological data, but attempts to clarify inconsistencies and not minimise or dismiss them, as has previously been done in early works.

Theories on the development of Southeast Asian planked watercraft

From the evidence available at the time, Manguin (1989, 1993, 2012), McGrail (2001) and Horridge (1982, 1995) have each posited similar theories on the development and evolution of Southeast Asian boatbuilding. Horridge (1982:1, 32–33, 56–58) proposes that the first Southeast Asian boats must have been joined exclusively by plank-lacing, as he asserted metal technology was necessary for drilling dowel holes through plank edges. With the development of appropriate metal tools, boatbuilders began to depend more on dowels until lacing was discarded.

Manguin (1993:260; 2012:5) and McGrail (2001) have posited that lashed-lug vessels from the early first millennium were primarily laced and supplemented with dowels. They referred to these boats as "stitched-plank and lashed-lug" (Manguin 2012: 5) and "boats with stitched planks" (McGrail 2001:297). They agree that dowels gradually replaced lacing, around what McGrail (2001:305–306) theorises was the seventh century, while Manguin (2012:5–6) proposes it began to occur towards the end of the first millennium. Looking at the archaeological evidence of lashed-lug boats in Southeast Asia, dowels are always present, even if only as reinforcement to primary ligature fastenings, or the alignment of planks, as seen in the Pontian, Medan, Sambirejo and Kolam Pinisi boats (Manguin 1993:260; McGrail 2001:298). Thus, the matter of exclusive dowelling evolving from exclusive stitching cannot be ascertained without additional evidence of much earlier plank-built boats.

McGrail (2001:304–308) presents a chronology for the appearance of new construction features on Southeast Asian watercraft, while acknowledging instances of the survival of early construction techniques even up to modern times. He believes that prior to the seventh century, lashed-lug boat planks were typically laced together. From the seventh to fourteenth century, lashed-lug boat planks were fastened to each other entirely by dowelling. He also proposes that during this period, sometime from the eighth or ninth century, double outriggers began to come into fashion (McGrail 2001:307). He bases this entirely on iconographic evidence—depictions of such boats are shown for the first time in the eighth- to ninth-century Borobudur stone carvings in Central Java, Indonesia. From around the fourteenth century onwards, McGrail (2001:307–308) suggests that sea-going vessels were constructed with multiple layers of planking as well as bulkheads, similar to Chinese ships. He distinguishes Chinese from Southeast Asian vessels primarily by the fastenings used in their planking, i.e. the Chinese used iron nails while the Southeast Asians dowelled. Manguin (1993:270–274) refers to these ships with mixed construction methods as a hybrid South China Sea tradition. Where this construction method originated, however, remains uncertain.

Manguin (2012:5) suggests a chronology for the development of plank fastenings of lashed-lug boats. Specifically, he considers evidence that plank lacing was the primary fastening supplemented by a small number of dowels. By the second half of the first millennium, boatbuilders began to rely on a greater number of dowels relative to lacing, and towards the end of the millennium, lacing was completely abandoned. He continues that larger lashed-lug vessels began to decline in the fifteenth century, when frames were fastened to planks with treenails.

Manguin and McGrail's timelines are based on archaeological watercraft sites in the East Asian and Southeast Asian regions, though both admit the sampling is still a relatively small one. This scarcity of information is compounded by the, at times, poor quality of data produced by primary investigators. While awaiting the location of new sites to support or disprove the chronologies, a careful re-examination of evidence from existing, particularly Philippine, sites can greatly contribute to the currently limited information.

Watercraft studies: Development, perspectives, and theory

Maritime archaeology is an extensive field encompassing every human epoch and a great variety of material culture related to human interactions with the seas, and even extending to rivers, lakes and other waterways (Adams 2013:2; Bass 2011:4). Because of maritime archaeology's beginnings it is often perceived, even by its practitioners, to be synonymous with underwater archaeology which in some instances is not maritime in nature, as is the case with some types of submerged terrestrial sites. The most well-known underwater sites are shipwrecks so in turn, it is widely thought of as shipwreck, and nautical archaeology (Gould 1983; McCarthy 2006; Muckelroy 1978). Nautical archaeology, or the study of watercraft, does not always deal with shipwrecks and sites underwater, as vessels may be deposited, intentionally discarded, or reused in different environments and for a range purposes (Richards 2008, 2011, 2013).

Few of the Southeast Asian boat remains discussed in this thesis were found in underwater or shipwreck environments. Most were located buried in waterlogged terrestrial sites, which provide the greatest chance for wood preservation. Questions regarding their deposition are necessarily raised, and though previous work has done little to investigate this further, it is possible that a significant number of these were deliberately abandoned. Deliberate abandonment is recognised as a widely practiced act of retiring or discarding watercraft that are no longer useful, and is distinct from the premature loss brought about from the act of scuttling or "abandoning ship" to escape or avoid impending disaster (Richards 2011:858–859). Studies on discarded vessels have so far been marginal, with focus pointed predominantly to shipwreck sites. For example, Richard Gould's (2011) book *The Social History of Ships* treats shipwrecks as the primary source of his research. The difference between a wrecked and an abandoned vessel is significant, as are the approaches used in examining them, and the knowledge that can be gained as a result (Richards 2011:858). Maritime archaeologists did not always acknowledge that this was the case, and made few adjustments in their methods of inquiry (Richards 2008:6, 7). Vessels that are purposely discarded are a contrast to shipwrecks, and receive far less attention. Nathan Richards proposes that abandoning vessels evokes negative feelings, which might explain the lack of attention they receive (Richards 2013:2–4). Studying sites containing abandoned watercraft can "contribute to our understanding of behaviours associated with cultural site formation processes such as salvage demolition and scuttling [and how] they translate to the archaeological record" (Richards 2005:71).

Researchers have investigated behaviours related to economic and technological influences leading up to ships' abandonment as well as behaviours present in exploiting ships after they have been abandoned (Babits 2013; Bennett 2014; Delgado 2011, 2013; Hunter 2012, 2013; Richards 2008).

As with archaeology's antiquarian and object-based roots, maritime archaeology's growth has moved in a similar path, though this came decades later (McCarthy 1998). Today, more complex forms of inquiry using scientific and theoretical approaches have been developed through all branches of archaeology in investigating the human past and searching for universal human truths. Maritime archaeologists, however, have long tried to demonstrate their field's "scholarly legitimacy beyond the arcane details of nautical history and technology" (Gould 2000:xii), amidst widespread views that what they were practicing was not academic, and certainly not archaeology (Babits and Van Tilburg 1998; Bass 1983; McCarthy 2006). Early on, land archaeologists also struggled to see the value of underwater archaeology and shipwrecks as it was believed that the underwater environment destroyed data that was worth collecting (Gould 2011:3). This view was disproved with clear evidence that organic materials survived longer in waterlogged environments than in dry environments (Werz and Seemann 1993). Moreover the preservation of shipwreck cargoes under water has in the last 50 years provided material evidence that has not yet been found in land sites (Polzer 2011; Pulak 2008).

Technological approaches

The study of plank-built watercraft and their construction within the maritime archaeology discipline developed from a strong technological approach. Questions about construction sequence and the manner of plank joinery were formulated early in the development of ancient boat and ship studies. Craft were classified depending on their planking as clinker- or carvel-planked. Later, vessels were identified according to building sequence, as either shell-first or frame-first (Basch 1972; Hasslöf 1972). Such typologies and classifications were also used by scholars to relate to the technological development of plank-built watercraft construction (Hocker 2003).

Early plank-built watercraft studies dealt almost exclusively with evidence from European and Mediterranean sites. These sites suggested that the earliest plank-built boats, having evolved from built-up dug-out canoes and rafts, were shell-based, that is, planking was first assembled to a complete watertight shell, or skin. Ribs or frames were inserted into this shell to strengthen it. Earliest evidences of shell-first craft were shown to have been built by fastening together overlapping strakes, a technique known as lapstrake or clinker planking, or they were joined edge-to-edge.

Examples from later European and Mediterranean sites suggested that shell-based construction was replaced by frame- or skeleton-first construction, at least in ships and larger craft (Casson 1963). In skeleton-first construction frames were first assembled and made watertight by the addition of planking. The method of assembly generally produced a smooth-skinned vessel with carvel planking fastened directly to the frames (Basch 1972:16). As a result, clinker planking and edge-joined carvel planking were associated with shell-first construction in early planked boats, while non-edge-joined carvel planking was associated with the later frame-first construction of ships. There were exceptions, however, where the planks of frame-first vessels were also edge-joined (Basch 1972:17; Lemée 2006), while Chinese vessels exhibited lapstrake planking over frame-first (or bulkheads-first) construction (Basch 1972:17).

It was thought that in later times, shell-first construction was deemed impractical for building all but the smallest boats (Casson 1963, 1964). Lucien Basch (1972) critiqued this conclusion, citing examples from outside of Europe and the Mediterranean to show this was not universally true. He argued that various regions did not use exclusively shell-first or frame-first construction methods. Both techniques could have been present contemporaneously (Basch 1972:17). Furthermore, Basch (1972:16) highlighted the idea that just identifying planking and construction sequence were insufficient for the study of nautical archaeology. Instead, he considered the role and function of the frames. If they were made to fit the shape of the already formed hull, he described the frames of a shell-first vessel as "passive" (Basch 1972:16). Whereas "active" frames were assembled first and these determined the shape of the vessel (Basch 1972:16).

While the classification of shell/skeleton sequences seemed to afford a neat and convenient dichotomy for a wide range of watercraft throughout the past, it became increasingly clear that this was not always appropriate. Mixed-construction, a combination of shell- and skeleton-based construction, was seen in watercraft that was thought to represent a transition in technology (Hocker 2004b:7). On the other hand, bottom-based construction as seen in northern European and South Asian watercraft was seen to have no affinity with either shell- or skeleton-based building (Hocker 2004a:65; Van Duivenvoorde 2015:9). Frederick Hocker (2004b:6) believes that there are three major aspects to be considered in shipbuilding concepts. These are design, assembly sequence and structural philosophy. He defines structural philosophy as:

> the way in which the shipwright intends the component timbers of the hull to distribute the different working stresses the vessel can be expected to encounter… few plank-built hulls rely entirely on shell or skeleton; instead the two complement each other in an integrated system (Hocker 2004b:6).

Particularism: Critiques and responses

The technological approach, and the overly descriptive accounts used in early examinations of ship and boat archaeology were criticised as tedious when compared to archaeological scholarship that had moved on to apply processual and later post-processual views as active critiques to previous approaches (Adams 2013; Hodder 1982; Trigger 1989). During the late 1970s and early 1980s, younger maritime archaeologists advocated a shift in focus by linking watercraft and their construction technologies to the cultures that created and used them. Keith Muckelroy's reminder that archaeology is the study of the human past "and not the ships, cargoes, fittings or instruments with which the researcher is immediately confronted" (Muckelroy 1978:4) is often repeated (McCarthy 1998:33). In response, and probably irritated at the suggestion that nautical archaeologists tended to be "men of action more than men of contemplation" (Lenihan 1983:39), others such as Steffy (2012) and Bass (1983) insisted that while closely examining construction and techniques, their focus was on people and cultures all along. At any rate, watercraft increasingly came to be seen as cultural material, and their construction recognised as a complex social activity. From what had been perceived to be purely technical and technological studies, watercraft came to be viewed as a product of complex societal constructs of which the boatbuilder was a part.

Further disconnects between land and shipwreck archaeologists became apparent in a 1981 seminar on shipwreck archaeology held in the United States with participants including historical, classical, and anthropological archaeologists, as outlined by Richard Gould (1983). Because classical shipwreck archaeologists of the time reasoned implicitly, without formal research designs, other practitioners criticised their particularistic approach as inadequate (Gould 1983:18–19). The call for more explicit research designs, methods and interpretations was made, in order to "provide a basis for both maintaining and improving upon the standards set during the course of earlier work" (Gould 1983:19). George Bass (1983), who was admittedly presenting a biased perspective as the only classical shipwreck archaeologist in the seminar, defended the work and output of classically-trained shipwreck archaeologists and strongly supported the use of historical particularism in nautical archaeology. Bass (1983) further criticised the use of formal research designs which he viewed as inflexible, where potentially significant aspects of a site are ignored or lost with researchers limiting their study to answering specific questions that had been generated before the full extent of the site could be assessed. Worse was the danger that the questions shaped how evidence was interpreted instead of allowing the evidence to speak for itself (Bass 1983).

Today, maritime archaeologists continue the oft-repeated calls for recognising the human aspects in studies even as they concede, sometimes seemingly as an afterthought, the necessity of recording the minutiae (Adams 2013). Frederick Hocker (2004b:2) observed that while ship studies often appear to focus on trivial details, differentiating the trivial from the significant is not easily done until thorough recording has been completed. Even so, he cautions against the tendency to fixate over every detail of construction as if it existed in a vacuum, and in ignoring the perspectives of the shipwrights and the culture in which they lived. Jonathan Adams (2013:1) asserts that instead of clarifying, the vast database that has been assembled from material evidence has repeatedly generated unsolvable problems, that he proposes might be more easily explained if they were "investigated within the social contexts…in which they were conceived and created".

The greatest criticism aimed at particularistic research was not that it was used at all, but that it did not seem to progress beyond itself, with researchers delving into increasingly more miniscule details and refusing to answer broader questions. It was not long, however, before generalists themselves became the objects of criticism by newer archaeological theorists, who recognised that each site and the data contained within were embodied by multiple contexts and not singular, universal meanings (Hodder 1982:4). But just as earlier criticisms by generalists accepted that previous practice by particularists was not wrong, per se, relativists also "accepted the need for scientific rigour in field methods, generalisation and theory-building" (Hodder 1992:156).

As stated in Chapter 1, Southeast Asian maritime and underwater archaeology is still developing, and in-depth watercraft studies have until recently been ignored. Theoretical approaches to interpreting ships and boats is understandably underutilised, if at all. Historical particularism is the necessary starting point for a field of study such as this as it is still in its early stages. Bass maintains that "the emphasis on data collection and classification is both inevitable and necessary for a new area of enquiry assembling its database" (Bass 1983:97). In the same vein, Green, in reference to the status of Australian maritime archaeology in the early 1990s, explained that:

> this approach is particularly appropriate…because, being a new field of study, the material artefacts are often not well understood. It is important, therefore, to build up a clear understanding of the material before constructing the

deeper hypotheses (Green 1990:235).

Historical particularism then can be used to effectively build social-scientific approaches about the past (Gould 2011:4). While not a theoretical perspective, particularism as a phase of all archaeological research emphasises the importance of empirical observation and data collection (Adams 2013:8). When applied to nautical archaeology, watercraft remains are the primary source of archaeological evidence that can then be linked to societies on several levels, from the practical to the symbolic (Adams 2013).

As mentioned earlier, theories for boat and ship studies in Southeast Asia are rare, even as their role in symbolism is apparent. Manguin (2001), from the point of view of a historian, cited numerous examples throughout island Southeast Asia where the boat is a metaphor for a socio-political unit. In the Philippines, for example, a small village is called a *barangay*, the Tagalog word for *balangay*, or boat. Apart from this, the importance of the boat in Philippine societies, especially with beliefs regarding the afterlife, is evident from the use of boat coffins and boat-shaped grave markers (Dizon 1998). Probably the most notable singular example is the *Manunggul* jar, a secondary burial jar that has on its lid a clay scultpure depicting a boat with two figures aboard it: a tillerman steering the deceased into the next world (Dizon 1998).

Tradition and innovation

Many studies, including this one, are interested in the regional and cultural origins of watercraft, and operate with the assumption that different groups will produce distinct forms of watercraft, designed for the environment in which they are used and within the cultural standards of their society. In line with this, studies have focused on particular aspects of defining watercraft characteristics which belong to certain geographical regions (Hocker 2004b:3–4). A dominant type of watercraft can become a region's "traditional" watercraft (Hocker 2004b:4).

The words "tradition" and "traditional" are often used in social sciences and cultural studies, including archaeology and maritime archaeology; though surprisingly, the definition of "tradition" is rarely provided. To the layperson, the concept of tradition is perhaps primarily identified as a force of cultural continuity, where any deviation from this is a break in traditional practice. The Oxford English Dictionary Online (2016) defines tradition as "the action or an act of imparting or transmitting something; something that is imparted or transmitted," where that something can include beliefs, statements, customs, doctrines, practice, customs, art, or teaching. Edward Shils (1981) was the first to write extensively on the nature of tradition within sociology and related studies. To him, the most critical mechanism of a tradition is that it is handed down from one generation to the next, and for it to be an enduring tradition, it should continue for at least three generations (Shils 1981:12, 15).

In watercraft construction, a tradition implies "technological continuity and conservatism…as well as a substantial cultural or social component in the forces encouraging that continuity" (Hocker 2004b:8). This is problematic when a great range and variety of vessels are found within one culture. For this reason, other archaeologists hesitate to assign certain shipbuilding methods to specific ethnicities (Hocker 2004b:7–8). McGrail offers a definition of the boatbuilding tradition as "the perceived style of building generally used in a certain region during a given time range" (McGrail 2001:10; 2014:4), and that within a polythetic tradition, each craft shares a large number of characteristics, but "no one characteristic has to be possessed by all boats" (McGrail 2001:10). He recognises weaknesses in making such classifications that mainly relate to the problems of modern theoretical constructs being assigned to bygone peoples and societies. He argues, however, that as increasing numbers of shipwrecks are located and examined, identifying certain diagnostic features, such as plank fastening, as belonging to a particular tradition becomes possible (McGrail 2014:4). Hocker reluctantly refers to "traditions (for lack of a better word)" as "a particular method of shipbuilding [that] is defined by a group of techniques or characteristics, rather than a single distinctive feature" (Hocker 2004b:8). Still, limiting a tradition to a definitive region and time range is difficult, and new evidence, as will be seen in this study, seems to only stretch and blur erstwhile boundaries and overlap with others.

While using tradition is unavoidable in describing certain types of watercraft, ships and boats are just as often hailed as the most advanced technological achievement a society could produce prior to the industrial revolution (Adams 2013; Muckelroy 1978). Experimentation must then have also been constant within the context of an existing tradition. The study of archaeology, and indeed of technology, is really a study of a culture's change and stasis (Adams 2013:1). Caution should be employed, however, to not rely on simple diffusionist or linear explanations when confronted with change and innovation. By examining changes in boat and ship technology, Adams (2013:49) posits that we see a reflection of changes in a society. He considers tradition as one of seven interrelated factors that may influence the characteristics of watercraft. The others are: ideology, technology, economics, purpose, environment and materials. Adams views tradition itself as a complex idea encompassing:

> material, technological, aesthetic and symbolic characteristics, none of which are necessarily diagnostic or exclusive individually, but which together characterise a coherent assemblage in space and time (Adams 2013:25).

These are subject to constructs, both on the part of the boatbuilder, as well as the archaeologist (Adams 2013:24–25).

This study joins others in seeking to understand traditional watercraft. In this case, edge-joined and lashed-lug watercraft from Southeast Asia represent a traditional boatbuilding practice with easily perceivable diagnostic characteristics or what Hocker (2004b:8) calls the "physical expression of a conceptual approach", alongside clear variations in examples that span more than 1,500 years.

Conclusion

The archival record holds only a small number of accounts about Southeast Asian boats and much less on boatbuilding. What are both noteworthy and obvious are the similarities that tie the accounts, which span hundreds of years, together. That chroniclers from the fifteenth, seventeenth, eighteenth and twentieth centuries were all describing the process of construction of a lashed-lug boat and marvelled at the skill of the boatbuilders at joining planks so that seams were barely noticeable, is significant. At the same time, a closer look at the most detailed accounts shows some differences. Could these be due to inaccuracies in the description, or actual changes made by boatbuilders through changing times, geographic locations, or individual preferences? Or did the boatbuilders even consider these differences significant? The historical and ethnographic evidence is at the same time revealing and leads to further questions that might be answered by looking closer at the material record and the incomplete timber remains of old boats. Adams wrote the following:

> So often it is pots that are used to explore social interactions of the past. Yet in so many cultures, ships and boats have acquired such a prominent symbolic profile, it might be argued that they are even more potent carriers of meaning

than the pots they so often transported (Adams 2001:1).

Research in the Philippines and in fact many countries of Southeast Asia can be criticised for overlooking Adams' point. In large shipwrecks from the region that have been examined archaeologically, the thousands of pieces of portable inorganic cargo have, sometimes understandably, always received almost all of the scholarly attention. The shipwreck timbers, often obscured by sediment or other shipwreck materials would unfortunately merit only cursory inspections by divers before being reburied because of the difficulty related to physically raising them and the conservation treatment that would necessarily follow.

In the case of the Butuan Boats and watercraft found in similar environments throughout Southeast Asia, the inattention to detailed recording is more difficult to fathom, but is likely due to a lack of experience with studying archaeological watercraft. Whatever the reason, the chance to thoroughly document the remains has not been completely lost, but is more challenging without excavation records. Even badly degraded timbers can convey data, however tainted, which can be valuable for technical analysis and interpretation. In further studies, the information can lead to a more meaningful understanding of the Philippines' and Southeast Asia's maritime culture and history.

There is valid criticism that studies on watercraft construction were overly descriptive and biased towards technical details while ignoring the role craft and technology played within a culture and among cultural interactions. In spite of this, researchers should avoid the temptation of glossing over technical details as it is universally agreed that these are the basis of any kind of meaningful interpretation. It is important to find a balance between the two approaches, with neither being disregarded.

The research undertaken for this thesis focuses on the construction of Southeast Asian planked watercraft, and in particular the edge-joined, lashed-lug boat by examining texts and archaeological material. Identifying specific elements of construction that represent stasis, variation, and innovation through time and space can lead to a greater potential for developing theories and interpretations about the watercraft, their builders and the societies of which they were a part in Southeast Asia.

Chapter 3 Maritime history of Southeast Asia and the Philippines

Introduction

This study in Southeast Asian lashed-lug boat construction extends beyond technological considerations. Watercraft play a complex role in society where they act as transport for people, goods and ideas. As objects, they are designed and built using cultural, economic, and natural resources, and are shaped by individual expression tied to traditional practice. If construction techniques are to be considered as part of a region's boatbuilding tradition, it is then necessary to understand the context in which they existed. This chapter provides the regional and cultural setting for this study based on the archaeological, linguistic, historical and geographical evidence of the maritime peoples of Southeast Asia prior to the modern era.

Geographic overview

Southeast Asia is a generally tropical region bounded by China to the north, Australia to the south, Papua New Guinea to the east, and India and Bangladesh to the west (Figure 3-1). The countries within this region include Myanmar, Lao People's Democratic Republic (PDR), Thailand, Cambodia, Vietnam, Malaysia, Singapore, Indonesia, Timor-Leste, Brunei Darussalam, and the Philippines. Most populations settled within the monsoonal zones, beyond the fifth-degree latitudes north and south of the equator (Bellwood and Glover 2004:9). The climate here allows farming of staples such as rice and millet to support denser populations. Nearer to the equator, which experiences constant rain and heat, smaller populations have depended on tubers and tree crops for their subsistence (Bellwood and Glover 2004:9).

The region is geographically divided into two parts: mainland Southeast Asia includes Myanmar, Lao, Thailand, Cambodia, Vietnam, and peninsular Malaysia; and island Southeast Asia which comprises Singapore, Indonesia, east Malaysia, Brunei, the Philippines, and Timor-Leste. Though the term "maritime Southeast Asia" might be used synonymously with island Southeast Asia, here, the broader meaning applies and includes maritime cultures from the entire region, including those on the mainland.

Up until the beginning of the current interglacial period more than 10,000 years ago, the Sunda Shelf islands, which included Sumatra, Java, Borneo, and Bali, were connected by land bridges to the mainland, to make up the area known as Sundaland

Figure 3-1. Map of Southeast Asia. Illustration modified by author from http://freevectormaps.com.

(Figure 3-2; Glover and Bellwood 2004:7). The Philippine island of Palawan was also connected by land bridge to Sundaland, but this occurred more than 440,000 years ago (Robles et al. 2014). The remaining Philippine and Indonesian islands belonged to Wallacea. New Guinea and other neighbouring Indonesian islands were connected to the Sahul continent along with Australia. While Late Pleistocene sea levels, from 125,000 to 11,500 years ago, reduced distances between Sunda, the Wallacea islands, and Sahul, travel between these areas involved water crossings of no less than 10 km, and as much as 90 km (Bellwood and Glover 2004).

Many of the current political borders are a modern and very recent construct that conceal the more fluid and at times overlapping cultural boundaries that shifted over time. Mainland Southeast Asian cultures were once spread through the southern part of modern China, while cultural characteristics of island Southeast Asia, sometimes referred to as maritime Southeast Asia or the Malay Archipelago, were evident at some point in

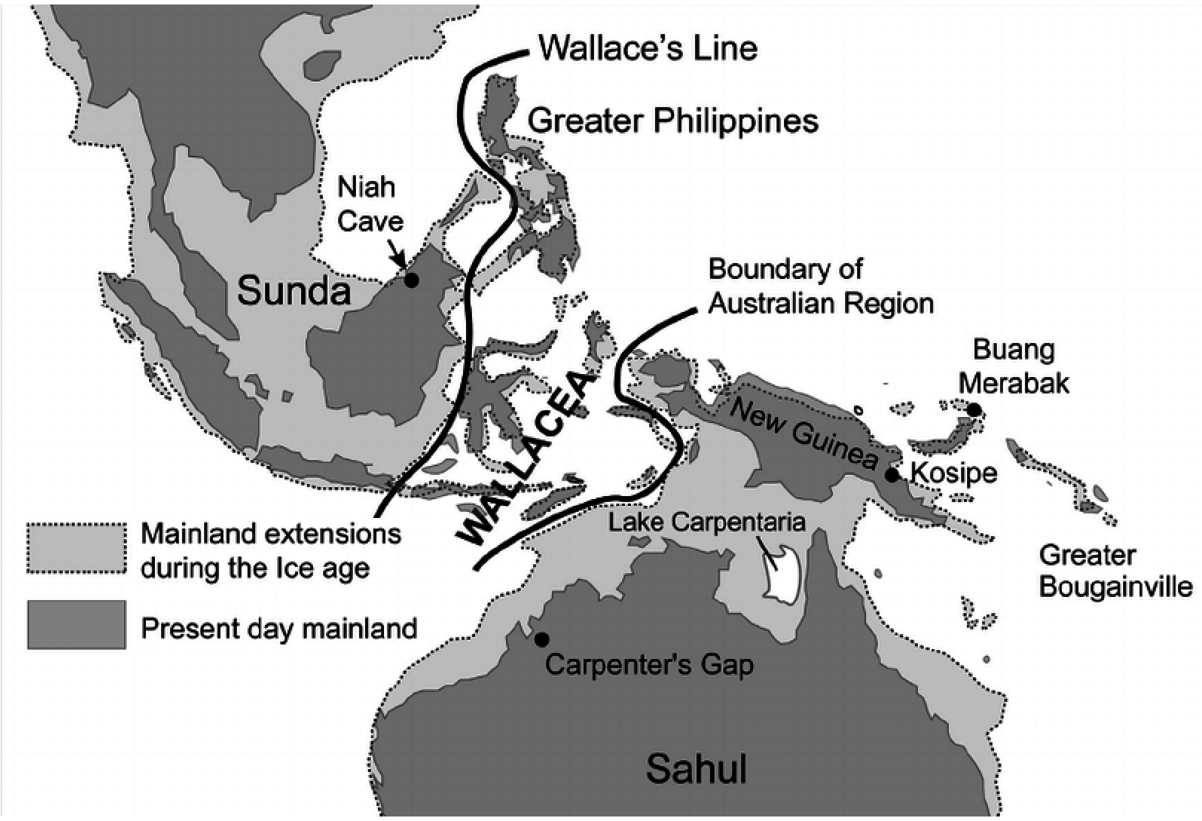

Figure 3-2. Sunda, Wallacea, and Sahul (Matisoo-Smith 2015:94).

southern Vietnam, the Malay Peninsula and southern Taiwan, but not always in Indonesian New Guinea (Bellwood 1999:7).

The early peoples of Southeast Asia

The earliest sea crossings in the Southeast Asian region occurred hundreds of thousands of years ago. Recent evidence of hominin species have been found in parts of the Philippines and Indonesia that were never connected to the mainland. The Callao Cave fossil of a *Homo*-species metatarsal in the northern Philippines is approximately 67,000 years old. On the other hand, *Homo Floresiensis* fossils recovered from a sandstone layer in Flores Island in eastern Indonesia have been securely dated to 700,000 years in age (Brumm et al. 2016:249; Mijares et al. 2010:1). Even older stone tools were excavated from geological layers in Flores Island that date to 800,000 years ago (Brumm et al. 2010:748). Human migration to Australia most likely passed through Southeast Asia at least 50,000 years ago (Balme 2013; Bednarik 2003; Bellwood and Glover 2004; Détroit et al. 2004; Green 2006). How hominins and the first modern humans crossed the seas and came to the islands, and whether they did so intentionally, remains unresolved.

On the mainland, evidence of human activity in the late Pleistocene and earlier is patchy. Cave habitation sites at least 40,000 years old were unearthed in Thailand and Vietnam, though actual human remains dating to more than 20,000 years ago have yet to be found (Bellwood and Glover 2004:16). From around 10,000 years ago, the use of flaked and cobble lithic assemblages that are referred to as a *Hoabinhian* industry, was widespread throughout the entire mainland Southeast Asia, as well as southern China and northern Sumatra (Bellwood and Glover 2004:16).

Generally, clearer evidence of modern human activity, both in mainland and island Southeast Asia, dates to about 10,000 years ago, with the widespread of use of pebble and flake industries by hunter-gatherer societies (Bellwood and Glover 2004:16). The Niah Cave in Sarawak, on the northwest coast of the island of Borneo, however, is a significant archaeological site that provides evidence of a rather dense sequence of activity. Beginning about 45,000 years ago and extending into the protohistoric period, Niah Cave has revealed evidence of bone tool technology, inhumation and cremation mortuary practices, and rainforest subsistence patterns (Barton 2005; Barton et al. 2009; T. F. G. Higham et al. 2009). Research has also uncovered sequences from similar periods in cave sites on Palawan island (Détroit et al. 2004).

By about 5,000 years ago, agriculture, particularly of rice and cereals, began to spread. This coincided with the dispersals of Austro-Asiatic and Austronesian languages from southern and central China where rice and cereal farming had been established more than 3,000 years previously (Bellwood 2004:21, 24; 2006:108; C. Higham 2004:46). While trade and interactions across wide areas of the region continued, the new farming communities began to settle in lowland and coastal areas, and colonised, assimilated with, or displaced original hunter-gatherer groups (Bellwood 2004:36). Hunter-gatherers did not completely disappear; some groups have persisted to modern times, but they are marginalised and their original languages have since been lost, as they adopted Austronesian and Austro-Asiatic languages (Bellwood 2004:36).

Southeast Asian language families

Despite obvious external influences and assimilations that resulted from Indian, Chinese, Arab and European interactions, today's Southeast Asian peoples have generally retained ethnolinguistic and genetic traits that began to take shape in the Neolithic Period and have now been in place for at least two thousand years (Bellwood and Glover 2004:4). The cultural divisions of Southeast Asia are largely related to the distribution of the region's five major language families (Bellwood and Glover 2004; Ricklefs et al. 2010; Winzeler 2011:17). These are discussed here to provide greater insight into the region's cultures before moving on to the more recent periods of Southeast Asia's past.

Austro-Asiatic languages include Khmer and Vietnamese, as well as others spoken widely, but in scattered areas throughout the mainland and northeastern India. Austro-Asiatic speakers are thought to have settled on the mainland from southern China about 5,000 years ago, and were the first to grow rice in the region (Bellwood and Glover 2004:11; Winzeler 2011). Tibeto-Burman languages include Burmese and highland languages spoken throughout the mainland. The origins of this language family have been traced to western or central China, though when it spread south has yet to be determined (Bellwood and Glover 2004:9; Winzeler 2011). Tai-Kadai languages spoken in Thailand and Laos are younger, spreading into the region within the last millennium (Bellwood and Glover 2004:11; Winzeler 2011:17). Even younger are the Hmong-Mien languages, also referred to as Miao-Yao, that came into the highlands of Vietnam, Thailand, and Laos only in recent centuries from China's middle Yangzi region (Bellwood and Glover 2004:11; Ricklefs et al. 2010).

On the other hand, one language family, Austronesian, is spoken throughout all of island Southeast Asia and Peninsular Malaysia, as well as parts of Thailand, Vietnam, Cambodia, and beyond (Glover and Bellwood 2004:1; Ricklefs et al. 2010:4; Tyron 2006:19). The origin of the Austronesian family is believed to be related to Tai, Austro-Asiatic and Sino-Tibetan roots. The approximately 1,200 Austronesian languages spoken by about 350 million people today, originated from southern China about 5,500 years ago (Bellwood 2004:25, 28; Tyron 2006:19). At the time the Austronesian migrations commenced, sea levels had stabilised to reach approximately the same levels as today (Bellwood 1999:63). By the early first millennium, Austronesian was geographically the most widely-used language family in world history. It reached as far west as Madagascar, and east through most of the Pacific islands up to Easter Island, or more than half of the world's circumference, only failing to penetrate the New Guinea highlands and Australia (Bellwood 2004:25; Bellwood and Glover 2004:11; Blust 2011:539; Glover and Bellwood 2004:1). Before proceeding further, it should be noted that the originators of the Southeast Asian languages in southern China were likely related to modern Southeast Asians. They were not related to the Han people from which modern Chinese people are descended, as it was not for another several thousand years that the Han empire expanded south of the Yangzi river (Bellwood 2004:24; Ricklefs et al. 2010:2).

A great deal of multidisciplinary research in island Southeast Asia, as well as the Pacific, was motivated by ethnolinguistic studies that suggest that active maritime networks in island Southeast Asia existed from the time Austronesian languages began to spread (Bellwood and Dizon 2005, 2013; Bellwood et al. 2003; Chang et al. 2015; Diamond 2014; Matisoo-Smith 2015; Simanjuntak et al. 2006; Solheim 1988, 2006). Two prevailing theories supported opposing routes the Austronesian speakers took in their migrations. One proposed that they travelled from their south China origin along the coast of the mainland to the Malay Peninsula, before spreading east and north through the islands (Solheim 1988). The other suggests that movements originated in southern China, from where populations of Austronesian speakers travelled through southern Taiwan, then south through the northern Philippines, before spreading to the rest of the archipelago and the region (Bellwood and Glover 2004:11; Horridge 1995:143; Ronquillo 1998a:261–262; Spriggs 2011).

In-depth studies of Southeast Asian peoples from 10,000 years ago to the Common Era have investigated a wide range of evidence including genetics, the spread of agriculture, animal husbandry and domestication, pottery-making and the exchange of exotic stone such as nephrite and obsidian as possible markers of movements and interaction. Based on material and archival evidence, a common boatbuilding tradition appears to have likewise developed across the maritime realm (Bellwood and Glover 2004:4; Doran 1981; Horridge 1982, 1995; Manguin 1993; McGrail 2001). The spread of Austronesian-speaking peoples over such a large area of island chains, and later through vast swathes of open ocean, gives greater weight to the already cliché idea that water is an aid rather than a hindrance to movements within the region and among close neighbours.

Linguistic studies complemented, and often even guided archaeological research of Austronesian peoples. Robert Blust's (1995) hierarchical subgrouping of Austronesian language has been particularly influential. His classification, based on comparative work, finds that the first true Austronesian language spoken was Proto-Austronesian by Formosans some 5,500 years ago. Proto-Austronesian branched into several other Formosan language groups, as well as 1,200 Malayo-Polynesian languages that developed outside of Taiwan (Blust 2011). Blust (2011:542) suggests that the major language groups that grew from Malayo-Polynesian are:

- Western Malayo-Polynesian, that includes 500 to 600 Philippine, western Indonesian, mainland Southeast Asian, Malagasy, and western Micronesian languages;
- Central-Eastern Malayo-Polynesian, with 600 to 700 languages in eastern Indonesia and Pacific islands;
- Central Malayo-Polynesian, and its 120 languages in Indonesia's lesser Sunda islands and Moluccas;
- Eastern Malayo-Polynesian, that accounts for 500 languages in the northern Moluccas and Pacific islands;
- South Halmahera-West New Guinea, with 30 to 40 languages in the northern Moluccas and the north coast of New Guineas' Bird's Head Peninsula; and
- Oceanic, which includes 460 Melanesian, Micronesian and Polynesian languages.

By reconstructing early Austronesian vocabulary, linguists believe that 5,500 years ago, Proto-Austronesian speakers cultivated rice and millet, had domesticated pigs, dogs, and chickens, were familiar with tattooing, used bows and arrows, produced pottery, and built canoes (Bellwood 2004:29; Blust 2011:539). These people then spread to the northern Philippines about a thousand years later (Bellwood 2004:29; Blust 2011:539).

The languages are extremely informative with regards to their speakers' socio-political organisations. Though they recognised hereditary rank, Austronesian speakers formed small scale-societies that promoted the rapid spread of numerous related, but distinctly separate languages carried over great expanses of water (Blust 2011:540).

Proto-historical period

The close of the Neolithic in Southeast Asia came some 3,500 years ago and extends into the first millennium. Metallurgical skills led to the appearance of iron and bronze objects, and the production of decorated pottery intensified. On the mainland, Bronze Age cultures spread from this period, to be replaced by the development of Iron Age technologies 1,000 years later (C. Higham 2004:57). Insular Southeast Asia saw the concurrent development of bronze and iron metallurgy around 2,300 years ago (Bellwood 2004:36). By the Common Era, contacts with India and China commenced, resulting in Indian cultural influences becoming apparent in pottery designs, in the use of Indian writing systems, and in particular in the advent of monuments, images and inscriptions inspired by Hindu and Buddhist religions. This occurred throughout most of the region, with the limited exception of mainland forest interiors and the extreme eastern islands of Indonesia and the Philippines (Bellina and Glover 2004:68; Bellwood 2004:36; C. Higham 2004:57). Questions relating to the degree and nature of direct contact between India and Southeast Asia have yet to be answered, though regional scholars now agree that it came about from the expansion of overland and maritime trade, rather than a direct Indian colonisation as was previously put forward (Bellina and Glover 2004:68–69). Bérénice Bellina and Ian Glover (2004) assign two phases in the development of Indian and Southeast Asian interaction based on available archaeological evidence. The first phase, from about 300 BC to AD 100, is characterised by the scattered appearance in "non-Indianised sites" of a great variety of items such as semiprecious stones (agate, carnelian, crystal and nephrite), glass, bronze containers with a metal cone, rouletted pottery, and megalithic grave markers (Bellina and Glover 2004:72–80; Bellwood 2004:24). The second phase, from the AD 300 to 500, saw the rise in the quantity, but decreased variety, of exchanged material, mostly of ceramics with Indian-style aesthetics (Bellina and Glover 2004:80–83).

Historians have depended greatly on third- to fourth-century Chinese written records for deciphering what is referred to as Southeast Asia's proto-historical period (Ricklefs et al. 2010:18). These chroniclers described the emergence of various Southeast Asian empires and kingdoms that held sway over contiguous borders through a series of dynastic periods: the kingdoms of Funan, Champa, Srivijaya, Dvravati, Java and Pagan were among the large and powerful polities led by Indian-titled rulers that reigned in the first millennium. More recently, this view of early Southeast Asian nation-states was revisited as it appeared inconsistent with all other evidence of the region's previous and later patterns of socio-political organisation, and more in-line with Chinese imperial history (Hall 2011; Ricklefs et al. 2010:18). Merle Calvin Ricklefs (2010:18) suggests Chinese sources were coloured by their perspectives of governance and a limited understanding of Southeast Asian realities. Western historians who later accepted the Chinese accounts were also probably influenced by colonial-period attitudes (Ricklefs et al. 2010:18). Thus, obvious and undoubtedly external influences were probably over-stated in discussions regarding Southeast Asian periods of "Indianisation" and "Sinicisation".

Regarding the shift in historians' understanding of this period, Ricklefs (2010:24–

25) explains that rulers who adopted Hindu titles such as *Siva* and *Visnu* and others related to the *Buddha*, were once perceived to be more powerful by those who held the less grand titles. In fact, chiefdoms, regardless of what they were called, were fragile and subject to the quality of the individual's leadership traits, and lines of succession, while preferred, were not guaranteed (Ricklefs et al. 2010:24–25). Maintaining control over people and networks of smaller chiefdoms, rather than acquiring new territory, is now seen as more crucial for that time period (Ricklefs et al. 2010:24–25). While revenue was collected from a polity's "subjects", a distribution of rewards was expected in return (Ricklefs et al. 2010:24–25). Because of this, territories had no real borders; these shifted depending on the effectiveness of the authority's centre. These aspects of Southeast Asian political relations are incorporated in the concept of *mandala* (Dellios 2003:1; Hall 2011:17; Ricklefs et al. 2010:24–25). Adapted from the Sanskrit word for "circle", it was applied most notably by Oliver W. Wolters to relate to the region's geopolitical conditions where unlike modern political systems, states had no formal delimitations (Dellios 2003:1; Hall 2011; Ricklefs et al. 2010:24–25; Wolters 1968). The circle represented the power radiated by a polity at its centre, which expanded or diminished, sometimes incorporating or intersecting with other circles, depending on the changing political situation or the leader's appeal and charisma. This power was also influenced by networks based on personal ties between leaders of different polities (Ricklefs et al. 2010:25). So, as Ricklefs puts it, "the fact that authority was now 'royal' and articulated in new ways did not mean that a ruler had to work any less hard to acquire or maintain it" (Ricklefs et al. 2010:24–25).

The reports of Sinicisation in the region are likewise probably exaggerated. The Han Chinese, at around 100 BC began to venture south and expand their empire, annexing areas that now encompass modern China and Vietnam (C. Higham 2004:57). Other parts of the region were only indirectly affected by the Chinese expansion, mostly in the form of increased trade and commerce (Ricklefs et al. 2010; Scott 1989).

Official Chinese records of the Southern and Northern Dynasties in the early centuries A.D. use the word "*Kunlun*" to refer to the peoples living south of China (Heejung 2015:27). But according to Scott (1989:1), there was little indication that China had any familiarity with Southeast Asian islands south of Taiwan and east of Java until the Tang Dynasty (618 to 906 A.D.). By the year 972 A.D., commerce with the neighbouring region had grown to such an extent that the emperor had to appoint a superintendent of maritime trade to oversee these activities. The edict specifically mentioned the locales of Achen, Java, Borneo, Ma-yi (or Mai, a Philippine polity), and Srivijaya, from where products such as:

> aromatics, rhinoceros horn and ivory, coral, amber, pearls, fine steel, sea turtle, agate, carriage wheel rims, crystal, foreign cloth, ebony, sappan wood, and such things [were traded for Chinese] gold, silver, strings of cash, lead, tin, many-coloured silk, and porcelain (Scott 1989:1).

Many polities were encouraged to gain tributary status from China. Scott explains the tribute system as a way for underdeveloped neighbouring states to extend diplomatic ties with China while maintaining independent and sovereign standing (Scott 1989:2). While they acknowledged the "[Chinese] emperor's primacy among human rulers, [it was] not [considered as] a tax or direct source of revenue" (Scott 1989:2). Exotica, including pearls, frankincense and myrrh were the preferable tribute items (Scott 1989:2). In return, and as a sign that their states were now recognised by China, envoys received "brocaded court costumes with gold-and-jade-encrusted belts and high-sounding titles, bolts of marketable gossamer silks fit for the tropics, and long strings of coins of the realm" (Scott 1989:2).

Still, these ongoing commercial relations appear to not have been enough to adequately earn China's full awareness of the islands east of Java until the early thirteenth century (Scott 1989:5). This is when the Song Dynasty began to actively encourage their merchants to sail Chinese vessels and market their wares directly to foreign lands (Scott 1989:5). Islam entered into the region during this period, and scholars agree that this was brought about through Chinese trade, either by Arab travellers or Chinese Muslims (Ricklefs et al. 2010:124).

Official Chinese trade in the region continued to flourish until isolationist sentiment in the mid-fifteenth century Ming Dynasty, resulting in the so-called "Ming Ban" (Ricklefs et al. 2010:120). This proved unsuccessful as traders resorted to clandestine operations (Ricklefs et al. 2010:120). China re-opened trade in the mid-sixteenth century, but by this time European powers had taken hold of major ports (Ricklefs et al. 2010). Most of Southeast Asia had become colonies controlled by European states such as Portugal, Spain, France, Britain and the Netherlands up until the nineteenth and twentieth centuries (Ricklefs et al. 2010:127–133).

The Philippines

The Philippines is an archipelagic nation made up of 7,107 islands lying in the tropics between 5 and 20 degrees north, in an area of approximately 300,000 square kilometres (Bacus 2004:257). The country is divided into three island groups: Luzon in the north, Visayas in the centre, and Mindanao in the south (Figure 3-3). Except for the island groups of Palawan, Mindoro, Romblon, and northern Panay, which are part of the Sunda shelf connected to the Asian mainland, the rest of the islands form part of a volcanic arc connected to Japan in the north and Sulawesi in the south (Aurelio et al. 2012:1). None of the island groups, including those on the Sunda shelf, have been completely joined by dry land to each other or to other land masses at any period of hominin settlement, and thus could have only been reached through sea travel (Bacus 2004:257; Bellwood 1999:64; Bellwood and Glover 2004:7; Mijares et al. 2010:9). Two types of tropical climate affect the country: the equatorial southern and eastern areas experience year-round precipitation, while the northern and western areas are subjected to differentiated wet and dry seasons (Bacus 2004:257).

Figure 3-3. Map of the Philippines. Illustration by author.

The earliest secure date for human settlement in the Philippines is 66,700 ± 1,000 BP, which was obtained by the uranium-series ablation dating of a metatarsal bone, classified as belonging to the genus *Homo,* recovered from Callao Cave in the Cagayan Valley in northern Luzon (Mijares et al. 2010:3–4). The single fossilised bone was found within a breccia layer amongst animal bones and teeth, that were likely redeposited by water movement (Mijares et al. 2010). Several years before, an assemblage from the cave containing chert flake tools, burnt animal bones and a hearth feature, was identified as the oldest human occupation site in the Philippines outside of Palawan, dating to 25,968 ± 373 BP according to radiocarbon analysis (Mijares et al. 2010:2).

Previous to the Callao metatarsal find, the oldest direct evidence of human occupation in the country was from a tibia fossil recovered from an excavation in the Tabon Cave Complex, southwestern Palawan, that was dated to 47,000 ± 11,000 by uranium-series dating (Détroit et al. 2004:710). While this fossil was found in a layer disturbed by bioturbation, the Tabon Cave Complex provides a record of human occupation and use from about 30,500 to 8,000 years ago based on radiocarbon-dated charcoal associated with flake tools and human remains (Bacus 2004:259; Détroit et al. 2004:706; Ronquillo 1998b:40). Assemblages dating to between 13,000 and 8,000 years ago have been identified throughout the country, in the Cagayan Valley, the Sierra Madre ranges, Mindoro, Palawan, Samar, and Tawi-Tawi. A site in Ille Cave in northern Palawan shows evidence of human cremation dating to 9,500–9,000 cal BP, the oldest evidence of such a practice in the region (Lewis et al. 2008).The first humans to the Philippines are believed to be from a *negrito* people. Preliminary analysis of the Callao and Tabon fossils found that while they are related to present Philippine *negrito* populations, the Tabon remains demonstrate a variability in morphology that suggests at least two morphological groups that include an admixture (Detroit et al. 2013:59).

The Philippine Neolithic period coincides with the Austronesian migration some 5,000 years ago. This brought agriculturalists to the islands to integrate with or displace existing hunter-gatherer groups (Bellwood 2006:98). Artefact types associated with the Neolithic and Austronesian speakers include polished and ground stone tools, red-slipped pottery, clay spindle whorls, stone barkcloth beaters, and shell implements (Bellwood 2006:98). Evidence supports that Austronesians from Taiwan first crossed into the Philippines through the country's northernmost Batanes islands by crossing the treacherous Bashi channel, which is known for prevailing northward currents (Bellwood and Dizon 2013:4). It was the rough conditions of the channel that convinced earlier researchers to dismiss Batanes as an entry point from the north (Solheim 1988:81). But counter surface currents have been found to allow southward movement from Taiwan, as evidenced from continuous interactions between Lanyu people in southern Taiwan and the Itbayaten of Batanes (Bellwood and Dizon 2013:4).

Maritime cultural exchanges were evident throughout parts of the Philippines and Southeast Asia from at least 2,500 years ago based on traded earthenware vessels and glass, shell and stone ornaments, particularly carved double-headed animal earrings and pendants called *lingling-o,* that are found mostly in burial sites (Bacus 2004:263). This period also saw the emergence of intricate mortuary practices such as secondary jar burial. Elaborately-designed earthenware vessels, including the *Manunggul* burial jar mentioned Chapter 2 (Figure 3-4), and the anthropomorphic burial jars from Ayub cave in Mindanao, together with the exchange of exotic stone and prestige items such as beads and *lingling-o*, suggest increasing social complexity throughout the archipelago (Bacus 2004).

In what is termed as the Southeast Asian proto-historical period, however, the Philippines is largely in the periphery, if mentioned at all. It had no major states or kingdoms, nor was it especially renowned for its resources in the same way the Moluccas were known for their spices. But the islands were an important market, especially of Chinese goods, for which resins, aromatic woods, rattan, beeswax, cotton (both as textile and unwoven), other fabrics, civet, gold, pearls, sea cucumber, tortoiseshell, and bird's nests were traded (Scott 1989:1). Chinese records cite several major Philippine entrepôts, and trade ceramics are found in abundance in archaeological sites throughout the country (Francia 2010; Scott 1984, 1989).

Archaeological evidence of commercial trade with China is apparent from at least the tenth century, with the appearance of Chinese Yueh Dynasty (907–960 A.D.) tradewares in Butuan burial sites as clear evidence of this (Ronquillo 1987). Chinese dynastic texts mention trade with Philippine polities beginning in the tenth and early eleventh centuries. One of the earliest trades was with Ma-yi, though there is debate about to where this refers; it is widely thought to be in Mindoro, but new arguments contend that is the town presently known as Bay, in Laguna on the island of Luzon (Francia 2010:46; Go 2005; Scott 1989:1). Chinese documents contain conflicting information as to its location, with one in 977 A.D. saying that it was a 30-day journey

Figure 3-4. The Manunggul burial jar (Casal et al. 1998:174).

from Brunei, while another cites it as a two-day sail east from Champa (Scott 1989:2–3). As Scott correctly notes, the latter account is "… obviously erroneous. There is no land east of Vietnam for 1,000 kilometres" (Scott 1989:3).

The polity of P'u-tuan, which is likely Butuan, is listed in the Chinese record *Song Shi* (Sung History, 1343) as having sent several trade missions to the imperial court beginning in the year 1001 A.D., as well as maintaining regular contact with Champa (Bacus 2004:269; Scott:3; Wade 2009:258). As discussed earlier, from this period commercial trade with China and Southeast Asia began to intensify (Bacus 2004:266–278). As a result, several Philippine polities flourished as entrepôts for international trade. Chinese records refer to them by the names Ma-i, Mao-li-wu, Min-to-liang, Su-lu, and Lu-sung (Francia 2010:46; Scott 1989:1). While Chinese wares predominate among imported objects in the protohistoric archaeological record, items of Thai, Vietnamese, and Burmese origin were also widely exchanged.

By the early sixteenth century, it was only from Luzon, or Manila, in particular, that traders known as the *Luzones*, would travel to foreign ports (Scott 1982:365). This ended by the middle of that century, and the *Luzones* instead shifted to the resale of Chinese wares, taken by Fukienese junks to the rest of the archipelago (Scott 1982:366). All Philippine communities took part in domestic trade which was often accomplished by boat. Commodities included foodstuffs such as rice, sweet potatoes, bananas, coconuts, wine, fish, game, and salt as well as cloth, iron, gold, jewellery, porcelain, livestock and slaves (Scott 1982:367). Rice was an important commodity, and it was sold from the major redistribution centres in Manila and Cebu (Scott 1982:367). The vibrant trade led to Cebu becoming the second-largest settlement after Manila despite having no direct access to rice fields, forests, or goldmines (Scott 1982:368). The active inter-island exchanges also created specialised economies. As Scott puts it:

> The breeding of goats, for example, caused Simara Island to be called Cabras Island, just as the sale of swine (*babuy*) and sugarcane (*basi*) branded the Babuyan Islands and the Bashi Channel. Expert shipwrights supported the economies of Cagayan de Sulu and tiny Buracay of Panay, while those of Catanduanes literally peddled their wares by loading smaller ones into larger. Cuyo Islanders wove cotton but did not grow it, and kept the inhabitants of neighbouring islands in mat-weaving and salt-making subjugation. Farmers on Batbatan Island raised wheat on the north coast of Panay, and Bohol potters marketed their wares in Butuan, where pre-Hispanic samples have been recovered from archaeological sites (Scott 1982:368).

From their introduction, Chinese porcelains became essential prestige items and easily the most far-reaching merchandise to be exchanged in the archipelago. They penetrated all markets, including difficult regions, no matter how “war-making, slave-raiding or head-taking … they may have been” (Scott 1982:368). Jars and plates, along with gold, were a show of wealth, and traded for human slaves. Without these items: “no Filipino *datu* [chieftain] could demand respect or exercise leadership”(Scott 1982:368).

Complementing inter-island trade, raiding and piracy or *mangayaw*, was a common maritime activity in the Philippines and the rest of island Southeast Asia (Alcina 2005

[1668]:161; Scott 1982:370). Chinese records even report an instance of Visayan raiding parties composed of several hundred men and led by three chiefs, landing on the Fukien coast sometime in the late twelfth century but they were successfully repulsed (Scott 1982:366).

Sleek and fast outrigger boats called *caracoa* (a Spanish derivative of the Malay *kora-kora*), were best-suited for raiding. Though they were used for other purposes, *caracoa* became known as warships (Scott 1982). So-called "trade-raiding" saw the capture of people who became slaves or were held for ransom. This raiding was carried out by a specific Visayan social class known as *timawa* (Scott 1982:371–372). The middle-class *timawa* were descendants of the *datu*s by the *datus'* marriages to second and subsequent wives. The *timawa's* role was to act as crew to their *datu*-captain (Francia 2010:32; Scott 1982:372). *Mangayaw* also played a large role in socio-political networks of various small communities, and alliances through marriage or vassalage were made to gain deference or protection (Scott 1982:376).

The first Europeans to arrive in the Philippine archipelago in March 1521 were part of the Spanish fleet led by Ferdinand Magellan (Pigafetta et al. 1962 [1525]). Magellan introduced Catholicism and convinced several polities to ally with Spain. It was because of these ties that he engaged in a battle with a new Philippine associate's rival, Lapu-Lapu, the chief of Mactan, which lead to his death in April 1521, just over a month after his arrival (Pigafetta et al. 1962 [1525]).

Other Spanish excursions into the Philippines followed, and from the middle to the later part of that century, most of the Philippine archipelago came under Spanish rule. The archipelago came to play an important role in Spain's galleon trade, a highly profitable enterprise that ran from Manila to Acapulco, and saw the exchange of Chinese products for silver coins from Mexico (Francia 2010:74–75). The far-north and the far-south of the country, however, were the most difficult to subdue, and the Spanish were never able to completely control southern Mindanao (Francia 2010:90; Hornedo 1998:10).

By the end of the nineteenth century, Philippine uprisings and the Spanish-American War forced Spain to relinquish control over the country. The Philippine revolutionary government declared independence on 12 June 1898. However, in December of that year Spain and the United States had both signed the Treaty of Paris, which ceded the Philippine archipelago to the United States (Francia 2010:141). While the United States wrested control of the islands, the Philippine-American war was waged from 1899 to 1902 to try and achieve independence (Francia 2010:10, 118, 166). Except for a short period of Japanese occupation during World War II, the United States controlled the Philippines until 4 July 1946, when the country was granted its independence (Francia 2010:184).

Conclusion

While our knowledge of the earliest periods of Southeast Asia and Philippine history is patchy, there is enough direct and implied evidence to support the idea that local inhabitants undertook substantial long-distance journeys in order to embark on migrations, interactions and exchanges. The next chapter addresses this knowledge by presenting the evidence from the available limited sources, and then synthesising them in a way that clarifies aspects of Southeast Asian boat construction.

Chapter 4 Archival and ethnographic sources

Introduction

This chapter presents accounts of Southeast Asian watercraft and their construction. The earliest information drawn from Chinese and European material is often fragmentary and is incidental to the authors' intended subjects. Translated from non-English languages, the texts, which span almost 2,000 years, are also infused with varying terminology and transliterations that are not always easy to reconcile.

Four sources, written over a period of more than 400 years, stand out because of the emphasis placed on the details of the construction of lashed-lug boats in the Indonesian and the Philippine archipelagos. The earliest is the description by Portuguese writer Gabriel Rebello of Moluccan *kora-kora* in the sixteenth century. The second and by far the most comprehensive is by Spanish priest Francisco Alcina on seventeenth-century boatbuilding in the central Philippines. Alcina devoted three chapters of his 1668 manuscript, *Historia de las Islas e Indios de Bisayas*, to explain the step by step process of boat building, including the types of tools used to construct them, and he described the varieties of Philippine boats. The third source is by British scientist and explorer Alfred Russel Wallace on boatbuilding in the Ke (or Kei) Islands in Maluku, Indonesia which appeared in Chapter 29 of *The Malay Archipelago* first published in 1869. A fourth account on boatbuilding in Lembata, Indonesia, was written by anthropologist Robert H. Barnes in 1985.

Proto-historical sources

As pointed out in the previous chapter, the earliest written accounts of Southeast Asia were by Chinese authors from at least the third century A.D. These mostly related to regional trade and contained a few incidental texts describing watercraft. Chinese writers used the term *kunlun bo* to refer to Southeast Asian ships (Manguin 1993:261–263). Manguin (1993:261–262) believes the term was first used in a third-century text written by a Chinese observer who described ships that sailed between Srivijaya, India and Chinese harbours, transporting Buddhist pilgrims (Figure 4-1). The unknown author relates that "the people of foreign parts call ships *bo*"; while *kunlun* is recognised as a word used to refer to Southeast Asian people, the "people beyond the barriers", south of

Figure 4-1. Map showing location of Srivijaya in relation to China and India (Kartapranata 2009).

China (Heejung 2015:27; Manguin 1980:275; 1993:261–262). The author continued on to describe the largest *kunlun bo* to be of considerable size. They reached at least 50 m in length, and extended 4 to 5 m high from the waterline. They were propelled by up to four sails lined from forward to back; they were set obliquely so that the wind could spill from one sail to another. In terms of capacity, they carried six to seven hundred people in addition to "10,000 bushels of cargo" (Manguin 1980:275). According to Manguin (1980:275), this amount of cargo could be interpreted to be anywhere from 250 to 1,000 tons.

Manguin (1993:261) cited an A.D. 304 Chinese book on Southeast Asian flora which described the bark of sugar palm (*Arenga pinnata*) as pliable in water when used to make rope, and that this kind of ligature was used to bind the timbers of Southeast Asian watercraft together (Hui-Lin Li 1979:90). Manguin (1993:261) took this to signify stitched planks, but had acknowledged earlier that the passage was vague and could be interpreted to mean lacing, lashed-lugs, or both (Manguin 1985:336).

An eighth-century Chinese text also cited by Manguin (1993:262) relates that the *kunlun* made use of coconut tree bark rope to bind parts of the sailing ships together while eschewing iron fastenings. The author, a Buddhist monk, explained that the Southeast Asians feared that iron parts could heat up and cause fires. The largest ships were said to exceed 60 m in length and were able to carry more than 1,000 passengers in addition to cargo (Manguin 1985:336).

Some descriptions were quite peculiar, suggesting the observers had misunderstood what they were seeing. A passage from 1225 by Chinese Superintendent of Trade Chao Ju-Kua (Zhao Ru-gua) related that the Visayan seafarers that attempted to raid the Fujian coast half a century earlier, in 1172, "[did] not travel in boats or use oars, but only [took] bamboo rafts for their trips; they can fold them up like door-screens, so when hard-pressed, they all pick them up and escape by swimming off with them" (Scott 1982:344). Scott (1982:344) believes Chao was describing outrigger vessels that sat so low in the water that they could be mistaken for rafts.

Scott translated a passage from *Tao I Chi Lüe* written by Chinese traveller Wang Ta Yuan who visited Madura in the fourteenth century:

> They make boats of wooden boards and fasten them with split rattan and cotton wadding to plug up the seams. The hull is very flexible and rides up and down on the waves, and they row them with oars made of wood, too. None of them have ever been known to break up (Scott 1982:340).

Probably the earliest depiction of Southeast Asian outrigger boats appeared in the ninth-century Borobudur temple bas-reliefs (Figure 4-2; Horridge 1986:6; Manguin 1980:273; McGrail 2001:302–303). They also show multiple tripod masts, a foresail, and quarter rudders on these boats.

Historical sources

More accounts about Southeast Asian ships and boats were recorded with the arrival of Europeans to the region beginning in the sixteenth century. Most of these were just as brief as the Chinese accounts. The first Portuguese sources referred to Sumatran

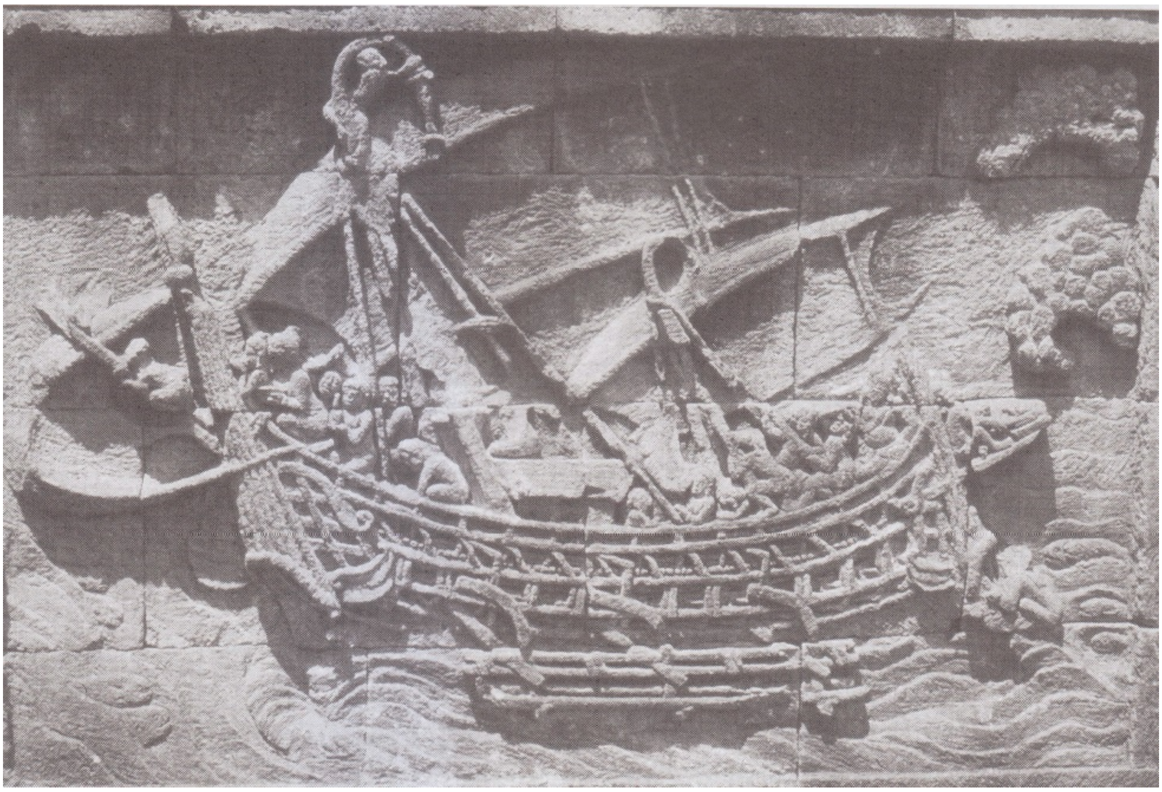

Figure 4-2. Borobudur bas-relief depicting Southeast Asian outrigger boats (Miksik 2013: Figure 1.00).

trading ships as *junco*, which is derived from the Malay and Javanese word *jong* (Manguin 1993:266). The word "*jong*" appeared as early as the eleventh century, in a Javanese inscription (Manguin 1993:266). The planks and frames of the *jong* were fastened exclusively by wooden dowels. The ship's hulls were sheathed with wooden planks, used multiple masts, and were steered with quarter rudders (Manguin 1993:266–267).

Antonio Pigafetta, who chronicled Ferdinand Magellan's voyage to Southeast Asia, recounted eight men on board a small boat that they called a *baloto* approaching the flagship on their first day in Philippine waters (Pigafetta et al. 1962 [1525]:137). A few hours later, it was followed by two *balanghai*, which he described as "large boats … full of men, and their king was in the larger of them being seated under an awning of mats" (Pigafetta et al. 1962 [1525]:137). When Magellan's party was received on shore, they conversed with the king in a *balanghai* that was sheltered under a bamboo roof. This *balanghai* was described to be the length of "eighty of my palm lengths and resembling a *fusta*", which is a low but spacious armed vessel that can be propelled by oars or sails (Pigafetta 1903–1905 [1525]-a:119; Smyth 2012:329). While there, Pigafetta collected a list of local words and phrases from various locations. In Cebu, non-native boats were called *sampan*, and ships were called *benaoa* (1903–1905 [1525]-a). He was later able to construct a much longer list of Moluccan words (Pigafetta 1903–1905 [1525]-b:75–105). Among the maritime-related words were the following:

gurap	galley
capal	ship
asson	the bow of a boat
biritan	the stern of a boat
belaiar	to sail
tian	ship's mast
laiar	ship's yard
tami	rigging
leier	a sail
sinbulaia	maintop
danda	anchor rope
san	anchor
sanpan	boat
daiun	oar

Throughout his manuscript, Pigafetta also references *prau* (or *perau*, *prahu*) that resemble *fustas*, and *almadies*, the small fishing boats, found both in Borneo and the Moluccas (Pigafetta 1903–1905 [1525]-a:213, 215, 231, 235, 251; 1903–1905 [1525]-b:39, 53, 59, 69)

While Pigafetta failed to go into much greater detail than this in relating most Southeast Asian vessels, he later described the large boats in Borneo, referring to them as "junks" (translated from *jonci* in the Italian manuscript; Pigafetta 1903–1905 [1525]-a:224–225):

> Junks are their ships and are made in the following manner. The bottom part is built about two *palmos* [hand spans from the tip of the thumb to the pinkie finger] above the water and is of planks fastened with wooden pegs, which are very well made; above that they are entirely made of very large bamboos. They have a bamboo as a counterweight. One of their junks carries as much cargo as a ship. Their masts are made of bamboo and the sails of the bark of trees (Pigafetta 1903–1905 [1525]a:225).

Then in the Moluccas, Pigafetta told of the king of Bachian (Bacan) arriving in a *prau* "with three rowers on each side. In all there were one hundred and twenty rowers…. There was much sounding of those gongs, for the rowers kept time in their rowing to those sounds" (Pigafetta et al. 1962 [1525]:220).

In 1526, Andres de Urdaneta related that Philippine vessels had rowers who were positioned over the outriggers that extended over the sides of the vessels (Scott 1982:340). Scott summarised Urdaneta's description of these vessels as six metres longer than the outriggers that extended three and a half metres out from the boats. The paddlers were situated on the outrigger supports about a half-metre outside the boat. A three-masted Bornean vessel was described by Miguel de Legazpi as "a ship for sailing anyplace they wanted" (Scott 1982:340).

Interestingly, not all the sources have commented on double outriggers on Southeast Asian boats, though this is a feature that today is relatively common in Indonesian, and especially Philippine vessels, and would have been peculiar to the eyes of Chinese and Europeans. Illustrations of Indonesian and Moluccan vessels from the late sixteenth and early seventeenth centuries help to establish that outriggers were not ubiquitous (Figures 4-3 and 4.4; Manguin 1980:271).

Portuguese chronicler Gabriel Rebello wrote a detailed account of the Moluccas in the 1569 text *Informação das Cousas das Molucas*, (Description of the Moluccas). Artur Basílio de Sá annotated Rebello's work in what is considered the first reliable copy of the text in the third volume of *Documentação para a história das missões do padroado português do Oriente* (Boxer 1965). Unfortunately, no full English translation has been made of either publication. Manguin (2012) cites Rebello as the first European to provide a detailed description of watercraft construction in Southeast Asia and translated the following passage:

> After luting the planks [at the seams], they close them off with mallets, and they are made so tight that the seams are barely visible, and they tie them from the inside, over cleats or lugs that have been left [protruding from the planks], with ropes made of roots, made tight as necessary, with which they make them strong (Manguin 2012).

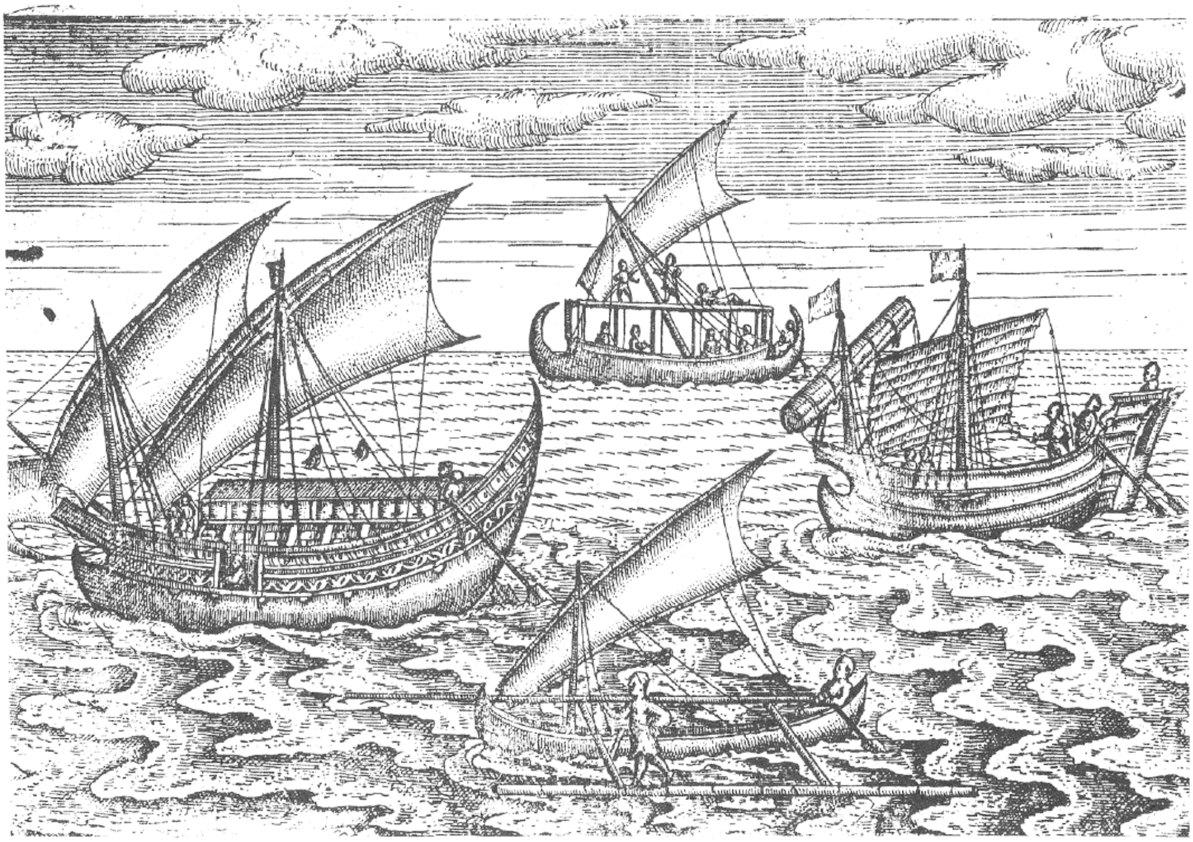

Figure 4-3. A drawing of Indonesian vessels by D'Eerste Boeck (1598; in Manguin 1980:271).

Francisco Alcina

The most complete source for Philippine watercraft and their construction was produced by Alcina (1960 [1668], 2005 [1668]) in chapters 8 to 10 of his 1668 manuscript. Translations of his work have appeared in several publications. Two full translations exist: the first is referred to as the Muñoz text, translated by Paul S. Leitz in 1960, and the second was translated by Cantius J. Kobak and Lucio Gutierrez and published in 2005. Other translations, specifically of the sections where Alcina described watercraft and their construction, appear in literature by Scott (1982) and Horridge (1982) that deal specifically with lashed-lug craft. While there are a few inconsistencies found in the four versions, they are relatively minor, and there is general agreement in the work of the four translators. Alcina's self-proclaimed experience in boat- and shipbuilding makes his insights especially valuable. Alcina describes Filipino sailing expertise and how the Spanish recognised and exploited this:

> These natives surpass, perhaps…all the others who sail about these islands—
> be they Spaniards or Chinese, Dutch or those from any other nations of the

world—in the certain knowledge about the large and powerful currents which these islands produce…. For it would be almost impossible to sail these seas without evident risks and very frequent shipwrecks, as it happens, if God would not have given them a peculiar instinct to know and to choose the opportune times, which they call *tuig*. Without the latter, shipwreck is certain and with it is safer and quicker. The Spaniards, faced with such numerous dangers, make efforts to take [along] some of these experienced natives even aboard the galleons of the greatest tonnage. As a result of this precaution, their lives and cargoes were preserved a number of times; otherwise all would be lost. About these matters I could give many examples and even some striking ones. Although in the beginnings they were well paid, rightly so, today they are given so little that hardly any native can be found who would be foolish enough to take the risk of being killed or hung for something that might not turn out well. This is how poorly they are paid (Alcina 2005 [1668]:69–71).

<u>Types of vessels during Alcina's time</u>

Alcina outlined the types of watercraft in use at the time, beginning with the smallest. A simple dugout log, called a *balutu* (or *baloto*) by Visayans of the central

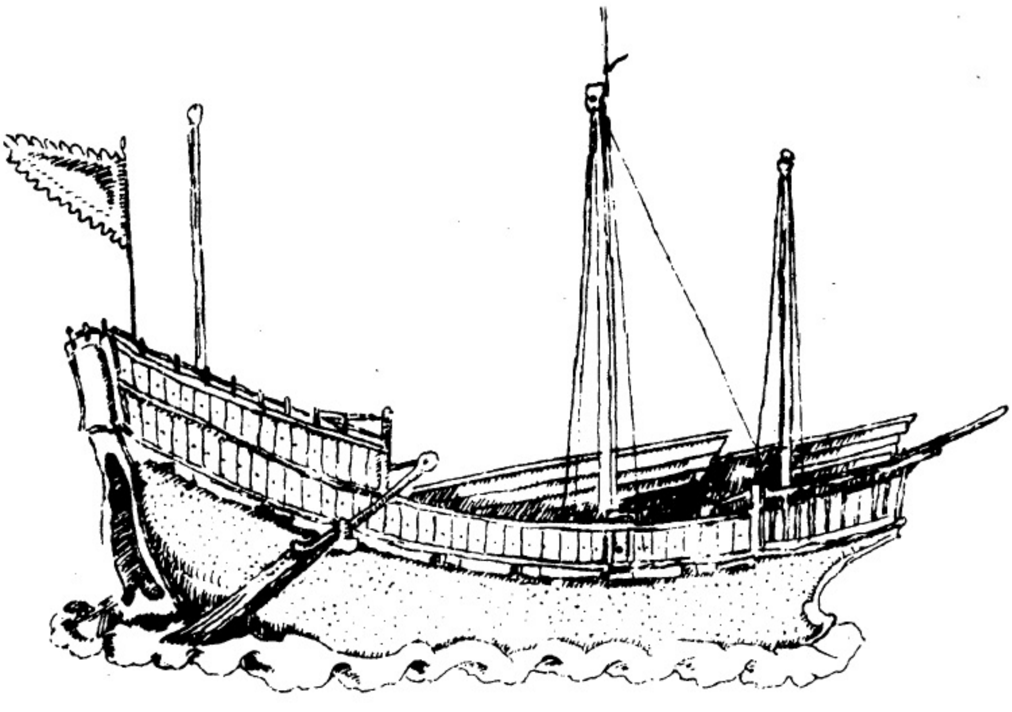

Figure 4-4. Godinho's drawing of a jong in Manguin (1613; in 1980:271).

Philippines, and *banka* by Tagalogs of the northern Philippines, was used for day-to-day activities such as fishing, hunting, and traveling (Alcina 2005 [1668]:161). These varied in shape, and each had a different name that Alcina (2005 [1668]:163) did not specify. They also varied in size, with some just large enough for a single person (and sometimes a pet dog or several) who could carry the boat on his shoulders from the beach or river bank to his house (Alcina 2005 [1668]:161). Others had a capacity of up to a dozen *bariga*, or paddlers, who Alcina emphasises,

> are accustomed to travel in a very small boat so that a finger can scarcely be placed on the outer side of the ship above the water line. If it should tip, the boat would turn over immediately. If two Spaniards wish to travel in the same *balutu*, or little vessel as often happens, they soon capsize or founder (Alcina 2005 [1668]:161–163).

Balutu of all sizes handled well in rough seas, though constant bailing was necessary, for which they used their paddles, called *bugsay*; or if the occasion required, the paddlers would "jump into the water and swim until they all get the water out and then they embark again" (Alcina 2005 [1668]:197–199). The *balutu*, as discussed above, sat very low in the water. If the sides were extended, this vessel was called a *tilimbaw* or *tinimbaw*, and was better suited to carrying cargo (Alcina 2005 [1668]:199). According to Alcina, in places such as the central Philippine island of Bohol, a *tilimbaw* was made with the dried tree trunk (*upak* or *dagpak*) prepared with rattan edges, and affixed to the *balutu* with bamboo pegs. Such was the effectiveness of this addition, that the loaded *balutu* could then travel with half of the *upak* or *dagpak* submerged in the water, and without tar or coating applied to them (Alcina 2005 [1668]:201). A more detailed account of *balutu* construction is provided later in this chapter.

The next boat that Alcina (2005 [1668]:201) discussed is the *balasian* that was used for quick travel, say, to a nearby feast or celebration. He called this the smallest "among those vessels which are truly fashioned with skill" (Alcina 2005 [1668]:201), but provided little else to distinguish this from a *tilimbaw*, other than to say the *upak* or *dagpak* sides could be extended further with *dalupi*, or woven palm leaves. Here, Alcina added that the bark and palm leaf extensions or wash-strakes work adequately in small waves, but not in rougher conditions (Alcina 2005 [1668]:201).

Alcina then described the *barangay* (or *balanghai*), the next larger-sized vessel, which was extremely light and fast. It was constructed by adding planks to a square keel, but kept low in the water to facilitate paddling (Alcina 2005 [1668]:201–203). Alcina was especially impressed by the speed of the *barangay*, even with no more than two paddlers on each side propelling it. It was the only vessel used in races, or *romba*, as they were called (Alcina 2005 [1668]:211). He recalled an account, which should be considered almost fantastical, that a *barangay* built more than 40 leagues away in Cebu (more than 220 km), was delivered to him in Samar just before sunset after departing at sunrise the same day—travelling at a speed he calculated to be four leagues per hour, or close to an incredible 12 knots for the entire journey (Alcina 2005 [1668]:209–211). This great speed is surpassed by the next vessel Alcina discussed. Before continuing with Alcina's list of Philippine watercraft, it should be noted that a *barangay* made in Luzon was built with laced planks (Cuevas et al. 2004:2).

The *biruk* was a vessel constructed with higher sides than a *barangay*, to be able to carry more cargo. Alcina relayed that "although the ones they used to have ordinarily were of small capacity, after the coming of the Spaniards, they made them much larger" (2005 [1668]:205). In turn, the use of *biruk* declined while the numbers of *champanes* (or *sampan*, *sanpan*), which Alcina calls "ships from China… which are more adapted for cargo", increased (2005 [1668]:205–207). Alcina (2005 [1668]:211) likewise has a story of the *biruk*'s incredible speed, where one supposedly travelled from a town called Catbalogan in Samar at rate of 6 leagues per hour to reach Cebu City.

The last class of vessels Alcina described was the *karakua* (or *caracoa*, and *korakora* in Indonesia), which he compared to the smaller Spanish brigantine (Alcina 2005 [1668]:207). As touched on in the previous chapter, these vessels became closely associated with slave-raiding throughout the archipelago. These light and swift *karakua* were adapted by the Spanish, who because of their demands for more comfortable travel, built versions that were heavier, negating the original virtues of the vessel. As Alcina observed:

> Thus, it is that those of the natives who are enemies of ours and construct these ships always in their own way, as they used to make them when they were alone, they make mockery of ours because by their lightness they disappear. On the sea, unless it is by some rare circumstance, never are they beaten because the difference between them is like the flight of a hawk from

> that of a chicken using these names as figures of speech (Alcina 2005 [1668]:207).

During Alcina's time, most vessels used a single rudder placed at the stern (Alcina 2005 [1668]:211). He described them as rather long and made from a single piece of wood, with three rings of rattan that held them well even in rough conditions. In contrast, he cited vessels from the southern Philippine island of Jolo, called *joangas*, that use two or four side rudders (Alcina 2005 [1668]:213).

As noted earlier, paddles called *bugsay* were used to both propel the watercraft as well as bail out water. Fashioned from strong wood that resisted breaking, they were five to six *palmos* in length. The blade of the *bugsay* was two *palmos* in length and a maximum of one *palmo* in width, shovel-shaped and narrowed to a point (Alcina 2005 [1668]:203). The rounded shaft was fastened to a cross-piece for a handle that is the diameter of "an arm and a *jeme* [about 14 cm] in length" (Alcina 2005 [1668]:203).

A longer paddle, meant to be used from the top deck of a vessel, was called a *gaut* (Alcina 2005 [1668]:203). This was made from two pieces—a round board that Alcina (2005 [1668]:203) described as larger than a plate, attached to a long cylindrical piece . A similar paddle from the mid-twentieth century was used to propel an outrigger canoe with a sail (Figure 4-5; Galang 1941). The *gaut* were placed on crossed poles that were tied to the sides and acted as tholes, set higher towards the stern and lower near the bow (Alcina 2005 [1668]:203). Each paddle was operated by one man, who, according to Alcina, could continue

> from sun up top sun down, and the next, and many more, according to the length of the journey, always with the same energy and force. They eat very moderately and rest little and it seems they were born to this task, especially the seamen who grow up in this undertaking. Those from the mountains tire in a short while and stop without being to move at all (Alcina 2005 [1668]:203–205).

<u>Dug-out boat construction</u>

Alcina provided accounts describing the fashioning of both a dugout *balutu* and a plank-built boat. The boatbuilders began *balutu*-construction by selecting a tree, and its more suitable side, then felling it so that side lands on the ground first (Alcina 2005

Figure 4-5. Paddle used for a Philippine outrigger canoe with a sail (Galang 1941:Plate 3-2).

[1668]:163). The bark was stripped while the tree was still green, as it was more easily done at this stage. A rope, called a *kutor*, was laid along the trunk's centre to keep it from twisting as it was being worked, and served as a mark to ensure the sides were reduced evenly (Alcina 2005 [1668]:163). The exterior of the *balutu* was shaped first, starting with the stern, then the prow (Alcina 2005 [1668]:163). When the outside form was completed, the inside was hollowed out with axes and adzes. The boatbuilders used two kinds of adzes, a straight one called a *daldag*, and another that was somewhat twisted, called a *bintung* (Alcina 2005 [1668]:167). To ensure proper and uniform thickness throughout, they used a gouge-like tool called a *lukub* to bore holes all over the vessel that were later plugged. The *lukub* bit was the diameter of a pinkie finger, and was "flat on one side and [had a] little opening like a gouge" (Alcina 2005 [1668]:165). A *pakang*, or a mallet, was used to pound it into the wood as it was turned, and the result was a "very round clean hole" (Alcina 2005 [1668]:165). They also left large protrusions that were later whittled down to lugs, or *tambuku* (or *tambuko, tamboco*), to which frames (*agar*) and other components, such as with the *tilimbaw* described earlier, were fastened (Alcina 2005 [1668]:165).

A person working alone was able to produce a *balutu* five to six *brazas* long (a *braza* is 1.67 m), and six *palmos* in width, in eight to ten days. Alcina lamented, however, that in most cases a boatbuilder could take several months to complete it due to "carefreeness, which is ordinarily enormous and his slowness insufferable" (Alcina 2005 [1668]:167).

<u>Plank-built boat construction</u>

For plank-built watercraft, Alcina wrote that after fashioning the keel, which is "ordinarily square like a small *balutu*" (Alcina 2005 [1668]:169), boatbuilders fastened to it a stem and sternpost, extending the length to about half a *braza* on each end (Alcina 2005 [1668]:171). The keel and posts were always hewn from *tugas* (also known as molave, or *Vitex parviflora*; Reyes 1938:435) "the hardest of woods" (Alcina 2005 [1668]:169). The resulting length was then provided to others who were sent into the forest to cut down trees for the planks. Finding a tree of adequate height, they cut this down, split it through the middle, and discarded portions which were deemed unsuitable, specifically the trunk's core and the outer section. This was because the *bukag*, or pith of the trunk, was prone to split, while the outer part, the *aramay*, was considered too soft, spongey, and often attacked by worms (Alcina 2005 [1668]:169). Alcina (2005 [1668]:169) added that if trees were not cut down under the moon, worms were likely to have infested even the harder and denser part of the wood. Only two planks were produced from a single tree. They then reduced the thickness of the planks using adzes and left a series of lugs. Alcina wrote:

> In order to cut these planks, a person is required who knows how to give both ends a kind of curve, which they call *lubag*. This means to twist, because lacking this curve the ships do not widen nor follow the necessary design. This curve has to be greater in the portion near the keel. The first ones next to it

> they call *dukot*, the next, *lunor*. On these depends the whole character of the ship, whether it widens or comes out narrow and as a result they may develop greater steadiness and capacity but sail less swiftly. If they are very narrow in design they become almost incapable of being navigated even if they have what is here called *katig* [outriggers]…. They leave on the inside of each plank, every five or six *palmos* at the most, what we said is left in the case of the *balutu*, which they call *tambuko*. Measured over all they will be a *palmo* long and three fingers thicker at the top but flush with the rest at the bottom.
>
> These *tambuko*, besides giving added strength to the planks, serve as a seating for crossing from the side or from plank to plank some rounded pieces which are tied to these *tambuko*. For this purpose each one of these has two holes where the rattan goes in and out by which these pieces are tied. These, as in the *balutu*, are called *agar*. On them is supported the whole strength of the vessels of these natives which as we shall see, they made without any iron whatever with wooden plugs and windings of rattan (Alcina 2005 [1668]:169–171).

The *agar*, or "round pieces" referred to above, are taken to mean frames or ribs. *Agar* was translated as 'rounded branches' by Horridge (1982:9) and 'rounded sticks' in the Munoz transcript (Alcina 1960 [1668]:42). In describing similar use in *balutu*, or dugout canoes, Alcina wrote that *tambuku* were "used to fasten to certain logs which lie athwart these boats when they are finished and which they call agar" (Alcina 2005 [1668]:165).

The wood used for the keel and strakes was always cut as "one piece from stern to prow in the ships which the natives build here, and they do not permit pieces and additions as in the vessels which are made in the European fashion" (Alcina 2005 [1668]:169). The builders then prepared to assemble the hull by edge-joining the strakes with dowels, while ensuring the lugs aligned from strake to strake. The dowels, made from *bahi* (the heart of a palm tree) or a hardwood, were inserted tightly through holes made on the edges of the keel and the planks with a *lukub* (Alcina 2005 [1668]:171–173). The inside of the adjoining planks were then marked appropriately for gouging, about one *palmo* apart (Alcina 2005 [1668]:171). When at least five to six strakes were attached, the boat was left for one to two months to dry. The boat was then dismantled and any broken dowels, said to be plenty, were replaced (Alcina 2005 [1668]:171). The planks were refitted, loosely at first, in order to prepare the planks for a tight fit, or *sugi*. This was achieved by using a tool, which, when traced against the edge of one plank, would make a corresponding mark on the adjoining plank. The tool was used on both the inner and outer surfaces of the planks, which served as a guide for hewing the edges with an adze. This left a gap between the two planks which was caulked with a palm fibre called *baruk* (Alcina 2005 [1668]).

The rebuilt shell was tightened by first securing logs laid across the top of the hull with rattan which was passed under the boat. Wedges were then driven through the logs with the result that "the seams between one board and the next so joined that they seem to be of a single piece" (Alcina 2005 [1668]:175). Before the logs were removed, the builders bored holes through the pre-marked planks into the dowels, to then drive in a square wooden pin, about two fingers long and made from *ipil* (*Instia bijuga*), which was reported to keep fresh and produce a sticky resin when wet (Alcina 2005 [1668]:177). This process of locking the dowels was called *pamuta* (Alcina 2005 [1668]:177). The pins prevented the planks from coming loose when the rattan was undone, and being stronger and more durable than the dowels, were never known to come loose or break (Alcina 2005 [1668]:177). The builders lashed rounded frames which they fashioned from any variety of a strong, tough, and light wood. They were rounded to a diameter "never smaller than a wrist, or larger than the fleshy part of an arm" (Alcina 2005 [1668]:179), and fastened to the *tambuku* that were drilled with two holes. One or two holes were made on the ends of the frames, to further secure them with ligatures. A small variety of rattan called *talulura* is what Alcina (2005 [1668]:181) reported to be best-suited for lashing the frames to *tambuku*.

While noting that iron was previously scarce in the Philippines, Alcina (2005 [1668]:181) believed that constructing the hull in this manner was superior to Spanish or European methods, and particularly suited to the tropical environment, where iron corroded more quickly:

> We see this happening here every day; wherever the boards are first weakened and loose at the joints, it is because of the nails, which not only become thinner day by day but also rot where they are. They deteriorate more quickly and holes through which the iron nails are fastened to open up. This

> does not happen with these native nails and with the plugs (Alcina 2005 [1668]:181).

Philippine plank-built boats were further described by Alcina (2005 [1668]:183–193, 212–213) as having bamboo outriggers (*katig*), one or two tripod masts, a single central rudder in Visayan boats and two or four quarter rudders in Mindanao *joangas*. In this period Alcina (2005 [1668]:185) observed that the use of double outriggers was unique to the Philippines and its close neighbours. The larger boats were furnished with up to five platforms that were used for fighting, in the times when raiding was more common, but also to add "symmetry, convenience and strength" (Alcina 2005 [1668]:187). Among these was a central deck which was made from split bamboo, and in larger vessels, ran along the entire length of the vessel (Alcina 2005 [1668]:187). This was large enough to accommodate the crew operating the sails, as well as some cargo (Alcina 2005 [1668]:187). Two narrower decks were placed parallel to both sides of the vessel, but above the space where rowers were positioned (Alcina 2005 [1668]:187). These three decks were called *burutlanes* (Alcina 2005 [1668]:187–189). One or two other platforms, made from whole or split bamboo, were added to the sides of larger vessels to accommodate more rowers (Alcina 2005 [1668]:187). A removable awning made from woven bamboo strips and rattan protected the crew from sun and rain, a convenience absent from small European and Mediterranean vessels and greatly appreciated by Alcina (2005 [1668]:187). To protect them from termites and rot when not in use, watercraft of all kinds were kept on land, atop large logs "so that the wind will bathe every part, and they scarcely touch the ground (Alcina 2005 [1668]:183).

Alfred Russel Wallace

Wallace (2014 [1869]:ch. 29, para. 29) wrote admiringly of the boatbuilding he observed in the Indonesian Ke Islands in 1857. His account is less detailed than Alcina's but provides additional insight, particularly in the order of the construction process which differed slightly to what Alcina outlined. He described the larger Ke vessels as having 20 to 30 tons in capacity and able to make "long voyages with perfect safety, traversing the whole Archipelago from New Guinea to Singapore in seas which... are not so smooth and tempest-free as word-painting travellers love to represent them" (Wallace 2014 [1869]:ch. 29, para 29). The Ke boatbuilders' only tools were an axe, adze and auger. They did not use any nails or other iron fastenings. Wallace noted that "tall, straight and durable" forest trees "superior to the best Indian teak" were used for the boats, with a pair of planks produced from a single tree. The planks were cut, shaped and prepared with lugs using an axe in the forest before being dragged by three or four men each a great distance to the beach, where the boat was assembled. Wallace described the keel plank as a foundation piece which was wide in the middle and curved upwards at either end. An adze was used to smooth its edges. The garboard strakes were laid against the keel plank and marked so that the builders could shape the side edge to fit exactly. When this was done, holes were bored on the edges of both timbers, which were then joined with dowels. Like Alcina, Wallace was especially impressed with the close fit of the joined planks obtained "without aid other than rude practical skill", and exclaiming at one point that "it is often difficult to find a place where a knife blade can be inserted between the joints" and again later "that the best European shipwright cannot produce sounder or closer-fitting joints" (Wallace 2014 [1869]:ch. 29, para 29).

When the complete shell was assembled, Wallace indicated that cross beams were then fixed to light notches carved in to the planks, and then further secured by being lashed to the lugs with rattan. Frames, formed from "single pieces of tough wood chosen and trimmed so as exactly to fit", were then placed on the lugs to which they were bound with rattan. The ends of the boat were then closed by securing the planks to the vertical stem and stern posts using pegs and rattan. Quarter rudders, masts and thatched covering completed the boat which Wallace believed was "actually stronger and safer than one fastened in the ordinary way with nails" (Wallace 2014 [1869]:ch. 29, para. 29).

Twentieth-century accounts

In the twentieth century, James Hornell (1920) wrote extensively on Indonesian outrigger vessels. While the variation of outrigger design and ornamentation from throughout the archipelago was his primary focus, he recorded some observations on the hull construction of plank-built outrigger boats. For example, the prow of a Manokwari outrigger is described as being "fitted upon the fore end of the canoe partly by means of pegs, and partly by a lashing on each side passed through holes on projecting cleats left when shaping these parts" (Figure 4-6; Hornell 1920:59). In describing the construction of a vessel from Galela on the island of Halmahera, Hornell made what was probably the first reference to the word "lugs" which he used interchangeably with "cleats":

> Each strake had a row of projecting perforated 'lugs' left in the centre at 5

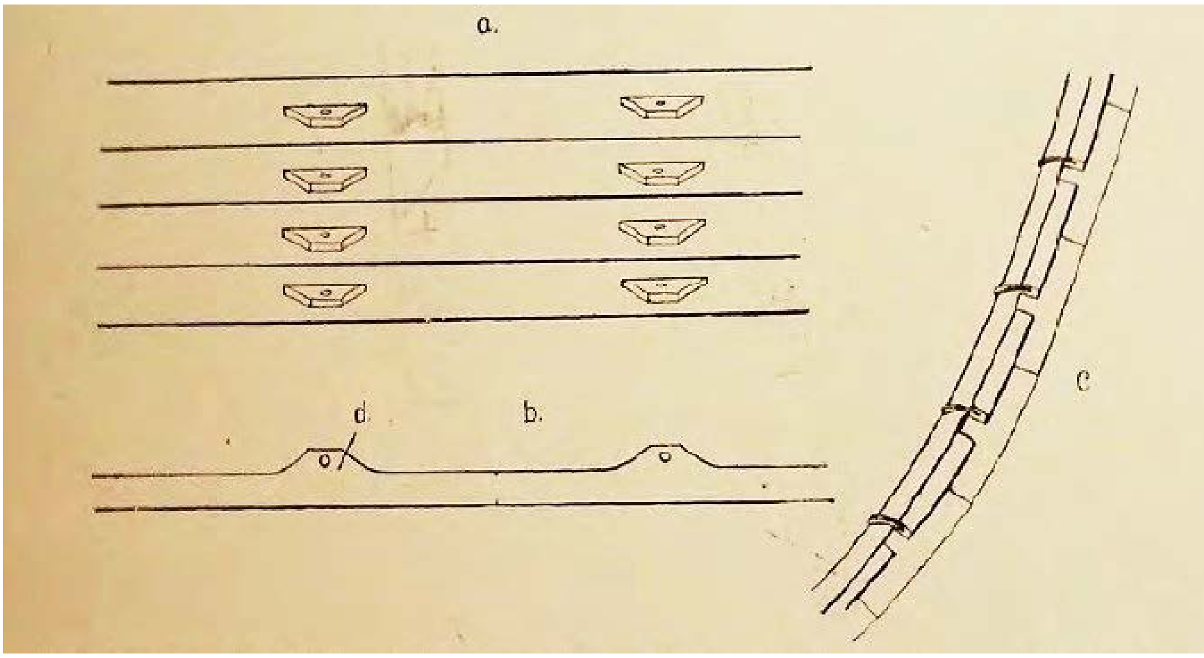

Figure 4-6. Drawing of a Galela boat showing construction details (Hornell 1920:59).

> intervals [units omitted in original] and those of each strake were spaced so as to coincide vertically with those above and below. In building, the planks are first secured together with vertical pegs; afterwards when the hull is complete, frames or ribs are fitted *over* [emphasis in original] the vertical rows of projecting cleats, and tied thereto by cord made from black palm fibre. Thus the ribs do not lie against the inner surface of the planking, but are separated therefrom by the thickness of the cleats to which they are tied. By this device no metal fastenings are required; such a hull possesses great elasticity and stands bumping in the surf in a way that no metal-fastened boat would long survive (Hornell 1920:59).

In terms of construction, the most prevalent form of traditional boats in the Philippines today are far removed from the plank-built boats of the pre-colonial and colonial times. Double outrigger vessels as small as 4 m, and as large as 50 m in length are broadly referred to as *baroto* or *banca*, but can have specific names such as *basnigan, paraw*, *balandra*, *subiran* and *tango* depending on function, form and size (Figure 4-7; Aguilar 2006:70; Funtecha 2000:112). A surplus of diesel engines and generators at the end of World War II boosted the use of motorised boats especially in the transport and cargo industries, though for fishing, non-motorised vessels still outnumbered motorised ones, at least up to the time of the last official census in 1985 (Aguilar 2006:71–72;

Figure 4-7. A Philippine outrigger banca (Galang 1941:Plate3-1).

Funtecha 2000:123). *Banca* hulls are assembled frame-first with a plywood skin constructed on a dugout base, with stem and stern posts (Figure 4-8; Aguilar 2006:72–73). They are generally built by eye, not in formal boatyards, but along the shore and close to the home of the master builder, who is assisted by several apprentices (Aguilar 2006:72). The wood for the dugout base is usually acquired from a suitable log, or is purchased from a hardware shop. Hardwoods are used for this purpose, and the popular species include *apitong* (*Dipterocarpus grandifloras*), *tindalo* (*Afelzia rhomboidea*), *yakal* (*Shorea astylosa*) and big-leaf mahogany (*Swietenia macrophylla*; Aguilar 2006:72). Larger vessels make use of steel for their hulls (Aguilar 2006:74). A recent development in *banca* construction is the use of fibreglass and of moulds, making production cheaper and faster (Dedace and Yan 2014). The devastating 2013 typhoon Haiyan, known as Yolanda in the Philippines, caused the loss of approximately 30,000 *banca*s, affecting 146,700 small-scale fisherfolk (Dedace and Yan 2014). In response to this, the World Wide Fund for Nature-Philippines initiated a program called *Bancas for the Philippines* which entailed providing training and materials to affected communities for fibreglass *banca* construction (Dedace and Yan 2014).

Figure 4-8. Frame-first construction of a Philippine banca (Aguilar 2006:73).

Plank-built watercraft in the Philippines have become less common, but when they are made, their builders still follow shell-based and dowel edge-joining (Abrera 2009; Green et al. 1995). The use of lugs has been abandoned, and frames are fastened directly to planks with wood or iron fastenings. In 2009, Sama-Badjao boatbuilders from the southern Philippines were commissioned by a group called *Kaya ng Pinoy* whose goal it was to sail in traditionally-constructed watercraft around the Philippines, Southeast Asia, and Polynesia (Kaya ng Pinoy 2009; Valdez 2009). While the Polynesian leg of the journey was abandoned, the 37-person crew successfully completed a 14-month expedition of 14,000 km through Southeast Asia aboard three boats (Kaya ng Pinoy 2009). The boats were originally intended by the organisers to replicate the lashed-lug Butuan Boats, but evidence suggests that lashed-lug construction was something the boatbuilders no longer practiced (Kaya ng Pinoy 2009). Photographs of the construction show lugs being carved out of the planks with adzes, but these were not all used for lashing frames. Photos show that frames were instead fastened directly to and flush with the planks. At the completion of the journey, the boats had undergone numerous repairs and plank replacements. The author observed that new planks on the vessel named *Diwata ng Lahi* were provided with

Figure 4-9. *Diwata ng Lahi* lug replacement. Photograph by author.

lugs merely for show—separate blocks of wood nailed and glued to the planks, and carved with a recess through the middle to accommodate and seat the frames (Figure 4-9). On the other hand, plank edge-joining with dowels was easily accomplished. The first boat, measuring 15 m in length was completed in three months by builders using manual tools, with the exception of an electric drill (Kaya ng Pinoy 2009). The three boats were built with true keels with no lugs, stem and stern posts, and did not make use of outriggers (Figure 4-10).

In Indonesia, plank-built boats are now constructed largely in the same manner, and lugs have generally been discarded with the exception of one notable example, discussed below (Horridge 1985, 1986). The use of stem and stern posts are common, but some boatbuilders construct "stemless" boats (Burningham 1990; Horridge 1986). Some varieties of stemless boats are simply closed at both ends with planks of both sides joined together, while others make use of forked end pieces (Figure 4-11). The latter are related to the wing ends used in the Butuan and Punjulharjo Boats (discussed in Chapters 5 and 6; Burningham 1990; Horridge 1986).

Protruding lugs were also observed by the author in twentieth-century A.D. Indonesian dugout canoes that are on exhibit or are held in storage at the Museum and Art Gallery of the Northern Territory. These lugs were used to position thwarts or seating across the canoes (Figure 4-12). Modern plank-built Indonesian fishing boats that are

Figure 4-10. Balangay Voyage boats (Kaya ng Pinoy 2009).

also displayed at this museum, such as the *Karya Sama* and the *Hati Marege* do not make use of lugs (Figure 4-13). Their heavy frames are treenailed directly into the dowelled planking (Figure 4-14).

While the use of lugs on Southeast Asian plank-built boats declined in the twentieth century, examples from outside the region could still be observed, particularly in southern Taiwan, the Maldives in the Indian Ocean, and the Solomon Islands in Oceania. (Barnes 2002; Green 1996; Hornell 1936; 1944; Horridge 1982:46; Kano and Segawa 1956; Millar 1993). Interestingly, the lugs were shown to serve a slightly different purpose, as will be demonstrated below.

Boatbuilding on Taiwan's Lanyu Islands (also referred to as Botel Tobago or Orchid Island) by Yami people was photographically documented in the 1930s (Kano and Segawa 1956). The Yami are an Indigenous people who speak an Austronesian language closely related to the Itbayaten and Ivatan languages of the northern Philippines (Barnes 2002:293–294; de Beauclair 1973; Kano and Segawa 1956:1). Tadao Kano and Kokichi Sagawa reported that the Yami built large plank boats called *inpanitika* only once in six to seven years, and this was accompanied with ritual and ceremony (Kano and Segawa 1956:298). A different tree was felled for each plank, and three planks comprised each

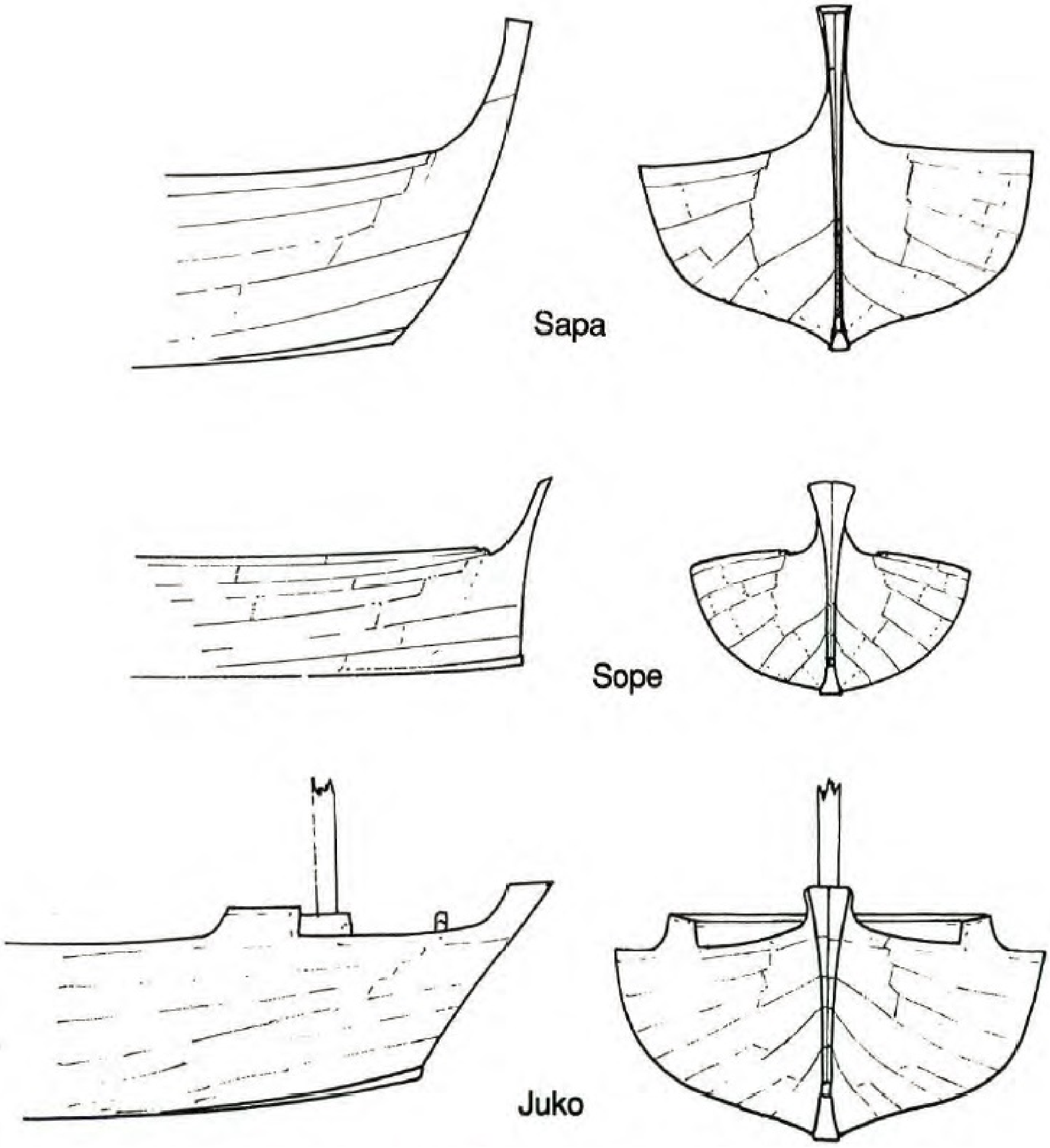

Figure 4-11. Indonesian stemless boats (Burningham 1980:107).

strake, with four strakes on each side (Kano and Segawa 1956:298). The Yami used small axes called *wasai* to chop down the trees as well as to roughly shape the individual planks and carve lugs while the wood was still green (Kano and Segawa 1956:299).

Specific trees were used for different parts of the boat. For example, *Ficus cumingii* (*anogo*), *Eugenia densinervia* (*pagoun*), *Palaquium formosanum* (*nato*), *Artocarpus comunis* (*chipogo*), *Neonauclea reticulata* (*itap*), *Chisocheton kanehirai* (*marachai*), and *Michelia compressa* (*porau*) were considered suitable for the end pieces of the sheer strake, called *pakaraten*, due to their curving buttress roots (Figure 4-15; Kano and Segawa 1956:314). For the *rappan*, or keel, the wood used was either *Pometia pinnata* (*chai*, or *malugai* in the Philippines) or *Eugenia densinervia*. *Neonauclea reticulata*, *Astronia comingiana* (*vusinsin*), *Michelia compressa*, and *Eugenia densinervia* were the choices for the stem and stern posts, called the *ipanogan-no-yamorogan* and the *ipanogan-no-maoji*, respectively. *Neonauclea reticulata* was chosen for the garboard strake, or *patoun*. *Palaquium formosanum* was used for the second strake, or *pabakun*. The sheer strake, or *pamakogan*, was prepared from either *Palaquium formosanum*, or *Ficus cumingii* (Kano and Segawa 1956:306, 314, 320)

The pieces were then carried back by the men to their village, "crossing hills and valleys" and when they arrived, "they shout[ed] exultantly, while women welcome[d] them and serve[d] them with cooked taro, fish, and fruit" (Kano and Segawa 1956:300). Under the supervision of an elder, the plank-carving was completed with an axe, a chisel called an *uma*, and a gouge called a *paut*, while more than 3,000 dowels were prepared out of white mulberry (*Morus alba*; Kano and Segawa 1956:306–311). After the boatbuilders were assured that the planks fit together properly by repeatedly fitting and refitting them, the hull was assembled, and *barok* fibres (*Zanthoxzylum integrifolium*) were used for caulking (Kano and Segawa 1956:316).

Figure 4-12. Lugs in Museum and Art Galleries of the Northern Territory canoe in storage. Photograph by author.

Figure 4-13. Indonesian fishing boats displayed at the Museum and Art Galleries of the Northern Territory. Photograph by author.

Three frames, called *majiro*, and four thwarts, or *panokato-kawan*, were then secured to the hull. How this was accomplished was not explained, but accompanying pictures seem to suggest that while the lugs were used to seat the frames and thwarts, they were not drilled to take ligatures (Figure 4-16). The frames were laid flush with the surface of the planks, though it is unclear if these or the lugs have been carved to receive them (Kano and Segawa 1956:320–321).

Some older vessels of the Indian Ocean country of the Maldives, called *dhonis*, bear a striking resemblance to Southeast Asian plank-built boats, with the use of thwarts, dowelling to edge-join planks, and lugs (Millar 1993:9–11). These traits show little

Figure 4-14. *Karya Sama* frame and plank fastening. Photograph by author.

relation to those of its immediate neighbours in the region, including Sri Lanka and India, from where Maldivians are known to have directly settled from around 2,000 years ago (Green 1996:92). When and how Southeast Asian boatbuilding influence came about has not been determined. One plausible explanation is that the Maldive islands served as a “way station” for Malagasi settlers sailing from Indonesia (Green 1996:92). North-east monsoonal winds would have influenced the routes of traders from Southeast Asia (Green 1996:92; Millar 1993).

Karen Millar (1993:15) reported that the use of lugs on Maldivian boats was rapidly declining, but their use was mostly confined to older boats made from locally-sourced coconut wood. Newer vessels were constructed using pre-cut, 5 cm-thick imported hardwood, and fashioning substantial lugs from these timbers was difficult and impractical (Millar 1993:15). Thus shallow lugs were only used to position the mast step frame. Lugs were also perceived to be problematic on the older coconut wood-vessels, as rot developed where water would collect between them and the thwarts (Millar 1993:15). On the other hand, the use of edge-dowelling was continued, and was made easier with electric drills replacing hand-operated rope drills (Green 1996:92; Millar 1993:15). Boatbuilders were then able to bore thorough the entire width of planks and

Figure 4-15. Yami boat showing buttress root sheer strake plank. (Kano and Segawa 1956:301).

use long dowels that joined three planks instead of two (Millar 1993:15).

Robert H. Barnes

Reports describing lashed-lug boat construction continued into the late twentieth century, particularly in remote islands of Indonesia. While conducting ethnographic research on Lamalera island, in Lembata, Indonesia in the 1970s and 1980s, Barnes (1985, 1996) observed the construction of lashed-lug whaling boats there and paid particular attention to the local Lamaholot terminology relating to boat components and tool names, and to the explanations provided by the boatbuilders for certain elements of construction and design, revealing insight into traditions and beliefs (Figure 4-16). Barnes' account of the building of whaling boats in Lamalera, Indonesia, details many key similarities to those of Rebello, Alcina and Wallace from previous centuries. It includes illustrations and additional information, such as the names of various boat components and the wood species used. What is immediately apparent is that the Lamalera boatbuilders purposely used separate sections of wood for the length of the keel and strakes, similar to the Yami practice described above. This is in contrast to Wallace and especially Alcina's account which explicitly noted that only one length of timber should be used from prow to stern.

The Lamalera boatbuilders used three sections for the keel, the *ié tūkã*, *ié fã*, and *ié uring*, or middle, fore and aft sections, respectively, which were joined by mortises and tenons (Barnes 1985:348; 1996:206). Each of the keel sections came from different logs of *Vitex* genus (Barnes 1996:213). The keel was prepared with lugs, and in addition, the middle section of the keel had a continuous ridge running between its lugs. This ridge was explained by boatbuilders to function as a protection for the hull against wear caused by bailing water (Barnes 1985:347; 1996:206). The stem and sternpost, made from *Cordia subcordata* (*kalimasada*, or kerosene wood) were attached to the keel also by mortise-and-tenon joints. A false keel, made of the soft wood known as *kusum* or *Schleichera oleosa* that was meant to last three to six months, was then fitted. The Lamalera boats were traditionally constructed with five strakes though at some point this was later

Figure 4-16. Lamalera whaling boat (Barnes 1996:202).

increased to six (Barnes 1996:210). Each of the strakes were assigned different names, and the middle, fore and aft strake sections were distinguished from each other as with the keel; *fã* and *uring* are added as suffixes to the strake name to denote fore and aft extensions (Barnes 1996:210–211). A seventh temporary strake made from a soft wood would sometimes be added to increase the freeboard. The sixth and seventh strakes did not have lugs and were held by thwarts secured on top of them (Barnes 1996:211). Except for the uppermost strake which was made from the softer *kapok*, or *Ceiba pentandra*, all the strakes are made from *Pterocarpus indicus* or narra (Barnes 1996:211).

Ideally, the length of plank sections used by the Lamalera was not arbitrary. They were meant to correspond with compartments of the boat and sections of other strakes in a rather complex fashion (Barnes 1996:211). It was also designed in such a way that adjacent strakes were not joined along the same section of the boat in order to distribute what could be perceived as the weak points of the vessel; the Lamalera believed that sperm whales could recognise such points and strike them. Barnes (1996:211–212) noted that the Lamalera whaling boat pattern differed from that used by boatbuilders in Sulawesi. The pattern was routinely discarded, however, because of the limited

Figure 4-17. False joint lines etched on a Lamalera whaling boat (Barnes 1996:212).

availability of suitable lengths of timbers. In such cases, false joint lines and other marks were carved in order to deceive sperm whales and protect the boats from attacks (Figure 4-17; Barnes 1996:213).

The planks of the Lamalera boats were built up in much the same way as described by Alcina and Wallace. The dowels, however, were purposely offset from strake to strake so that the marks made on the planks in preparation for gouging the dowel holes were not aligned and thus would not be an easy target for the whales (Barnes 1996:217). Locking pins were used on select dowels to secure them (Barnes 1996:217). Thwarts, outrigger booms that also functioned as thwarts, and thick, inflexible ribs were then lashed to the lugs as the final components of the Lamalera whaling boats' internal structure (Barnes 1996:217–218). *Vitex*-genus trees were used for the frames and lower thwarts, while upper thwarts were made from *Schoutenia ovata* (Barnes 1996:217).

Barnes also provides points of contrast to descriptions by Alcina and Wallace. For instance, the Lamalera boatbuilders shaped three separate sections from three separate *Vitex* trees to assemble the keel by means of tenon joins (Barnes 1985:347, 353). The wood to be used for the planks was roughly shaped in the forest where the trees were felled, about twice as thick as was needed; "blanks" were also left protruding where the lugs were estimated to be and were shaped later. Interestingly, Barnes (1985:353) relates that such roughly shaped planks were in the past often stored for years before being used. But during his visit, it was more common, but less preferable, for the Lamalera boatbuilders to utilise green wood (Barnes 1985:353).

Barnes' account of plank fitting and shaping is essentially the same as what was described by Alcina, where the master boatbuilder made use of a blackened string and a mortise gauge to mark the excess wood to be shaven off in order to fit precisely with preceding strakes (Barnes 1985). He also described the same technique of tightening planks with logs tied tightly over the top of the hull and wedges driven through them (Barnes 1985). Additionally, the Lamalera boatbuilders had the option of inserting sticks though the binding and twisting to increase compression (Barnes 1985).

Since Barnes' research, the Lamalera community has continued to receive some attention for their seasonal sperm whale hunts. It is now a tourist destination, as well as one of the stops in several cruises through Indonesia (Sea Trek Sailing Adventures 2016; See Kee 2015; Silversea 2015). An internet image search of the term "Lamalera boatbuilding" reveals numerous photographs depicting hunting activities, the exteriors

Figure 4-18. Lamalera 'mock whale hunt' (See Kee 2015).

of the boats and the superstructure that supports a crew of rowers, helmsmen, and a harpooner (Figure 4-18;Burnet 2015). Some pictures of a "mock whale hunt" performed for tourists, also show the occasional use of a tripod mast (Figure 4-18; See Kee 2015). One photograph partially shows at least two lugs used to secure a frame with what appears to be nylon fishing line, which is in turn fastened to a beam that lies atop the sheer strake (Figure 4-19; Burnet 2015). On this vessel, another frame appears to be nailed directly to the planks, and used to help secure a thwart with nylon fishing line.

Conclusion

The detailed descriptions by Rebello, and especially Alcina, Wallace and Barnes, which are presented here, provide much clarification about Southeast Asian plank-built boat construction. These written sources are strikingly similar in describing plank and frame fastening, but with some differences. Unlike Alcina and Barnes, Wallace did not mention the Ke boatbuilders drying the assembled shell prior to completion, nor the use of pins to lock dowels in place. The most obvious difference in the accounts is the description and order in assembling the stem and sternpost to the boat. Alcina and Barnes both related that the posts were attached to the keel before the planks were attached.

Wallace, on the other hand, described "vertical" posts added after the planks to close the ends of the hull. Neither Alcina nor Wallace explained in what manner the posts were fastened to the planks. While all described the use of lashed-lugs, the authors glossed over this aspect while focusing on plank-fitting and shaping, which impressed them considerably.

These sources, combined with the much shorter accounts and historical illustrations, can now be used to inform, as well as provide a basis for comparison to the archaeological evidence of lashed-lug boats that are presented in the following chapter.

Figure 4-19. Lamalera boat with lugs and nylon fishing line lashing (foreground; after Burnet 2015).

Chapter 5 Previous archaeology: The material record of Southeast Asian plank-built watercraft

Introduction

This chapter presents the available material record of Southeast Asian plank-built watercraft that exhibit any or all of the construction traits of edge-joined planking (by dowelling, and/or lacing) and lashed-lugs. To date, evidence of more than twenty such watercraft or their remains have been located throughout the region. Of these, at least 15 are lashed-lug vessels. The results of early research on these vessels by other authors were briefly discussed in Chapter 2, but will be expanded upon here in order to compare with the results of the recording and documentation from new research, particularly of the Butuan Boats which form the basis of this thesis. As highlighted earlier, many of the early results were problematic, particularly in relation to the fact that little scholarly work, including basic archaeological documentation and photography had been done in respect to many of these watercraft. In other instances where proper documentation was available, the results were rarely published, and instead were usually filed as reports or internal documents. Where available, circumstances surrounding the location, excavation, retrieval, and present condition of the remains, along with descriptions and dimensions, are provided within this thesis.

Overview of the Butuan Boats excavation and research

Butuan City is part of the Agusan del Norte province in north-eastern Mindanao in the Philippines. Butuan experiences regular rainfall throughout the year, at least 10 cm every month. Its wettest months are from December to February with about 25 cm of precipitation. In response to constant flooding brought about by rains, the local government of Butuan City undertook flood-control activities and canal-digging in the mid-1970s about 5 km from the city centre in the low-lying tidal flat area of Sitio Ambangan, Barangay Libertad. This work resulted in the unearthing of several wooden coffins that contained, along with human remains showing evidence of skull reformation, valuable grave goods such as gold ornaments and Chinese ceramics dating to the Yuan Dynasty (A.D. 1271–1368). The finds were reported by Butuan City Engineer Proceso Gonzales to the National Museum, which then sent researchers from the Archaeology


Figure 5-1. The probing end of a *sonda*. Photograph by author.

Section to investigate (Peralta 1980a; Salcedo 1976a, 1976b, 1976c). When news of the finds spread, extensive, illegal and uncontrolled looting of the area soon followed. The looters, who sometimes operated at night to avoid detection, used a tool called a *sonda* (Figure 5-1). This is a metal rod measuring about 1.5 to 2 metres in length. It has a handle on one end and a ball bearing on the other to probe into the ground. Whenever they believed they hit wood with the *sonda*, the looters quickly dug up the earth. As a result, numerous burials were disturbed and their associated grave goods sold to private collectors (Peralta 1980b:1–2).

At a site some 6 m west of where several coffin burials were found, looters came upon a wooden object. After breaking through some of the wood and expanding their digging, they realised this was not a coffin, but the remains of an old plank-built boat (Peralta 1980a:43). With the timbers having no economic value to them, they reported their find to Gonzales, who again relayed the information to the National Museum (Peralta 1980a). The archaeological excavation of the first *balanghai*, now referred to as Butuan Boat 1, commenced in late 1976, and it was fully raised soon after (Peralta 1980a:47). The timbers of Boat 1 were conserved by the AG & P Wood Preservation Plant using a process referred to as Wolmanized treatment involving a copper-based preservative and fungicide (Abinion 1977:1), as polyethylene glycol (PEG) wood treatment was still unknown in the Philippines (Peralta 1980a:47). National Museum conservator Orlando Abinion (1977:2) later observed discoloration in the wood as a reaction to the chemical treatment, as well as the presence of dried clumps of mud that had not been properly removed. A site museum, named the *Balangay* Shrine, was later erected several meters away from the original excavation site, which remains partially open today. The timbers of Boat 1 have been displayed there ever since.

While the timbers of Boat 1 were undergoing conservation treatment, looters found Boats 2 and 3 in 1977, approximately 1.2 km south of Boat 1 and only a few meters apart (Peralta 1980a:45, 47). Archaeologists and their assistants began to excavate both Boats 2 and 3, but only recovered Boat 2. The timbers of Boat 2 were treated with polyethylene glycol (PEG), before being transported to Manila for exhibition. The excavation of Boat 3 was suspended (Peralta 1980a:47) and the hull apparently forgotten, for its existence was omitted in subsequent reports. In a 1986 report, it was labelled in a site map as "unexcavated" (Figure 5-2; ASEAN 1986:52).

No pictures exist of the excavation of Butuan Boat 1. While reports state that site maps were drawn, the author has not found any to date. Only a drawing of the planks (Figure 2.7), later noted to have erroneous measurements, was published (Peralta 1980a:44–45). The numerous but brief reports, as short as two pages and none longer than six, provide little information of what specific field activities were undertaken, or even when the recovery was completed. The most detailed report filed at the Records Section of the Archaeology Division of the National Museum today is the *Butuan "Balanghai" Project: Preliminary Report on the Archaeology of the Butuan City* (Peralta 1980b, ca. 1977–1978). Its author, Peralta, was then head of the Archaeology Section but not was involved in the excavations. As noted earlier, all research in the near vicinities of the Butuan Boats came to be known as part of the "Butuan *Balanghai* Project" regardless of whether they were associated with the boat sites or not. For example, another report entitled the *Butuan Balanghai Project (May 21–June 19, 1978)* describes archaeological work at the Torralba property, or Locality 3, where 32 well-preserved and upright timbers were unearthed, along with another upright timber not aligned with the rest (Alegre 1978). The 1986 ASEAN report shows the location of the Torralba property site to be about 200 m northeast of the Butuan Boat 1 and describes the remaining timbers as a palisade (ASEAN 1986:49). The relationship of the palisade to the boat sites was not investigated.

The remains of Butuan Boat 2 were photographically documented while in situ and during recovery. While they provide extremely valuable information with regards to the original arrangement of the planks, the photographs are mostly wide shots of the excavation activity and any detailed photographs of the timbers were unlabelled and not

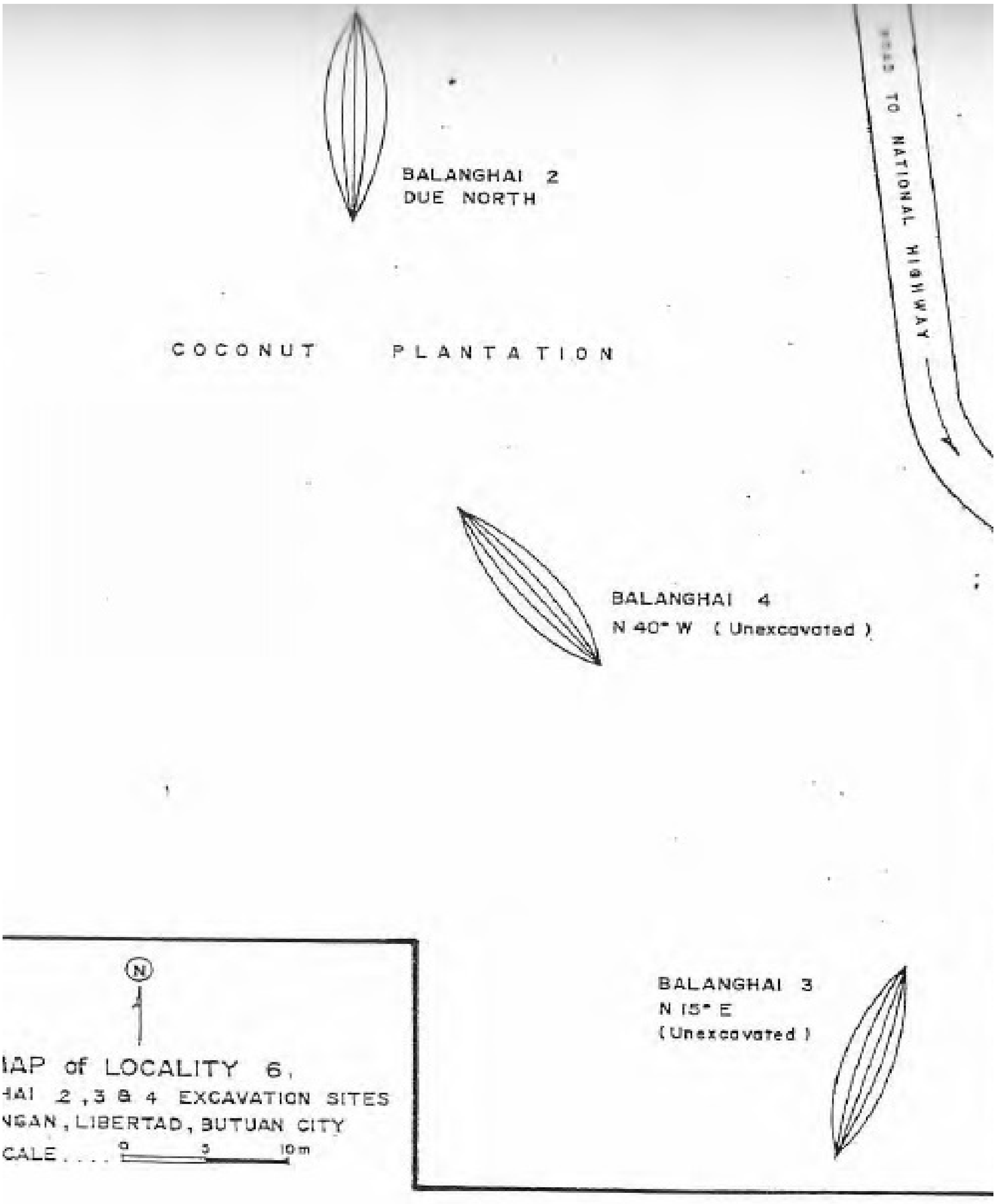

Figure 5-2. 1986 site map showing locations of Boats 2, 3, and 4. Boats 3 and 4 are labeled "unexcavated" (ASEAN 1986:52)

taken with a photographic scale. An uncredited sketch of Boat 2 (Figure 2.8, top) that appeared in a conservation report (Abinion 1978), also contains considerable faults. It is a line drawing that shows the strakes and lugs, and while it appears to be properly scaled, it shows few details, not even the position of the lug holes. At the same time, it appears to have made assumptions regarding the ends of planks that were not visible or did not survive. Furthermore, the drawing depicts an incorrect number of lugs, with an additional row. Two National Museum reports, entitled *Balanghai II Archaeological Project* and *"Balanghai II" Excavations and Salvage Archaeology Report* both from 1977 and filed by Alegre contain only vague descriptions of activities undertaken for those periods (Alegre 1977a, 1977b). Photographs or maps are not included in either report. More information is included in the conservation report by Orlando Abinion (1978). He described the use of nylon brushes and running water to mechanically clean the timbers of mud before soaking them in fresh, chloride-free water for four weeks to desalinate them. At the end of this period, Abinion (1978:7–10) wrote that the individual pieces were measured, drawn and photographed (only the aforementioned drawing was included in the report), and then soaked in a vat of fixative solution made from a mixture of 95 per cent ethyl alcohol, formalin and distilled water for 24 hours. This was followed by a thorough rinsing in tap water and air-drying, then another period of soaking in a vat containing a mixture of PEG 4000 and water. Starting with a 1-to-1 ratio, PEG was gradually increased to replace evaporated water, until all had evaporated. The wood was air-dried at 26.6 degrees C (80 degrees F) at 30 per cent relative humidity and finally coated with ethyl vinyl acetate to protect against biological attack and deterioration (Abinion 1978:7–10).

Little has been written on Boat 3 save for a brief description stating that only three planks had survived and that it was smaller than Boats 1 & 2. It was written that its excavation was halted, with the implication that it was not worth further examination due to its size and condition. Aside from the poorly scaled site maps that show its general location, the exact site of Boat 3 can be inferred from a little known 1982 report by Galpo (1982) that references the placement of another site in relation to the location or distance of both Boats 2 and 3. The report provides the location of the site as 24 m southeast of Boat 2 and 47 m northwest of Boat 3 (Galpo 1982). In the years that followed, Butuan archaeological work began to focus on locating and excavating habitation, workshop, midden and burial sites, and analysing ceramics and zooarchaeological remains (Alegre 1979a, 1979b; Barbosa 1978; Bautista and Galpo 1983; Burton 1977; Dizon 1977; Evangelista and Peralta ca. 1978; Galpo 1983, 1984; Jannaral 1977; Salcedo 1977).

After a period of inactivity in Butuan Boat research, Boat 5 was recovered in 1986 as part of the Third Intra-ASEAN Archaeological Excavation and Conservation Workshop held in the Philippines and hosted by the National Museum. The workshop's archaeological activities did not include the excavation of Boat 5—it was explained that it was unearthed and left in situ by the previous city government the year before (ASEAN 1986:46; Green and Clark 1993). The report also mentions that Boat 6, located just north of Boat 1, was completely destroyed by gold panners (ASEAN 1986:46). Boat 5 was located approximately 1 km southwest of Boat 1 and less than 400 m northwest of Boats 2 and 3. A report of the Boat 5 excavation was included in the final report produced by ASEAN, but again, many details were omitted. For example, photographs and drawings of Boat 5 in situ provide few details, and several possible frame timbers are not shown in any photographs or drawings. The report further states that when the timbers were recovered, the longer pieces had to be "divided into smaller parts" (ASEAN 1986:141), and their original locations were recorded on a map. These were not precisely marked in the map included in the report. Instead, timbers were labelled according to the particular 1m square they were located in. A total of 343 pieces of wood, placed in 48 bags from 24 squares were collected, with as many as 42 pieces placed into six bags from a single square (ASEAN 1986:216–217). One wood sample from the boat was collected for identification and another for radiocarbon dating, though their locations were not specified. The results are provided below. Meanwhile, the rest of the timbers then underwent preliminary treatment involving cleaning then soaking in fresh water, which was replaced until soluble salts had been removed. Fungicide (sodium pentachlorophenate) was added to the soak to prevent organic growth. Further conservation by soaking in PEG 4000, as with Boat 2, was recommended to replace the water content, recorded to be 430 per cent at the time of recovery (Abinion 1989:2; ASEAN 1986:144). In a 1989 paper, the wood was still soaking while conservators awaited the procurement of PEG (Abinion 1989:2). Regrettably, the PEG treatment never took place.

Archaeologists attempted to recover Butuan Boat 7 in 1989. When it was unearthed, however, its planks were found to be extremely degraded, and only the dowels were collected (Bautista 1989:6, 15). Photographs of this project were omitted in the excavation report, but maps and site plans are included.

By this time, maps appearing in reports and published papers depicted the general locations of eight boats, including those already excavated, in an area covering just over a 1 km radius. Though none of the previous literature describes when and how the unexcavated boat sites were found, or how and by whom these were verified, it is clear that the sites were labelled sequentially by number in the order that they were reported and not in the order that they were archaeologically excavated, which, at the time was 1, 2, 3, 5 and 7. Some understanding can be gathered from the aforementioned 1982 report by Galpo on how sites might have been located and identified. In the report, Galpo confirms, by *sonda* probing, the presence of an unnamed object about 1.2 m below the surface, measuring 8.8 m in length, 0.6 m in width. It was located 24 m southeast of Boat 2 and 47 m northwest of Boat 3. Based on the Butuan archaeological reports, it appears that no further action was taken with this site. Later site maps, however, show this to be near the approximate location of Boat 4 (Figure 5.2; ASEAN 1986:52).

A team composed of archaeologists from Australia's Western Australian Maritime Museum and the Northern Territory Museum of Arts and Sciences, and the Philippines' NM reinvestigated Butuan Boat 2 in Manila in 1988 and Boats 1 and 5, in Butuan City in 1992. The collaborative research produced much more data and in greater detail than any previous work. In two papers published as a result of their research, one on Boat 2 (Clark et al. 1993) and another for Boats 1 and 5 (Green et al. 1995), the group declared an intention of even more extensive and thorough reconstructions in the future. Unfortunately, subsequent research never took place. Though only part of their work was published, the raw data including detailed drawings and photographs are archived at the Western Australian Museum and were accessed for this study.

Recently, the National Museum has taken a renewed interest in the Butuan Boats. Two surveys were conducted in 2011. The first was undertaken in order to assess the present conditions of the various sites (Lacsina 2011). With the aid of the retired researcher Bernandinito Galpo as informant, the sites were revisited and points recorded with a handheld GPS (Figure 2-2; Lacsina 2011). Another survey later in the year made use of *sonda* ground probing in the vicinity of the Boat 2 excavation site. Following the survey results, the National Museum commenced excavation activities several months later in 2012 which are yet to be completed. The research team uncovered what are now referred to as Boats 4 and 9, but as alluded to earlier, these are now known to be not the same two referred to in earlier reports (Figures 2-3 and 5-2). Boat 4 is at least within the nearby vicinity in which it was initially reported to be, and recent *sonda* surveys indicate that other wooden remains exist nearby (Figure 5-3). On the other hand, the first Boat 9 was mapped hundreds of meters west of the Boat 9 excavated today (Figure 2-3).

Below is a synopsis of the results from previous research on the Butuan Boats. The results of reinvestigations beginning in 2012 will be presented in the next chapter.

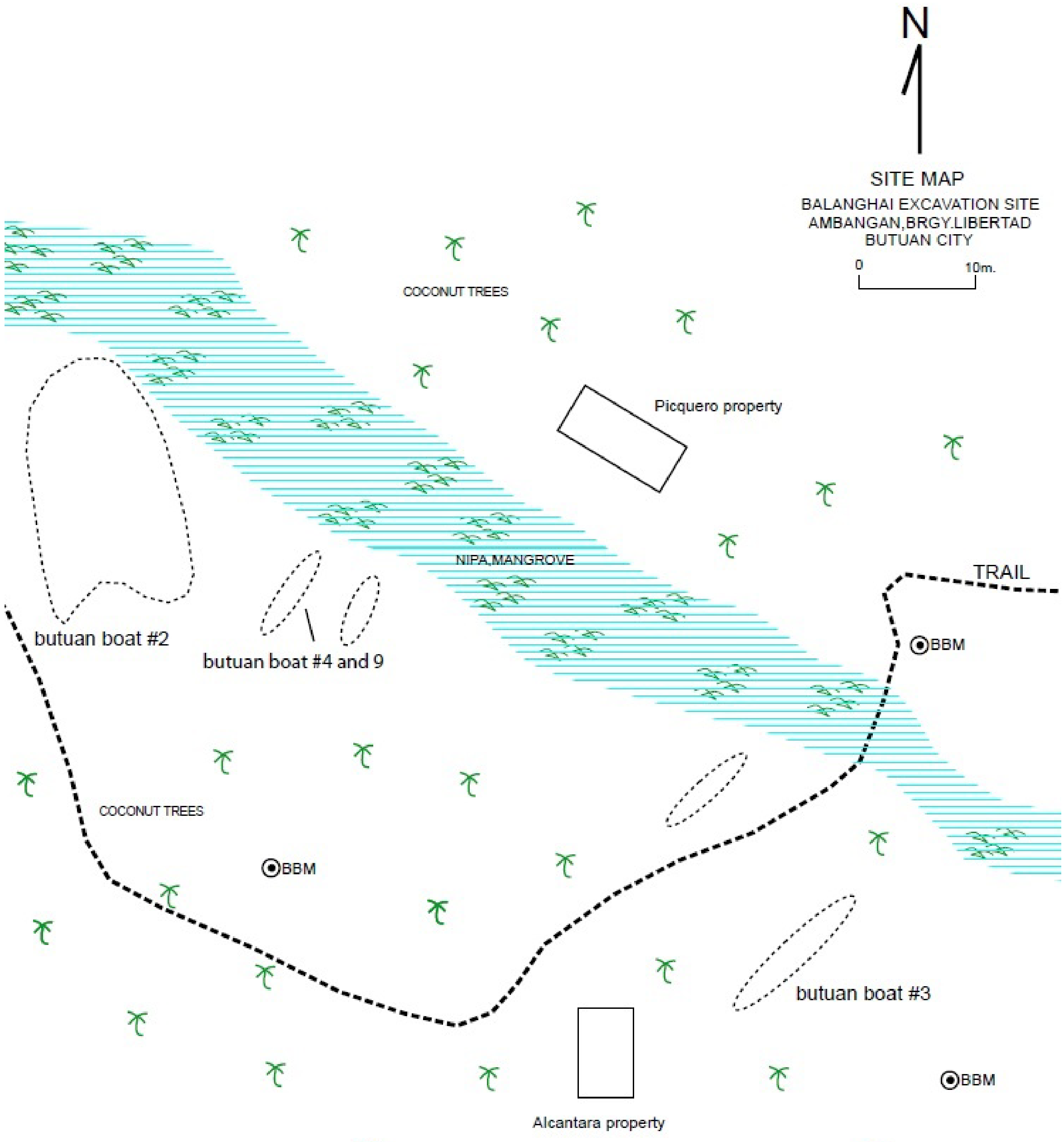

Figure 5-3. Site map showing results of 2011 National Museum survey. Courtesy of the National Museum of the Philippines.

Butuan Boat 1: Previous research results

Butuan Boat 1 was buried underneath 1.2 to 1.7 m of earth, situated some 50 cm below the water level, and oriented in a north-to-south direction (Peralta 1980a:43; 1980b:3). The boat was comprised of a keel plank, one strake on one side (east) and two strakes on the other (west). The looters exposed one end of the boat, presumed to be the prow, after they had dug through a midden some 60 cm above it. They claimed that they recovered several artefacts associated with the Boat 1, including a paddle, a clay crucible with coloured glass drippings, strands of cord and the head of a stone hammer (Peralta 1980a:44; 1980b:4).

Peralta (1980b:5) states that the longest plank from Boat 1 is 10.28 m long in his *Archaeology* article (Peralta 1980a:44–45), while a caption for a drawing of Boat 1 refers to the keel plank as the longest piece (Peralta 1980a:44–45). The scale provided with the drawing, however, clearly indicates that the keel is about 10.6 m long. The drawing also shows that the second strake is slightly longer than the keel plank. He described Boat 1 as having regularly spaced lugs throughout the entire length of its planks, not noting the gap between lugs amidships (Figure 2-7). The planks were fastened together with dowels, which were "counter-pegged", or locked with wooden pegs inserted through the sides of the planks. The early literature on Boat 1 provided inconsistent dimensions, particularly of its keel plank, which in several instances within the same papers, was said to measure between 10.28 to 10.6 m in length (Peralta 1980a:44–45; 1980b:5). Otherwise, the timbers and construction were described in general terms: planks were edge-joined by "counter-pegged" dowels and regularly-spaced lugs fastened with rope made from palm fibres identified as *Arenga pinnata* still inserted through them (Peralta 1980a:44). Reports noted the preliminary identification of plank timbers as *dongon* (*Heritiera litoralis*) and dowels as *camagong* (*Diospyrus* species;Peralta 1980b:4).

Greater attention was paid to the analysis of the midden in a layer about 60 cm above Butuan Boat 1, that had been largely disturbed by the looters. Peralta's assessment of this layer highlights interesting points in regards to the relative dating of Boat 1. Among the materials found in the deposit were Yueh-type Chinese ceramic sherds dated to the tenth century. No other ceramics that dated later than this, such as blue-and-white wares, were found in the midden, suggesting this layer was deposited no later than the tenth century. With Boat 1 in the older layer, Peralta thus surmised that it was deposited prior to the tenth century (Peralta 1980a:45).

Green and his colleagues (1995:186–187; 1992:11) provided a slightly more detailed, though brief description of Boat 1 when they recorded it, along with Boat 5, in 1992. They noted the keel plank's lugs carved in sets of three, with only the two outer lugs drilled with holes. The middle lug was thought to act as a support. The lugs of the keel plank and planks generally had three pairs of lashing holes. Two pairs of the lashing holes were noted to be equidistant to the ends of the lugs, while the third pair was

> spaced at an equal distance between the end of the lug and one of the sets of lashing holes. The latter pair of lashing holes is set on the side of the lug facing the centre of the vessel (Green et al. 1995:187).

Their investigations further clarified that the boat builders counter-pegged every other dowel on this boat. The papers, however, did not include drawings or photographs of Boat 1 except for one detailed photograph of the keel plank (Green et al. 1995; Green et al. 1992). The only measurement provided in the papers was the overall length, i.e. about 13 meters. Their papers were the first time the presence of a wing end associated with Boat 1 was reported. Its dimensions were not provided, though a photograph of the Boat 5 wing end was included in the 1995 paper (Green et al. 1995:183). It should be noted that the same lead researchers had previously examined the wing end of Boat 2, for which a detailed description exists (see below; Clark et al. 1993).

While Butuan Boat 1 was widely known as the oldest boat in the Philippines, thought to date back to the fourth century, it has, of all the recovered Butuan Boats received the least amount of attention by researchers in terms of its technical characteristics.

Butuan Boat 2: Previous research results

In describing Butuan Boat 2, Peralta noted that it measured about 14 m in length and shared with Boat 1 several “essential *balanghai* features: the flexible frames [mistakenly referred to as flexible bulkheads”], the collapsible mast, and the counter-pegging of the planking pegs [locking pegs on dowels through the planks]” (Peralta 1980a:45).

In subsequent papers, however, some of these characteristics to appeared in only one or the other boat. For example, locking pegs are found in the planks of Boat 1 but not in those of Boat 2, while a frame fragment was reported to be found with Boat 2 but not with Boat 1 (Peralta 1980a:45). There were also no further comments on the “flexibility” of the frames, nor was there any mention of the identification of the frame pieces.

Boat 2 was unearthed in a north-south orientation with a keel plank, three strakes on the west side of the keel and five strakes on the east side (Peralta 1980a:45). Just as with Boat 1, a wing end was recovered. While its recovery was photographed, it was not mentioned in the early reports (Figure 5-4). It remains unclear from the photographs or the conservation report drawing where this was found in relation to the other timbers.

Instead, Peralta remarked on “the base of a spar found amidships” that has not been mentioned again in later research reports.

When Clark and his co-authors (1993) recorded the timbers of Butuan Boat 2 in 1988, the remains were laid out in a gallery at the National Museum in Manila (Figure 5-5). The team judged the placement of the larger timbers to be properly oriented, but the smaller wood fragments had to be re-arranged before the assemblage was photographed for a photomosaic that was later traced, and used for a 1-to-10 reconstruction. The pieces included a keel plank, two strakes on one side and five strakes on the other, along with a number of smaller wooden fragments. Their paper mentions observing fragments of at least two additional strakes on the east side in excavation photos that were not included in this exhibit, and it was assumed that these did not survive conservation (Clark et al. 1993:152). This contradicts earlier reports and a drawing stating there were only five strakes on that side.

Figure 5-4. The recovery of the wing end of Butuan Boat 2, attached to a keel plank fragment (foreground) Note the protrusion on the underside of the keel plank (left). Photograph courtesy of the National Museum of the Philippines.

The team counted at least 14 rows of lugs, with most measuring to about 3.2 cm in length and 3 cm in thickness; the lugs at the extremities were found to be longer than those towards the middle, while the width of the lugs was just slightly narrower than the width of the planks. The keel plank of Boat 2 was noted to use double lugs, an attribute that was ignored in earlier reports. Each of the lugs had a pair of lashing holes, many of which still had rope fragments still inserted. Likewise, dowels or their fragments were still contained in many of the plank dowel holes. The badly degraded fragments of at least one frame were recorded; these pieces were not included in the later reconstructed exhibition. The recording team noted that scarfs near the ends of planks were found close to each other, which they interpreted to signify a drastic change in the shape of the boat at this point. The greater deterioration at this section suggested that greater physical stresses were generated here (Clark et al. 1993:150). They considered the possibility that these closely spaced hooked scarfs, when joined by dowels, strengthened joints rather than weakened them; or at least, the boatbuilders did not see them as disadvantageous, as the same building technique was noted elsewhere in Southeast Asia and the Pacific (Clark et al. 1993:150).

Figure 5-5. Butuan Boat 2 timbers on display in Manila in 1988. Photograph courtesy of Western Australian Museum.

A photomosaic was produced using a 24 mm lens, which was chosen because the Boat 2 remains were relatively flat and similar in thickness, minimising distortion (Figure 2-8). This also reduced errors from stitching together fewer photographs than if a longer lens had been used (Clark et al. 1993:145). In comparing the photomosaic to the excavation photographs and an early illustration of the boat (Abinion 1978:5), at least one strake, the third on the west side of the excavation, is not represented or was misplaced during the two occasions the boat was recorded after excavation (Figures 2-8, 5-6).

Figure 5-6. Butuan Boat 2 excavation photograph facing north. There are three strakes to the west (left) of the keel plank and 5 strakes to the east (right). Photograph courtesy of the National Museum of the Philippines.

Clark and his colleagues' (1989; 1993) Boat 2 descriptions, photographs and drawings are especially valuable because they were produced before the planks were re-assembled for exhibition, and they were able to record the positions of lashing and dowel holes. With the aid of statistical analysis, they noted that the dowel holes followed a closely-spaced pattern of six, suggesting that the boatbuilders intended this by design, perhaps using some form of template (Clark et al. 1993:153–154, 158). Unlike Boat 1, the dowels on Boat 2 were not locked to the planks with pegs. Because of this, the lashings that secured frames and thwarts were thought to play a greater role in plank-fastening by pulling the planks to the centre (Clark et al. 1993:154). Informed by Adams' (1985) work on East African watercraft, the researchers also accounted for possible compression forces that kept the vessel watertight and indeed kept it from breaking apart. These included the downward forces caused by the thwarts fastened across the sheer strakes and the legs of a tripod mast pushed down by wind hitting the sail, against the upward force from the buoyancy of strakes below the water line (Clark et al. 1993:154).

A tentative reconstruction of Boat 2 was carried out by one of Clark's co-authors,

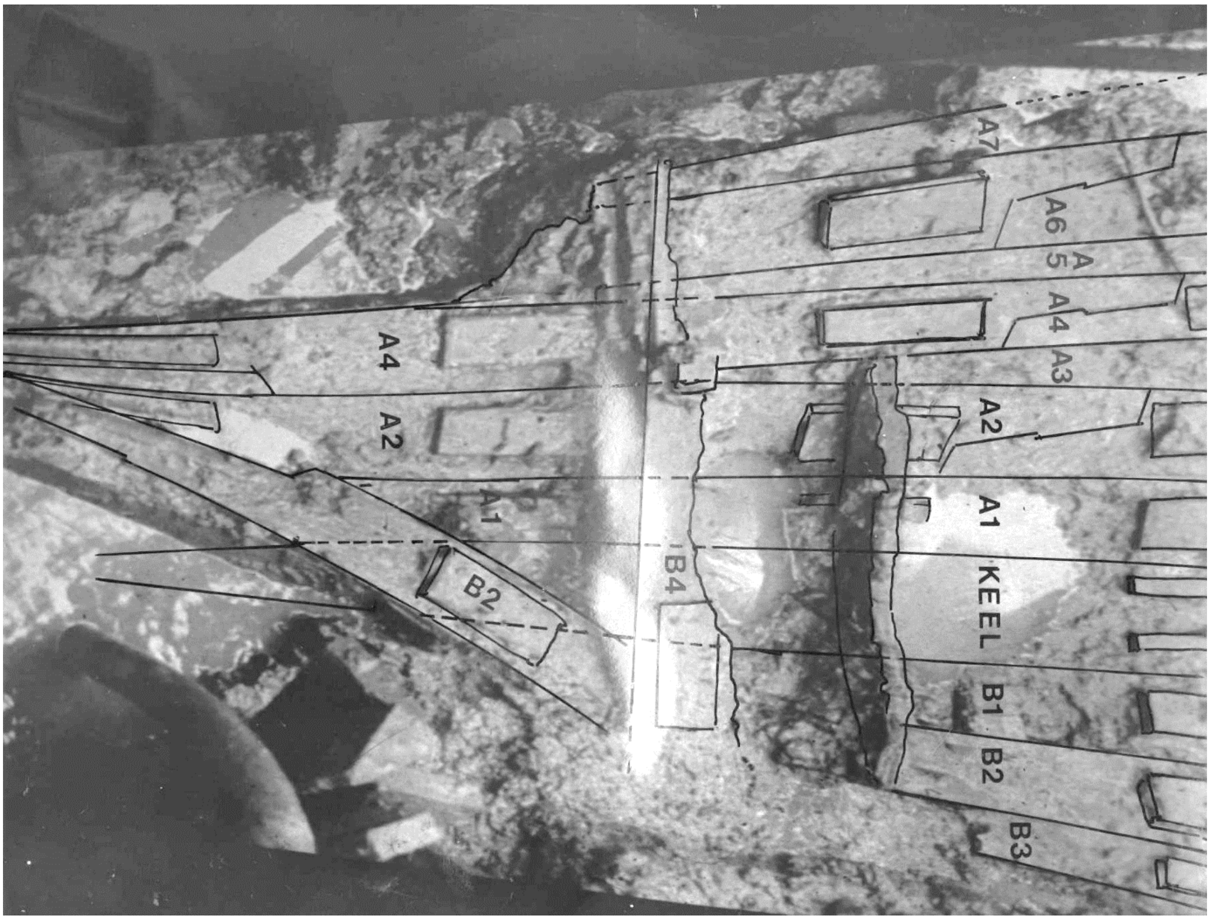

Figure 5-7. Excavation photograph showing one end of Butuan Boat 2, with scarfs and seams delineated by Vosmer (Clark et al. 1993:147; image courtesy of Western Australian Museum)

Tom Vosmer, who relied primarily on the photomosaic and excavation photographs, while focusing on a fragment of a floor timber, as well as the scarfed ends of the planks towards the end of the boat (Figure 5-7; Clark et al. 1993:145, 147). Textual sources and ethnographic examples also aided him in deducing the vessel's shape. The specific aims of the reconstruction, undertaken as part of Vosmer's postgraduate diploma in maritime archaeology in Curtin University, included hypothesising Boat 2's design, configuration and construction process; evaluating the vessel's probable capabilities, capacity, stability, handling and powering requirements. Vosmer also speculated on the role of this and similar vessels' in past Philippine society. He also aided the National Museum in rearticulating the vessel for display (Clark et al. 1993:145–146). His broader aims were to produce a resource for comparative studies and to develop theories for Southeast Asian cultural development and historical social interaction (Clark et al. 1993:146).

Vosmer clearly distinguishes what is based on fact, and what is conjecture in his plywood 1-to-10 scale model of Boat 2 (Figure 5-8; Clark et al. 1993:147–148). While confident of the shape of the vessel amidships and at one end, Vosmer had to speculate on the more fragmented opposite end (Clark et al. 1993:148). From here a lines plan was produced and entered into the *Pro-Fit* boat-design software installed on an Apple Macintosh SE30 (Clark et al. 1993:152). The software was then used to aid in finalising the reconstruction. Hydrostatic analysis suggested that Boat 2 had at a minimum eight strakes per side, and the lines drawing was adjusted for this (Figure 5-9; Clark et al. 1993:152). In addition, the software showed that outriggers fitted to the vessel would improve its stability both under sail or paddle without affecting carrying capacity (Clark et al. 1993:152). These characteristics, with a 1,800 kg displacement, led Vosmer to speculate that Boat 2 would have been suitable for carrying cargo, or

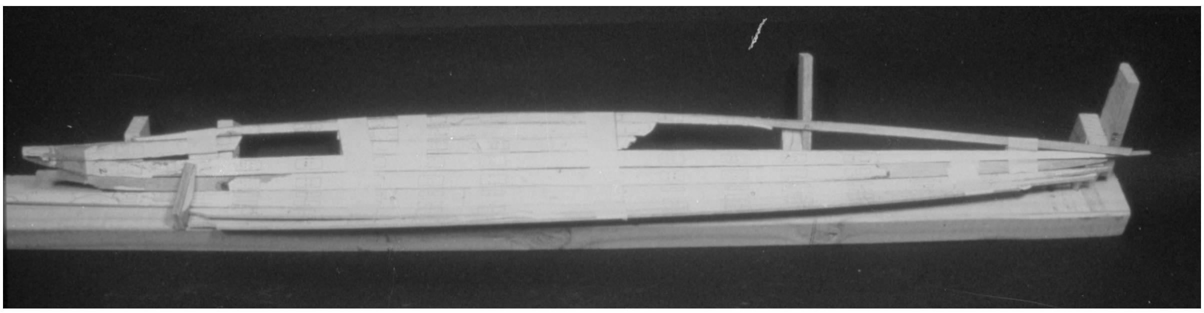

Figure 5-8. Scale model of Butuan Boat 2 by Tom Vosmer. Photograph courtesy of the Western Australian Museum.

acting as a raiding vessel (Clark et al. 1993:153). While they were inclined to think the boat was built with outriggers, the team was reluctant to state conclusively Boat 2's manner of propulsion, be it sail, paddle, or both (Clark et al. 1993:158).

Vosmer closely examined how Boat 2 components fit together. He constructed a 1-to-4 scale fragment model to determine how the frames and planks were joined and secured (Figure 5-10; Clark et al. 1993:151, 155 194). Because the dowel holes needed to be at an angle in order to allow some curvature from the joined planks, Vosmer suggested that these were drilled with a spoon-bit auger with a small-diameter shank. Several lashing variations were tested for securing the frame to the drilled lugs but only one was found to be suitable. He also produced a hypothetical drawing of the wing end fastened to the keel and planks (Clark et al. 1993:151). The wing end, fitted on top of a keel plank fragment, was made from individual pieces joined to each other and to the plank hood ends by dowels, as well as locked mortise-and-tenon joints.

Clark, Vosmer, Green and Santiago cautiously suggested that the end of the boat with the wing end portion, which showed evidence of heavier construction, was the stern. Its similarity to contemporary Southeast Asian boats that have heavily constructed sterns was cited (Clark et al. 1993:154–155). They could not determine what construction was used on the possible bow end, as this part of the boat was too heavily fragmented and incomplete (Clark et al. 1993:155).

Clark and his co-authors put forward some issues they were unable to answer. One unresolved question was why the midships portion of the boat does not have lugs, though they noted that on modern Indonesian vessels the midships area is kept clear to accommodate bailing water (Clark et al. 1993:155). They were also puzzled

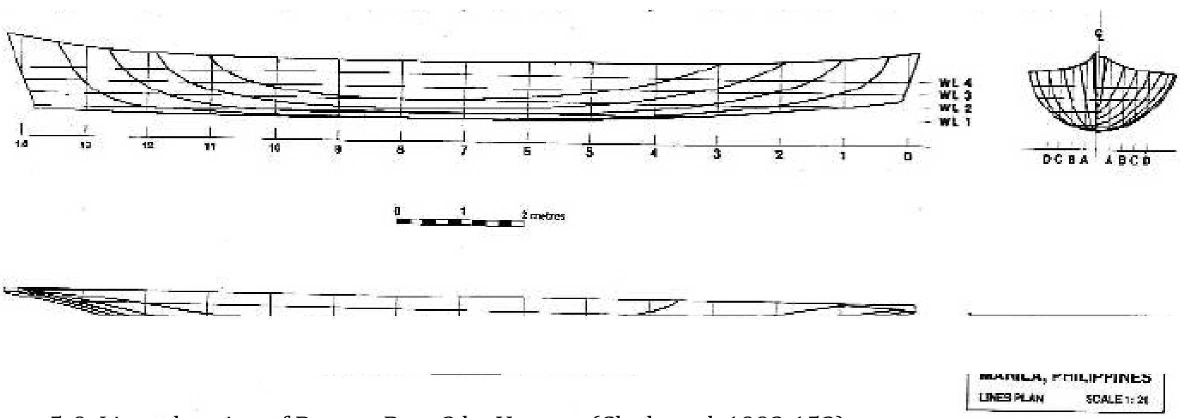

Figure 5-9. Lines drawing of Butuan Boat 2 by Vosmer (Clark et al. 1993:152).

by a small protrusion carved on the underside of the keel attached to the wing end (Figure 5-4), for which they had no explanation (Clark et al. 1993:155).

Butuan Boat 3: Previous research results

The little information on Butuan Boat 3 that is available is discussed in more detail here. The excavation of Boat 3 in the 1970s was not completed and little has been written about it apart from brief descriptions (Peralta 1980a:45–48). The remains of Boat 3 were comprised of three planks, and they were located around the same time as, and in close proximity to Boat 2. As noted earlier, several unlabelled photographs of an excavation of three timbers assumed by this writer to belong to Boat 3 have been found (Figure 2.6), but this has not been confirmed. Very little detail can be gathered from the photographs; the timbers, still partially submerged and embedded in the mud, appear to be highly degraded. The lugs of the middle timber, and what might be assumed to be the keel plank, differ from those on Butuan Boats 1 and 2, but might be similar to the keel plank lugs of Boat 4 (see Chapter 6). A continuous narrow protrusion appears to runs along the length of the timber, through wider rectangular protrusions. The planks on either side of it are also very different. The lugs are difficult to distinguish, and it is hard to determine if there are indeed individual lugs, or whether it is a continuous ridge with holes drilled through.

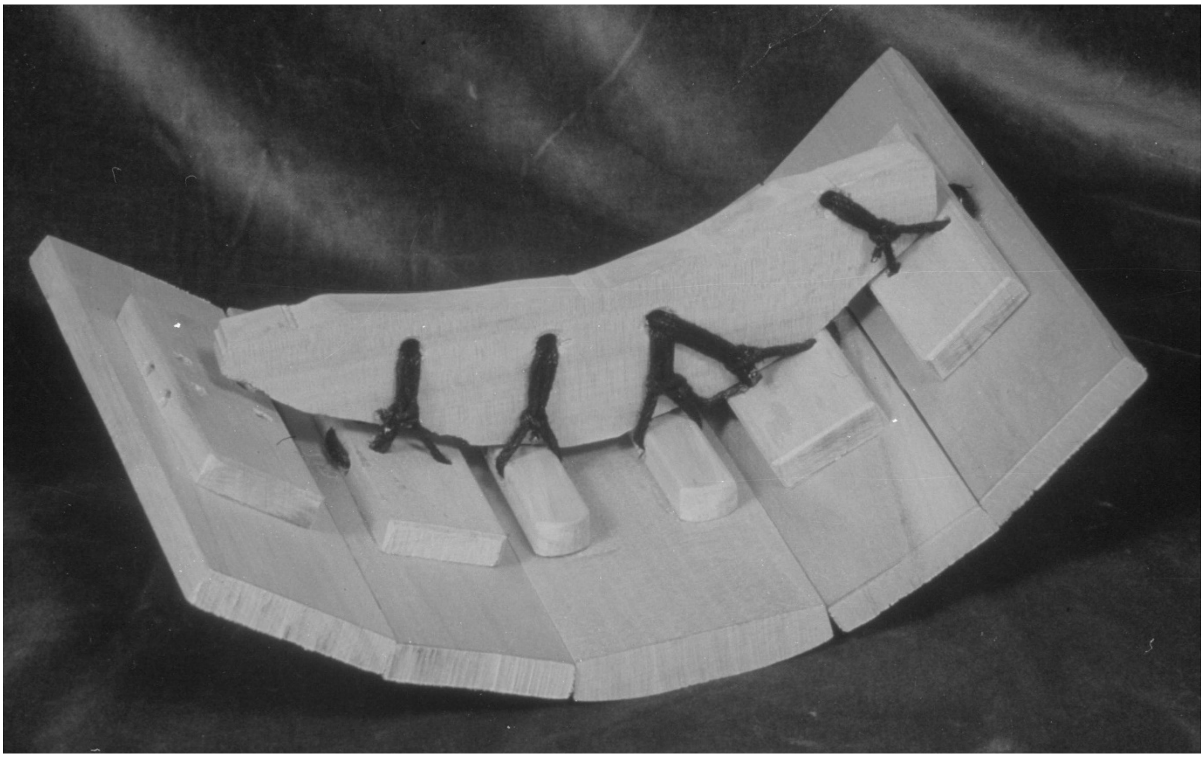

Figure 5-10. Fragment model by Vosmer based on Butuan Boat 2. Photograph courtesy of the Western Australian Museum.

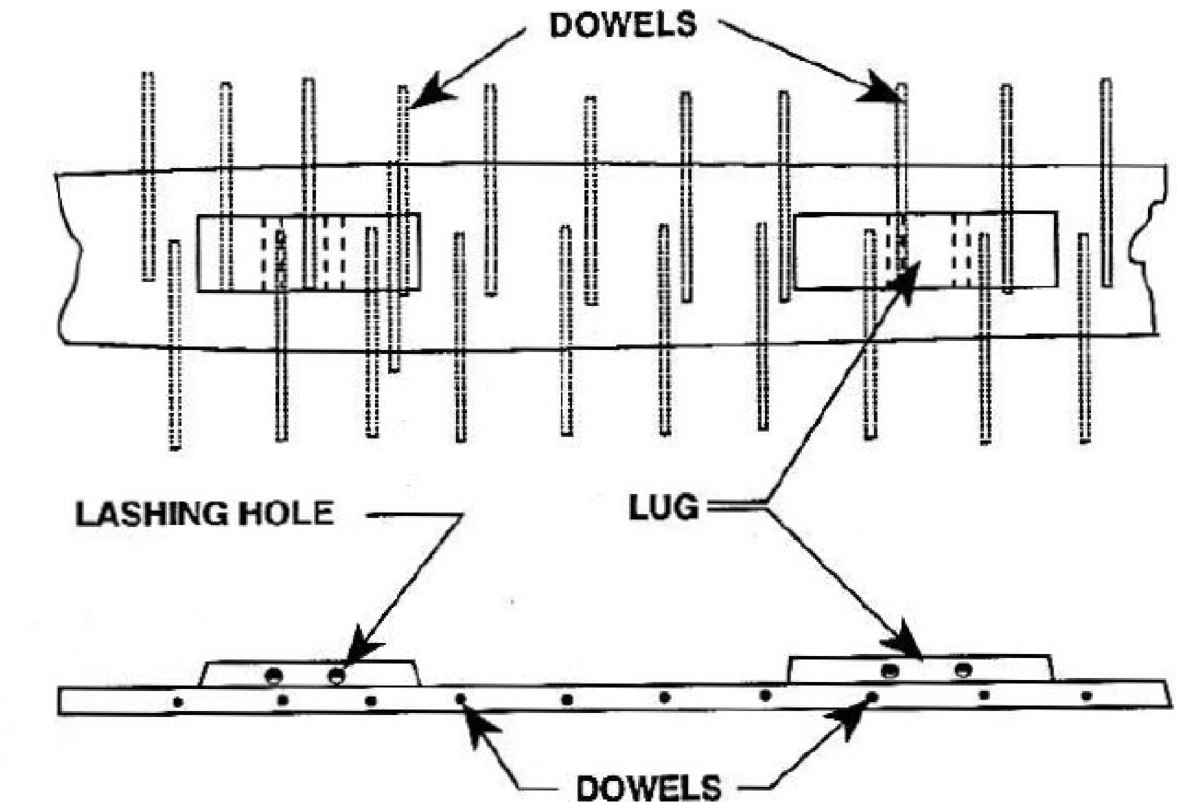

Figure 5-11. Dowel and lug arrangement of Butuan Boat 5 (Green et al. 1995:185)

There appear to be numerous degraded holes, probably used to receive either dowels or ligatures. Unfortunately, not much more information can be gathered from the photographs.

Butuan Boat 5: Previous research results

When unearthed by the local government in 1985, Butuan Boat 5 was oriented in a northeast-to-southwest direction. It is the most intact of the lashed-lug Butuan Boats. ASEAN workshop participants in 1986 counted seven strakes on each side, possibly overlooking a severely fragmented penultimate strake on the northwest side (Figure 2.9; ASEAN 1986; see below). The dimensions of the boat were presented in the ASEAN report (1986:132) as 13 m in length and 3 m wide; in a later paper it is reported as 14 m in length and 3.5 m in width (Abinion 1989). The included scaled excavation plan in the ASEAN report indicates its length is just over 12.5 m and 3 m in width (ASEAN 1986:133). Conservators elected to retrieve the timbers to protect them from further degradation (ASEAN 1986:138).

As with their 1988 recording of Boat 2, the collaborative effort of Australian and Philippine researchers that examined the timbers several years later in 1992 was more thorough. Unfortunately, the timbers of Boat 5 that had been soaking since their recovery were by that time fairly degraded (Green et al. 1995:182–183). The keel plank, the longest piece of the boat, was measured to be about 11.5 m, and it was estimated that the vessel must have been close to 13 m when built. In contrast to the ASEAN report that stated Boat 5 had 14 strakes, (ASEAN 1986:132), Green and his team (1995:183) counted 15 strakes: eight on the northwest side of the keel plank and seven on the other. A wing end and several frame timbers were also recorded, the latter found to be in better condition than the planking (Green et al. 1995:183). Neither the wing end nor the frames were mentioned in the ASEAN report.

Green and colleagues (1995:184) measured the planks to be between 3 to 4.5 cm in thickness. Measured with the lugs, the thickness came to an average of 6 to 7.5 cm, though the maximum thickness measured was 8 cm. They found that the dowels, which were spaced about 20 cm apart and measured about 1.2 cm in diameter, extended to more than half of the width of the planks; the dowel holes on either side of a plank were staggered so that they did not meet (Figure 5-11). Slightly tapered, square-sectioned locking pegs were observed on the dowels located on either end of the lugs, except in the midships portion where there is an absence of lugs. Here, locking pegs were found on every third dowel. The lugs on the planks were measured, from their centres, to be about 95 cm apart. Each had two lashing holes, about 3–3.5 cm in diameter, that were drilled from side to side on the athwartships plane. There was evidence of compression at the lugs where the

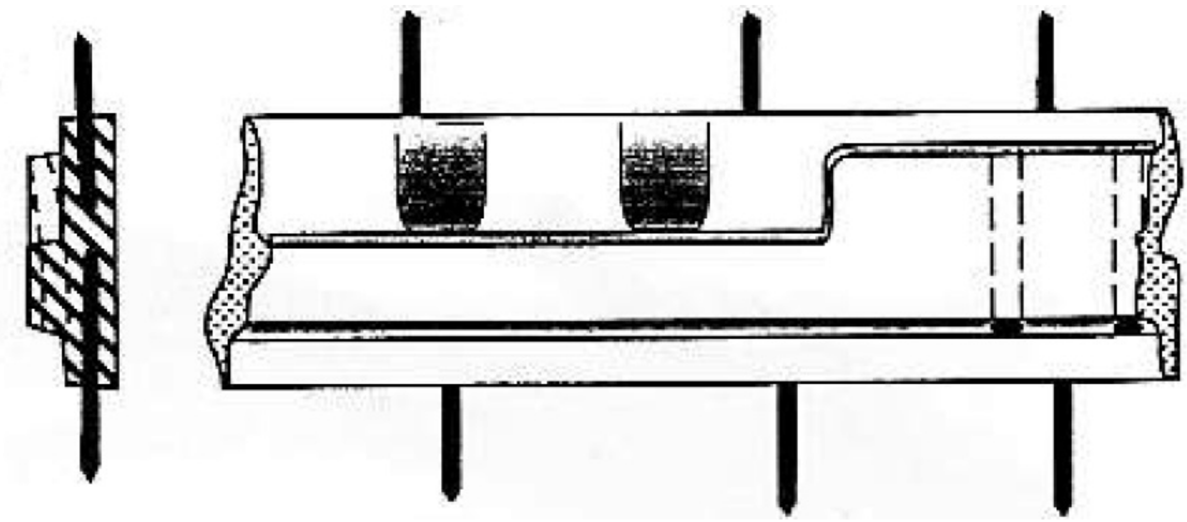

Figure 5-12. Section and plan drawing of plank 7 from Butuan Boat 5 (Green et al. 1995:186)

lashing was tightly fastened. The group also noted a slightly raised ridge:

> running across [some lugs] about midway between the lashing holes. It is not clear whether this ridge indicated that two frame timbers may have been lashed close together, or if the ridge was a result of a particular lashing procedure used on one frame (Green et al. 1995:185).

Two unusual pieces were noted: the first, which they refer to as plank 7 (Figure 5-12) has a continuous raised portion that is set off-centre, along with lugs with lashing holes. Notches were observed to be cut in between the lugs, which were presumed to hold beams or uprights (Green et al. 1995:184). The raised ridge was hypothesised to function either as a wale or a beam shelf (Green et al. 1995:184).

The second notable piece was plank 8, which has lugs that were carved in a triangular prism shape (Figure 5-13), and did not have any lashing holes. Plank 8 also exhibited dowels on both edges, which indicates that at least one other strake followed this one (Green et al. 1995:184).

Finally, the team noted the Boat 5 keel plank differed from those of Boats 1 and 2, for it had a continuous raised ridge rather than lugs. They referred to this as a “carinate or ridged keel” (Figure 5-14; Green et al. 1995:185). They believed this design was used to improve the strength of the keel plank by increasing stiffness and decreasing the likeliness of hogging (Green et al. 1995:186).

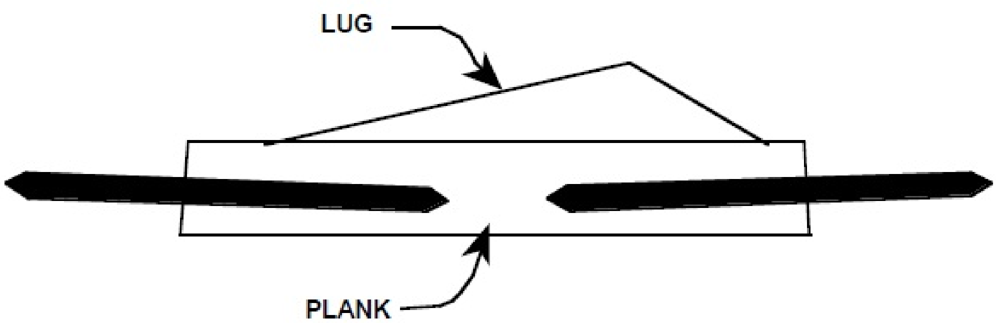

Figure 5-13. Section of plank 8 from Butuan Boat 5 (Green et al. 1995:186) .

Butuan Boat 7: Previous research results

Archaeological excavations took place in 1989 at the Torralba and Luna properties with the intent to determine the distribution of cultural materials and collect samples for dating and identification (Bautista 1989b). These included the remains of Butuan Boat 7.

Six one-metre squares were opened, and plank fragments and dowels were found about 180 cm from the datum point (the relationship, however, of the datum point to the ground surface was not specified). The planks were found to be far too deteriorated to be collected (Bautista 1989b:15). Photographs of the timbers were not taken, and the excavation plan shows only small scattered fragments of wood, that by themselves do not appear to exhibit a boat form (Figure 5-15).

As with Boat 3, the excavation of Boat 7 was not referred to in subsequent reports. It is not known if the samples collected were identified or dated, as no results have been reported.

Figure 5-14. Plan view of the keel plank of Boat 5, and its continuous raised ridge. Photograph by Tom Vosmer, courtesy of the Western Australian Museum.

Early attempts at dating the Butuan Boats

As stated above, Peralta (1980a:44–45) initially theorised that Boat 1 dated to before the tenth century. He based this on the absence of any Chinese ceramics more recent than the Yue-type tradewares in the midden layer above the hull. His hypothesis was tested when samples from Boats 1 and 2, and the midden layer above Boat 1 were sent to Gakushuin University in Japan for radiocarbon dating. Peralta (1980a:47) reported the dates but did not provide the laboratory numbers or descriptions of the samples analysed. The Boat 1 sample dated to 1630 ± 110 B.P., with the uncalibrated A.D. 320 cited (Peralta 1980a:47). This was met with the pronouncement that "not even the most optimistic member of the team had presumed that this ancient *balanghai* might have been 1,600 years old!" (Peralta 1980a:47). The Boat 2 sample dated to 700 ± 90 B.P., cited as A.D. 1250, and described as "also quite old" (Peralta 1980a:47). The unspecified samples from the midden dated to 640 ± 110 B.P. or A.D. 1310, and 210 ± 90 B.P. or A.D. 1740. The large disparity between the four dates was not addressed, nor the almost 1,000 year difference between Boats 1 and 2. While later authors were less enthusiastic, the dates were generally accepted—only a few openly questioned their reliability (see below; Cembrano 1998; Manguin 1993).

Other authors who subsequently wrote about the boats continued to present the same dates (Clark et al. 1993:143; Ronquillo 1989:62; 1997:79; Salcedo 1998:207). In one paper an obvious typographical error in a caption of the wing end of Boat 2 stated that it dated to A.D. 1320, referring to Boat 1's 320 date (Salcedo 1998:207). Only Manguin (1993:257) and Cembrano (1998:27) expressed doubts on the early date assigned to Boat 1. Manguin (1993:257) sought out and published the laboratory numbers of the dated samples. He cited Gakushuin University laboratory number GaK-7744 and the corresponding date of 1630 ± 110 B.P. for the first boat. Presumably, because of unclear labelling of the original samples, it appears that he initially confused the midden samples with the Boat 2 sample; he attributed the 640 ± 110 B.P. sample GaK-7742 to another boat, and the 210 ± 90 B.P. midden sample GaK-7743 as "from the same

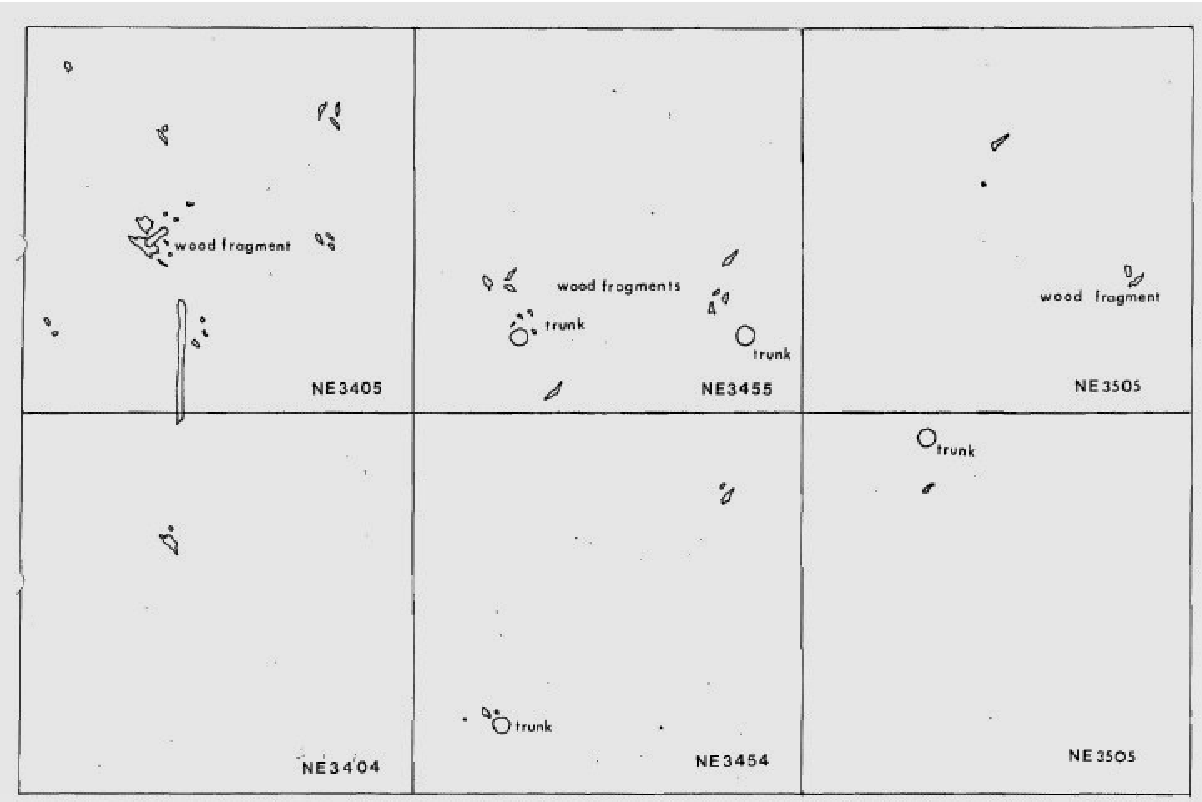

Figure 5-15. Excavation plan of Butuan Boat 7 (Bautista 1989b:Figure 13).

site" (Manguin 1993:257). The two latter dates match the dates Peralta (1980a:47) earlier offered for the midden. The official laboratory results were not located at this time and attempts to contact the Gakushuin University laboratory, which appears to no longer be in operation, have been unsuccessful. Manguin (1996:186) later corrected his earlier error, and cited the Boat 2 sample as GaK-7741 which now corresponded to the 700 ± 90 B.P. date provided by Peralta; samples GaK-7742 and GaK-7743 were now grouped with the Boat 1 site and match with the dates of the midden samples that Peralta had listed.

Further muddling the issue of the Boats' dating, various authors provided different ages for Boat 5. Ronquillo (1989:63; 1997:79) wrote that it dated to 960 ± 70 B.P., or A.D. 990. Cembrano (1998:4) reported a date of 900 ± 70 B.P. Papers by Abinion (1989:1) and Clark's team (1993:1) reported a date of A.D. 1215 with neither mentioning if this was a calibrated date nor providing an uncalibrated radiocarbon age. In citing personal communications with Ronquillo, Manguin (1996:186) lists Boat 5 as dating to 735 ± 90 B.P., or cal A.D. 1230–1295. Abinion (1989:1), was the only author to cite the laboratory which dated the sample as the Australian National University (ANU) but did not provide a sample number.

To clarify the date of Boat 5, the head of the ANU Radiocarbon Dating Laboratory, Stewart Fallon was contacted. Fallon (personal communication 2013) confirmed that sample ANU 6193 from the Libertad, Butuan City has a radiocarbon age of 960 ± 70 B.P. Using OxCal 4.2.2, the date corresponds to cal A.D. 966–1222 (p = .94) or 900–918 (p = .014).

No information was given regarding the exact provenance of any of the samples that were subjected to radiocarbon dating. Thus, it is not clear if they were collected from larger pieces of boat timbers, or if they were loose wood fragments.

Early attempts at identifying the Butuan Boat wood species

Timber identification results have also been unclear. In the earliest reports, the planks of Boats 1 and 2 were reported to have been constructed from the wood species *Heritiera littoralis*, locally known as *dongon*, while the dowels were identified as *Diospyrus* sp., locally known as *camagong* (Peralta ca. 1980:6). The identifications were noted to be only preliminary, and the source or basis for the identification was not cited. Abinion (1978:4) confirmed only that the Boat 2 plank timbers were identified as *dongon* and its dowels were *camagong*. Later, in a piece about the Butuan Boats, Ronquillo

(1997:79) wrote that Boat 2 was made from *dongon*. Salcedo (1998:207), referring to all the Butuan Boats, including Boat 5, stated that the planks were made from *dongon*. Abinion (1989:1) and the ASEAN report (1986:136, 214) stated that Boat 5 planks were identified as *Pistacia chinensis* or *sangilo* by the Department of Forestry of the University of the Philippines-Los Baños. Cembrano (1998:4) wrote that *dongon* was used for the planks of Boats 1 and 2, while *sangilo* was used for the planks of Boat 5. She further stated that dowels were made from *dongon*, *magkuno* (*Xanthostemon verdugonianus*) and *kamagong* (*Diospyras philippinensis*), but did not specify which boat or boats the identified dowels were from.

Other Southeast Asian lashed-lug watercraft remains from the region

As with the Butuan Boats, little information on the watercraft remains of Southeast Asia, other than general descriptions has been made available, with the depth and quality of reporting varying from case to case. There are also recent reports of new sites for potentially significant research with several more lashed-lug boats reported in Vietnam (Dwyer 2014; Nishino et al. 2014; Thorburn 2014) and Thailand (Jun Kimura, personal communication 2014).

As discussed previously, plank fastenings in Southeast Asian edge-joined lashed-lug watercraft have been classified into three types: the first is primarily laced and reinforced by dowelling, the second is primarily dowelled and reinforced by lacing and the third is exclusively dowelled. The Butuan Boats all appear to be exclusively dowelled (pending closer examination of Boats 4 and 9). Additionally, locking pegs were used to secure some dowels on at least Boats 1 and 5; the use of locking pegs on other vessels from Southeast Asia has not been investigated. There are also vessels that exhibit mixed Southeast Asian and Chinese construction, particularly with the use of Southeast Asian plank fastening with dowels and the recognisably Chinese trait of bulkhead compartments. These vessels have been generally referred to as hybrid, *mestizo*, or as a South China Sea boatbuilding tradition (Kimura 2011; Manguin 1993).

The watercraft compiled here are predominantly based on the research of Manguin who also personally reinvestigated several vessels (Manguin 1985, 1989, 1993, 2009, 2012). Supplementary information on the same vessels has been provided by McGrail (2001), who added vessels based on additional reports (Green and Harper 1983, 1987; Green et al. 1987). While Manguin and McGrail have published ordered descriptions of these boats, the classifications they use are slightly different. Both pay close attention to direct plank fastenings, (i.e. lacing and/or dowelling), but Manguin, in addition, considers lashed-lug construction in his classification. Unlike McGrail, he separates these from non-lashed-lug vessels. This research presents known Southeast Asian vessels following Manguin's approach of recognising lashed-lug vessels as a specific group. But while Manguin makes a distinction between plank fastening primarily by lacing supplemented by dowels, and those fastened primarily by dowels supplemented by lacing, a more cautious approach is taken here and vessels showing both fastening methods concurrently are grouped together. Lashed-lug vessels that use dowels to fasten planks are placed in a separate group. Lashed-lug vessels with only fragmentary remains are presented in the final group. These may exhibit one of the plank-joining techniques of lacing or dowelling, but because of incomplete evidence it cannot be determined if other fastenings were used. Another group, made up of non-lashed-lug vessels with dowel-joined planks, are beyond the scope of this research and are not included here. The grouped watercraft are further listed chronologically based on relative and absolute dating methods used by the primary researchers.

The list of lashed-lug watercraft presented here is meant to be comprehensive, based on written reports. It should be reiterated, however, that research in the region has often ignored the watercraft, and many more sites may yet be reported.

Lashed-lug watercraft with laced and dowelled planking

Manguin (2012) and McGrail (2001) view the watercraft in this section as depicting a transitional technique in plank fastening that progressed from lacing-only before developing to dowelling-only. The examples, located in Peninsular Malaysia and Indonesia (South Sumatra and Central Java) range in date from as early as the third and fifth centuries up to the seventh and eighth centuries.

Pontian Boat (Malaysia), third to fifth centuries

The oldest Southeast Asian lashed-lug boat, dating to between the third and fifth centuries, is the Pontian Boat. It, along with a cargo of pottery, was exposed as a result of erosion in the mangroves of Pontian in Peninsular Malaysia in the 1920s (Gibson-Hill 1952). When it was examined several years later in 1926 by Ivor Hugh Norman Evans (1927), the surviving remains consisting of four planks, seven frames and an end post, had fallen into the river. The pottery was in a mound of sherds, and two near-intact jars had reportedly been taken by fishermen. The plank timbers were identified as *merawan* (the Malay common name; or *Hopea* sp.) by Frederik William Foxworthy (Gibson-Hill 1952:111). Rope made from *ijok* (*cabo negro*/*Arenga pinnata*) was used for plank-lacing and a dowel was identified as *medang* (*Lauraceae* family; Gibson-Hill 1952:111).

About a quarter of a century later, the timbers were re-examined by Carl Alexander Gibson-Hill (1952:111) as they were exhibited in the Perak Museum. Manguin then reassessed them in 1982 at the Muzium Abu Bakar (Manguin 1985:333). The broken planks were measured by Gibson-Hill (1952:111) to be between 15–20 ft (4.5–6 m) in length, 1 ft (30 cm) in width and 2 in (5cm) in thickness. The frames, which he described as slightly curved, measured between 4–5 ft (1.2–1.5 m) in length. The end piece that was surmised to be a sternpost, was about 6 ¾ feet (2 m) in length, 7 ½ in (19 cm) in width on one end, which he called the "foot", and 12 ½ in (31 cm) in width on the other end that he called the "head" (Gibson-Hill 1952:111). Gibson-Hill believed that these surviving timbers were from the stern portion of the boat, with the planks consisting of a keel plank, which he described as "moulded" (Gibson-Hill 1952:111) on the underside, the garboard strake on the port side and the first two strakes on the starboard side. He further hypothesised that there were originally four strakes on the aft portion and one to two additional strakes in the fore portion (Gibson-Hill 1952:111). Gibson-Hill (1952) found that the (stern) post had grooved markings that were etched along two-thirds of its height that likely corresponded to the strakes that were joined to it. It was on this basis that he supposed that this end of the boat was constructed with four strakes. He estimated the

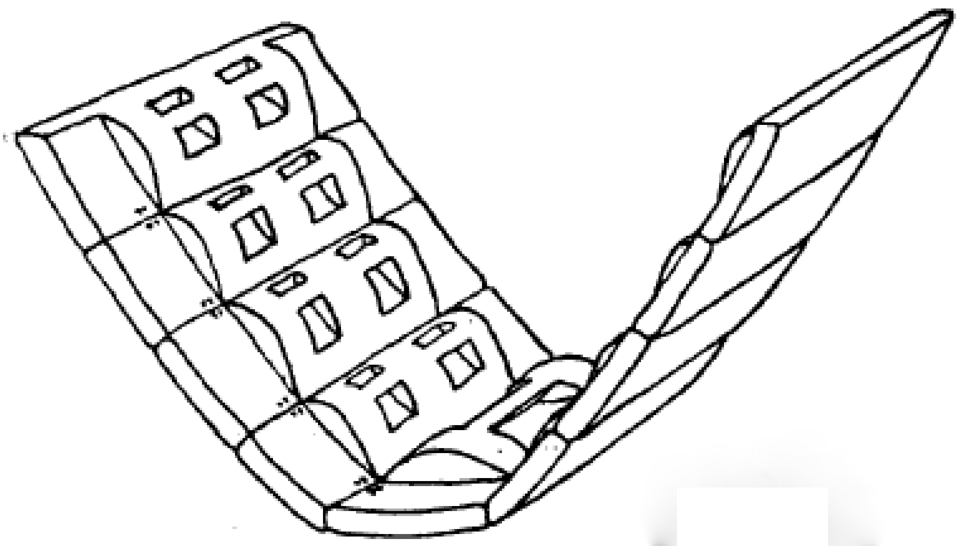

Figure 5-16. Gibson-Hill's (1952:114) conjectural reconstruction of the Pontian Boat planks.

original length of the keel plank to be approximately 30–35 ft (9 to 10 m) in length (Gibson-Hill 1952:111–112).

The lugs, referred to as “comb cleats” (Gibson-Hill 1952:112) were approximately 20 in (50 cm) in length and the same width as the planks they were carved on (Figure 5-16; Gibson-Hill 1952:112). A photograph published online (Figure 5-17; MACHU Project 2006–2009) and a drawing by Manguin (1985), however, show lugs that are slightly narrower than their planks, and spaced about 18 in (45 cm) apart. According to the descriptions and illustrations contained in Gibson-Hill’s (1952:114) paper, the keel plank lugs are curved, similar to the shape of a half-oblong cylinder rather that the rectangular blocks of the Butuan Boats. The lugs on the strakes are similarly shaped, but are thicker at the upper edge of the planks. The lugs on the keel plank and strakes were described as having a high narrow ridge with two rectangular holes cut through, though the illustration in the same paper depicts one large hole in the keel plank lug. These large lashing holes lead Gibson-Hill (Gibson-Hill 1952:114) to suggest the possibility that in addition to *ijok* rope (*cabo negro* in the Philippines*; Arenga pinnata*), rattan was used to reinforce the lashing.

The planks were fastened together by a combination of lacing and dowelling. Two lacing holes measuring 1 cm in diameter and bored from the edge to the inner surface of

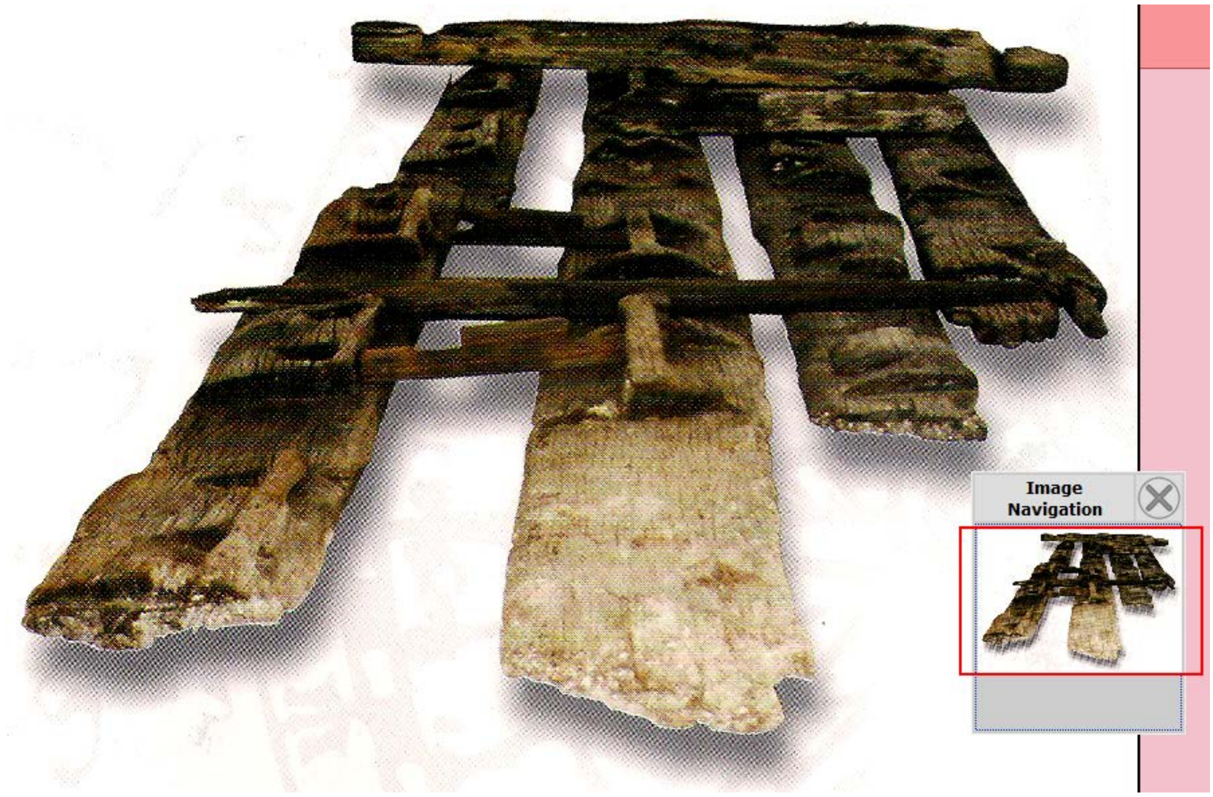

Figure 5-17. Pontian Boat planks (MACHU Project 2006–2009).

the planks, were placed on either side of the lugs, with “every clear space on the surviving strakes having two pairs of ties with a dowel pin between them” (Gibson-Hill 1952:112). From his typological analysis of the associated ceramics, identified as Oc-eo, Gibson-Hill surmised that these were manufactured during the first millennium, most probably the second half (Gibson-Hill 1952). Manguin, however, clarified that similar ceramics from an Oc-eo site in southern Vietnam date to the first to sixth century. Radiometric analysis conducted on a Pontian Boat timber (BM-958) in the early 1970s confirm the latter analysis with a result of 1576 ± 60 B.P. or cal A.D. 260–430 (Booth 1984:203; Burleigh et al. 1977:153).

<u>Kolam Pinisi Boat (Indonesia), fifth to seventh centuries</u>

The Kolam Pinisi Boat was recovered from southern Sumatra in a pond near the River Musi in Palembang in 1990 (McGrail 2001:298). This is a lashed-lug vessel with the planks fastened by lacing and dowels. Though dimensions were not provided, in reports it was observed that this boat was “quite large” and composed of 24 planks (Manguin 1993:257; McGrail 2001:298). The vessel’s keel plank was recorded by Puslit Arkenas after the lugs had been damaged and “trimmed” by looters (Figure 5-18; from Manguin 2012:Figure 3). It was radiocarbon dated to 1510 ± 50 B.P., or cal A.D. 434–631 (GiF-8483).

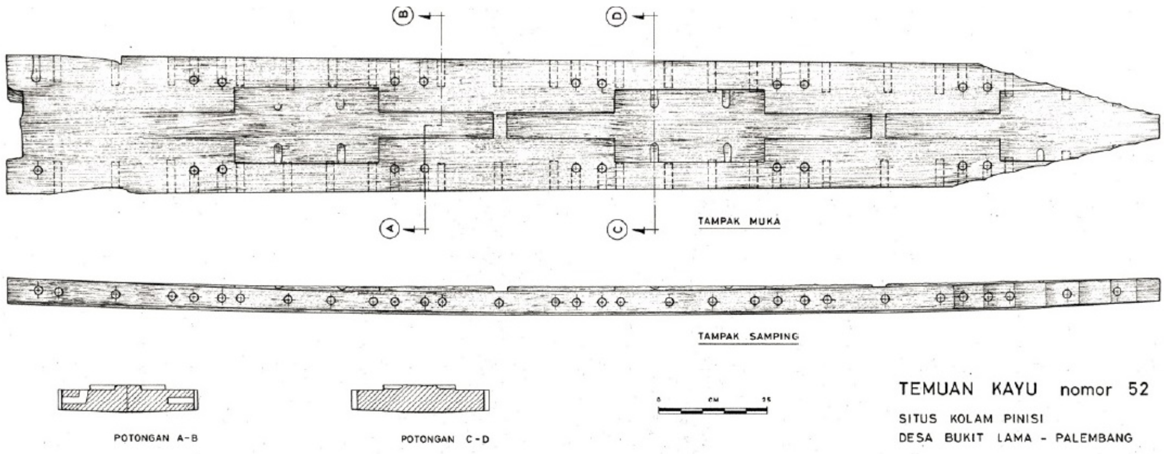

Figure 5-18. Kolam Pinisi Boat keel plank (Manguin 2012:Figure 3).

<u>Sambirejo Boats (Indonesia), seventh to eighth centuries</u>

Eleven planks from possibly three boats exhibiting lashed-lugs with plank lacing and dowelling were found in Sambirejo, South Sumatra, located downstream from

Palembang near the River Musi (Manguin 1989:202). The wooden remains were unearthed in 1987 by Javanese transmigrants in the area. The timbers, along with a quarter rudder, were assessed the following month by staff from *Pusat Penelitian Arkeologi Nasional* (National Research Center for Archaeology) during a brief visit, and again more thoroughly the following year (Manguin 1989:202). In between the two visits, the timbers were left in situ, but unprotected and partially exposed. While it was evident that all but two of the pieces had been moved, the remains were said to have undergone very little degradation. When archaeologists arranged eight planks believed to be from one vessel, referred to as Sambirejo Boat I, they found that the scarfs and curvature of seven of the plank pieces fit "perfectly" (Manguin 1989:203). The eighth plank was said with confidence to have come from the same vessel and probably joined with missing planks (Manguin 1989:203). A single timber, measuring 10.93 m in length, that lay across the site was referred as belonging to Boat II. Two planks, measuring 9.16 m and 9.05 m in length, that were left undisturbed came from what was called Boat III, though these also did not fit together or with other planks. The timbers were traced onto transparent PVC, while the quarter rudder was drawn to a reduced scale (Manguin 1989:203). These drawings have not been published; Manguin's drawing of a section of one of the planks, is shown here (Figure 5-19; Manguin 2012:Figure 2).

The planks of Boat 1 vary in dimensions, with the longest measuring 9.95 m and the shortest measuring 4.02 m. Manguin (1989:202) indicated that the average plank width was 23 cm and the thickness was about 3.5 cm. L-shaped lacing holes and dowel holes,

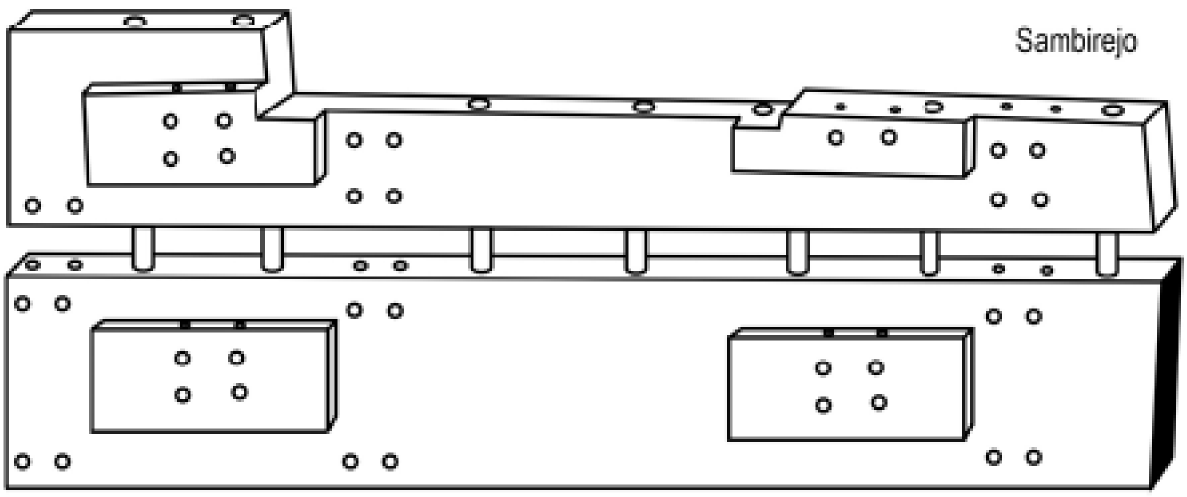

Figure 5-19. Drawing of Sambirejo planks showing lugs, lashing, lacing and dowel holes (Manguin 2012:Figure 2).

measuring about 1 cm in diameter, were set at regular spaces on the planks; pairs of lacing holes were set about 76 cm apart, while dowel holes were set at 18 cm intervals. This shows a larger proportion of dowels to lacing when compared to other laced and dowelled vessels. The rectangular lugs measure about 30 cm in length and have two pairs of L-shaped lashing holes. The lugs were spaced 50 cm apart from each other. Manguin (1993:257) and McGrail (2001:298) noted that in this case, dowelling was the primary plank-fastening and lacing was used as reinforcement. One lacing hole on a plank seam has a long oblong shape, perhaps an error drilled over several times.

A quarter rudder measuring 5.94 m in length and maximum 56 cm in width was found with the hull remains, with one rectangular hole presumed to attach to the tiller, and two holes for attaching to the hull (Manguin 1989:203).

According to local inhabitants, the timbers of Sambirejo Boats I and II were found directly on top of Boat III timbers. Scattered Chinese ceramics from the site were dated typologically to around the tenth century. A sample (Gif -7871) taken in 1988 from a timber of Sambirejo Boat III was dated to 1350 ± 50 B.P. or cal A.D. 610–775. All the timbers were reburied in situ (Manguin 1989:202).

Punjulharjo Boat (Indonesia), seventh to eighth centuries

The most intact lashed-lug watercraft found to date is the Punjulharjo Boat from Central Java, Indonesia (Manguin 2009). A detailed archaeological report was published in Bahasa Indonesian, though a version in English is presently being prepared (Manguin, personal communication 2015). It was unearthed around 2007 or 2008 while a salt pond was being excavated on an ancient beach ridge (Manguin 2009, 2012). This is now located about half a kilometre from the present shore. The find was further excavated and conserved in situ by archaeologists of the *Balai Arkeologi Yokyakarta* (Manguin 2012:4). The dimensions of the vessel as it was found were 15.6 m in length, 4.5 m in width and 1.2 m in height. The original size of the vessel is estimated to be about 17 m in length, 5.7 m in width and 2.3 m in height (Manguin 2009:4). Though it received some damage from the initial digging by locals, the vessel, particularly the parts of it that had been kept wet, was remarkably well-preserved. The upper-most strakes that were allowed to dry did show signs of disintegration, such as flaking.

The surviving timbers were composed of the lower part of the hull, still fastened by lacing and dowelling; wing end pieces at both ends; several frame timbers and thwarts

Figure 5-20. Punjulharjo Boat with well-preserved ligatures used for lashing and lacing (Manguin 2012:Figure 6).

still lashed to the lugs; long poles lashed to the floor timbers; fragments of upright timbers lashed to the poles; and a quarter rudder support. The level of preservation of the sugar palm rope (*Arenga pinnata*) used for both lashing and lacing, is so far unparalleled among archaeological sites in the region and provides the best example of Southeast Asian lashing and lacing techniques (Figure 5-20).

The hull was fastened by lacing and dowelling. The lacing holes, measuring about 1.5 cm in diameter, were set in pairs about 7 cm apart on either end of the lugs. As with previous examples of Southeast Asian laced planking, these pass through the inner surface of the planking to the seam in L-shaped holes. A close-up photograph shows two planks joined with the lacing holes on each plank roughly aligned (Figure 5-21). A strip of wood about 3.5 cm in width was placed across the adjoining planks in between the pairs of lacing holes. The ligatures threaded through the holes passed over this strip.

The dowels were inserted into 2 cm holes. While spaced irregularly, they were set in a three-one-three-three-one pattern with the single dowels placed in between lugs (Manguin 2009:3, 6). With the increased number of dowels compared to earlier-dated laced and dowelled watercraft, Manguin proposes that the Punjulharjo Boat plank fastening was an intermediate stage that lead Southeast Asian boatbuilders to completely abandon the use of plank lacing.

The keel plank was carved from a single timber, and has a maximum width of 60 cm at midships (Manguin 2009:6; 2012:5). The thickness of the keel plank could not be

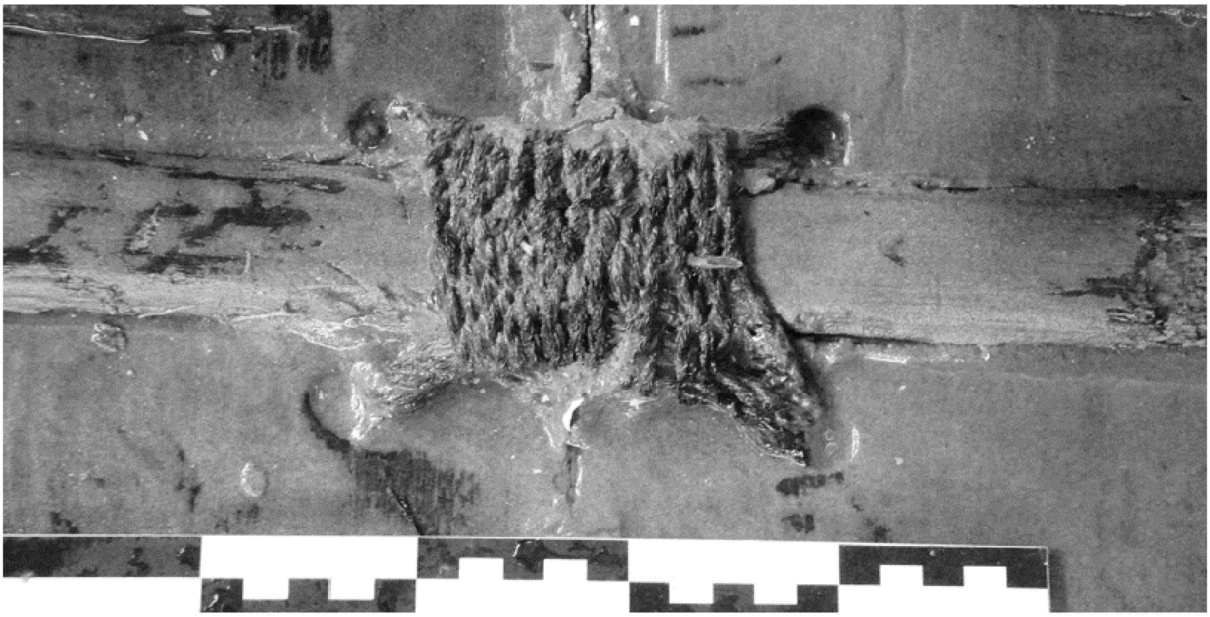

Figure 5-21. Close-up of Punjulharjo Boat plank lacing (Manguin 2012:Figure 7).

measured. There are five or six incomplete strakes on the either side (Manguin 2009:6; 2012:5). The strakes were each made from four planks joined with mortise-and-tenon scarfing (Manguin 2009:6). They measure approximately 5 cm in thickness and 40 cm in width amidships. Lacing and dowel holes on the upper edges of the fifth strakes indicate that the vessel had at least one additional strake.

There are 16 rows of single lugs on the keel plank and most strakes, each with two pairs of lashing holes that pass from the side to the top. The lugs are spaced about 50 cm apart except for a 75 cm gap amidships (Manguin 2009:6). The orientation of the frame timbers closest to the stern suggests a V-shape section. Based on scaled photographs, floor timbers were approximately 30 cm in width. These were set in the middle of the pairs of lashing holes. Unlike the examples depicted in drawings and photographs of other lashed-lug craft where the lashing is contained within individual lugs, the lashing of the Punjulharjo Boat frames were secured across two lugs on adjoining strakes. In effect, the lashing serves as a plank fastening in addition to the lacing and dowelling (Figure 5-22).

A strip of wood was placed on the frames so that the lashing passed over the strip rather than directly on top of the frame. Parts of the frames were also drilled with holes which were used to lash poles placed on top of the frames (and the strip) and were oriented longitudinally to the hull. These poles also had small pieces of wood on top where the lashing passed over. Shorter poles spaced closely together were then placed across the longitudinal poles, though it is not clear from the pictures as to where these were fastened. A photograph of the excavation shows another timber placed across these, then another. That portion of the boat appears to have at least five layers of criss-crossed timbers placed one over the other (Figure 5-23).

Planks in the fourth strake near what is thought to be the stern have a continuous lug that is similar to what has been observed in contemporary Indonesian boats, where it is used to support a small deck for the helmsman (Manguin 2009:6). This idea is reinforced by the presence of a quarter rudder mounting found just outside the hull near the stern (Figure 5-24), something similar to what can be found in contemporary Indonesian boats (Burningham 2000). The notches on this mounting indicate that two rudders were fitted to the vessel.

Wing end pieces were found fastened to the keel plank and the lower strakes on both the bow and the stern of the Punjulharjo Boat. The bow piece appears similar to the lower wing end of the Butuan Boat 5. The stern piece is much harder to discern while in situ (Manguin 2009).

The Punjulharjo Boat was dated to 1290 ± 40 B.P. (Beta-257670) or cal A.D. 660–780 (σ 2) by ^{14}C analysis performed on *ijok* rope fibres used for lashing (Manguin 2012:5, Table 1).

Figure 5-22. Punjulharjo Boat lashing used to secure a frame across two lugs on adjacent planks (Manguin 2012:Figure 8).

Lashed-lug watercraft with dowelled planking

Aside from the Butuan Boats, other evidence of lashed-lug watercraft with planks fastened exclusively by dowels have been found in Vietnam, Indonesia (Java Sea, north Sumatra), Hong Kong, and the Philippines (Sulu Sea and Zambales). They date from the ninth century to the sixteenth century.

Figure 5-23. The Punjulharjo Boat excavation (Manguin 2012:Figure 5).

Figure 5-24. Punjulharjo Boat, with the quarter rudder post just outside the hull, and behind the fence (Manguin 2009:1).

Chau Tan shipwreck (Vietnam), ninth century

The Chau Tang shipwreck is considered the oldest found in Vietnam, with cargo dating to the ninth century. It was one of three shipwrecks discovered in Quang Ngai Province along with the Binh Chau No. 1 and Bin Chau No. 2.

Recent examinations of this shipwreck's timbers have corrected earlier reports that implied its construction was Indian Ocean or Arabian in origin, and confirmed that is clearly a Southeast Asian lashed-lug boat with dowelled planks (Nishino et al. 2014:151).

Cirebon shipwreck (Indonesia), tenth century

The Cirebon shipwreck, also known as the *Nanhan* shipwreck, is a lashed-lug vessel with unusual and complex lug and strake patterns, and is by far the largest lashed-lug vessel found to date (Manguin 2012:4). It was found in the Java Sea by fishermen in 2003. Legal and ethical controversies accompanied the subsequent commercial salvage of its tenth century cargo, valued at US$80 million in 2010. Auctions of the entire lot of recovered items were organised by the Indonesian government but failed; the finds were eventually split between the salvage company and the Indonesian government. In the midst of this, the wooden ship that carried such valuable cargo has seemingly gone unnoticed (Liebner 2014; Mandari 2010). Parts of the hull had not even been exposed until 2 to 3 m high "piles of ceramics and debris" (Liebner 2014:243) were removed from what is thought to be the vessel's bow and where three iron anchors were found (Liebner

2014:243). Eventually, the surviving structure was exposed to reveal a lashed-lug ship with fifteen strakes on the starboard side and eleven strakes on the port side, all edge-joined with dowels. Horst Liebner's (2014) dissertation on the Cirebon shipwreck presents a level of detail on multiple aspects of the site, including ship construction, that is unparalleled in the Southeast Asian region, and certainly unexpected from a commercial operation.

The vessel lay on the seabed leaning at a 5 to 10 degree angle on its starboard side at a depth of 57 m (Liebner 2014:243). It carried a cargo composed of an estimated 600,000 pieces of tenth century stoneware and earthenware pieces, by far the most found in a shipwreck from that period; to compare, the ninth century Belitung shipwreck carried 100,000 pieces of ceramics (Liebner 2014:304). Other cargo on the Cirebon shipwreck included lapis lazuli, glassware, crystals, jewellery from gold, gems and beads, coins and silver, and other miscellany.

While the hull structure was left on the seabed when the project was abruptly suspended by the Indonesian government, a good deal of documentation using plotting software, photography, and videography was accomplished up to that point. Several timber fragments were also retrieved. These were the datasets that allowed Liebner to analyse the ship's construction.

One timber fragment that appeared to have been broken off from the bow was examined for species identification. A definitive identification was not reached, though several possibilities were put forward: these were *kempas* (*Koompassia malaccensis*), rosewood, (*Dalbergia sissoides*), and white siris (*Albizia procera*; Liebner 2014:244).

At the bow section, "the keel terminated in a bow-wing, or winged stem … [made from] a single, solid timber" (Liebner 2014:247–248). The keel and the wing end appear to either be scarf-joined, or else made from the same piece of wood. This was in contrast to previous examples such as the Butuan Boats where the wing ends were placed on top of the keel piece.

The individual strakes comprised of three to five plank pieces hook-scarfed and dowelled together at concentrated areas towards the ends of the vessel (Liebner 2014:248). The individual strake sections, as well as the incorporation of drop strakes, appear to have been used to accommodate a radical change in curvature towards the bow as the planks were carved to shape rather than bent (Liebner 2014:246–249). Evidence of crudely-shaped wooden bracing was found nailed to the planks at these scarfed joints on the "weatherside" surface, which are believed to be later additions probably in response to a weakening of the joints (Liebner 2014:249). On one particular hook scarf, Liebner noted "a rather tangled dowel placement that unquestionably had weakened the joints" (Liebner 2014:250).

Liebner (2014:250) classified the lugs used on the Cirebon into three types: type (i) on the lower hull planking, or strakes I–IX as well as the keel, were carved rabbets that ran continuously along the length of the planks through which sets of two pairs of L-shaped lashing holes were drilled, except for the thirteenth row of lugs (C-13) near amidships, that was not drilled with any holes; type (ii) on strakes X and XII where the lugs were joined with a central ridge, with two pairs of L-shaped holes drilled into the lugs as well as several drilled straight through the ridge; and type (iii) on the remaining strakes using "standard" lugs with two pairs of L-shaped lashing holes (Figures 5-25 and 5-26). None of the ligatures survived on the exposed shipwreck. The type (ii) planks are seemingly related to stringers that are lashed to the drilled ridges (Liebner 2014:262). Regarding the absence of lashing holes on C-13 type (i) planks, Liebner suggests two possible explanations. The first is that shipbuilders anticipated stresses at amidships that would make lashing here susceptible to breaking. The second is that it was intended to make this part of the vessel more flexible (Liebner 2014).

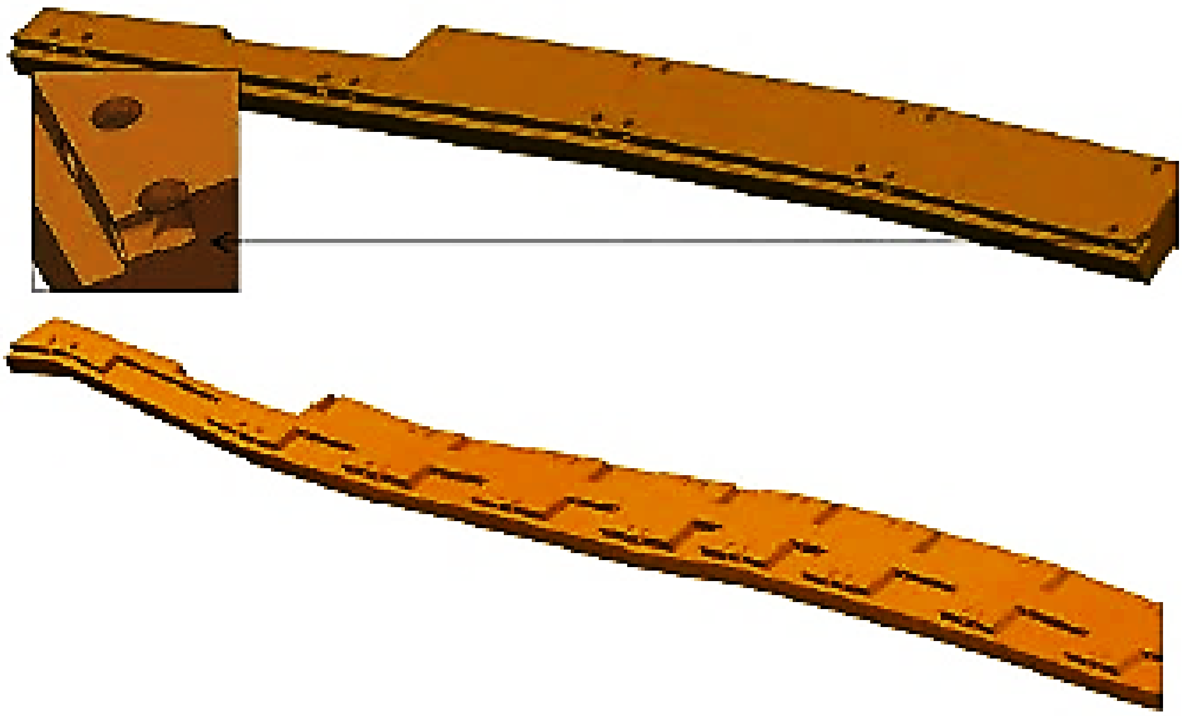

Figure 5-25. Cirebon planks types (i) (top) and (ii) (bottom; from Liebner 2014:Figures 3.2-28–29).

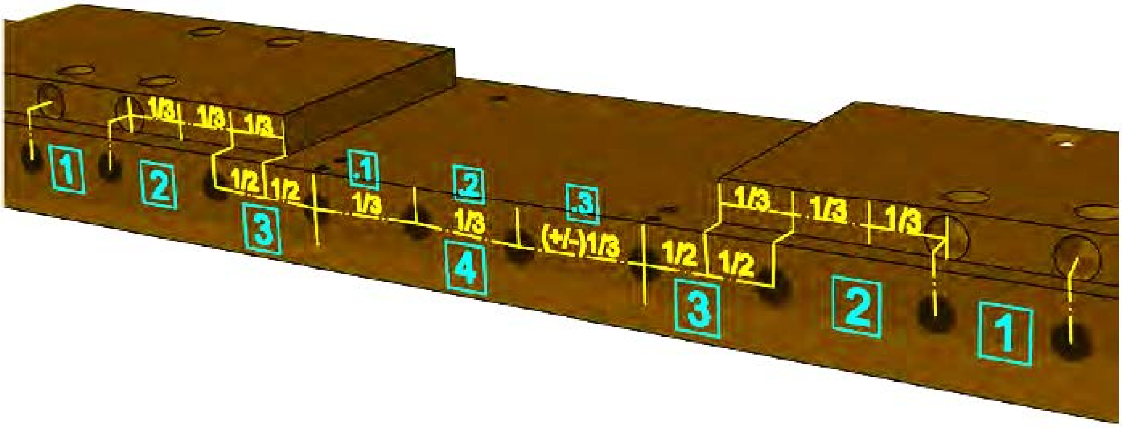

Figure 5-26. Cirebon type (iii) plank showing dowel arrangement (Liebner 2014:Figure 3.2-37).

On exposed planks, dowels on opposite edges of the same plank were positioned so that they almost aligned with each other. This in contrast to what Liebner (2014:251) had observed in contemporary boatbuilding in island Southeast Asia where dowels along opposite sides were staggered in order not to weaken the planks, and such as was observed in Butuan Boat 5 (Green and Clark 1993). The dowels were positioned in a complex pattern relating to the lugs (Liebner 2014:252). Locking pegs were used on select dowels, usually those positioned next to lugs. A number of scratch marks were found on the inner side of the planks corresponding with dowel positions. A pattern for regular dowel spacing was evidently used, based on at least one type (iii) plank fragment: four dowel holes were made along the length of the plank where a lug is positioned; the middle two dowel holes aligned with the lashing holes. Another four dowel holes were positioned on the plank edges between lugs (Figure 5-26; Liebner 2014:252).

Where planks were scarfed, the drilling of dowel holes was quite messy. Very closely spaced holes, in some cases intersecting, were drilled through the entire width of planks, even continuing through three strakes (Liebner 2014:252). Based on the presence of scratch marks that correspond with the holes, the shipbuilders positioned these dowel holes intentionally (Liebner 2014:252). Closely grouped dowels must have further weakened this part of the vessel along with the scarf joints. Tenons, or what Liebner refers to as square dowels, were also evidently used in a number of planks near scarf joints (Liebner 2014:254).

Several frames, floor timbers, and futtocks were retrieved during the salvage operation, and left to soak in a storage pool. According to Liebner, however, "none survived [the] closure of the warehouse throughout 2006, when one of the main storage pools partially dried” (Liebner 2014:255). Little in situ photography and video was taken of the frames, most of which had been damaged by the excavations. The evidence suggests a total of 24 frames, corresponding with the number of the rows of lugs. The frames were made of a floor timber scarf-joined to futtocks, but top timbers were not mentioned. They must have been secured to the lugs by the lashing holes, except on strakes I–IX of C13, which, as mentioned earlier, did not have lashing holes drilled through them. The frames also had lashing holes, probably used for complex lashing of additional components, as with the Punjulharjo Boat (see above; Liebner 2014:255). Evidence of stringers, beams and stanchions were found at the site, as well as a keelson so large that it might have been fashioned from a complete tree trunk (Liebner 2014:261).

Liebner assessed C13 to be the Cirebon’s amidships, dividing the vessel into fore and aft. The fore section is eight per cent longer, with 12 rows of lugs, and the shorter aft section had 11 rows of lugs “…due to the deterioration of the hull’s stern” (Liebner 2014:256–257). The shape of the vessel was narrower on the longer fore section and rounder on the shorter aft section.

Paya Pasir timbers (Indonesia), twelfth to fourteenth centuries

The Paya Pasir sand quarry site in Medan, north Sumatra is where disarticulated boat timbers, including a number that exhibit dowelled planking and lashed-lugs, were unearthed. Also found scattered at the site were numerous Chinese ceramics dating to between the twelfth and fourteenth centuries (Manguin 1989:206; 2012:Table 1; McGrail 2001). The site is thought to be the location of the old harbour of Kota Cina which is located nearby.

The site was heavily disturbed by quarry activities and by nearby residents, some of whom collected the exposed timbers for firewood, or as souvenirs. When staff from the *Pusat Penelitian Arkeologi Nasional* examined the site in 1988 and 1989, several years had passed from when the timbers were first unearthed. Many were further damaged from being exposed to the elements and left unprotected. Of the timbers that were in good enough condition to be examined, 17 were assessed to have been parts of one or more larger vessels based on their dimensions and quality. Five timbers were thought to be from smaller vessels, between 15 to 25 m in length. The remaining three timbers lacked diagnostic characteristics and could not be identified (Manguin 1989:207).

Among the timbers thought to be from a larger vessel, five were incomplete plank fragments. The longest measured 3.68 m; they reached a maximum of 37 cm in width and 7.5 cm in thickness (Manguin 1989:208; McGrail 2001:298–299). One plank ended with a stepped scarf. The dowel holes were 18 mm in diameter (McGrail 2001). Lugs measured 30 cm in length, 18 cm in width and 5 cm in thickness. Four lashing holes still held *Arenga pinnata* rope fibres (McGrail 2001:298). Frame timbers, comprised of floors and sides, were joined by simple scarf joints and each had a single dowel hole at the end. The dimensions of the frame timbers, measuring up to 20 cm across, suggest they supported a relatively large vessel, up to 30 m in length (McGrail 2001:299). One broken timber measuring 1.09 m in length was thought to be one end of a large keel piece attached by dowels to either planks or a wing end on top of it. It has a single lug which was drilled with two transverse holes (Manguin 1989:207–208).

Of the timbers from smaller vessels, none were of planking, and thus there was no evidence to show whether these were laced and/or dowelled, or if they were lashed-lug. Three were end pieces described as similar to the Butuan wing ends, a paddle, and part of a wooden anchor. The end pieces were described by Manguin (1989:207) as shaped as a "stepped stem (or stern) piece" which attached by dowels to the ends of planks, some 4.5 cm in thickness. One of the end pieces measured 85 cm in height and 1.45 m in length (Manguin 1989:207). The paddle was 1.17 m in length with its blade measuring 12 cm across (Manguin 1989:207).

Sha Tsui Boat (Hong Kong), thirteenth to fifteenth centuries

The remains of a dowelled and lashed-lug vessel were found during the construction of a quarry on High Island, Hong Kong in 1973 (Frost 1974:25; Horridge 1978:52; McGrail 2001:299), though the original reports published on the find only provided preliminary results (Frost 1974; Ho and Ng 1974). The Hong Kong Museum of History curator Brian Peacock later relayed his additional observations to Horridge (1978:52) and McGrail (2001:299). Strakes were comprised of planks joined by stop-splayed scarfs fastened by nail or treenail and a yellowish putty (McGrail 2001:299). A putty caulking was also applied on plank seams, before another plank layer was fastened using square-shank iron spikes (McGrail 2001:299). Both layers of planks measured 7.6 cm (3 in) in thickness, while dowels had varying sizes: those still joined to the planks were between 2.14 to 2.25 cm in diameter and 13 cm in length. Loose dowels, or possibly treenails, were 1.5–2 cm in diameter and more than 22 cm in length (McGrail 2001:299).

McGrail (2001:299) reports that a sample (HAR-867) was radiocarbon dated to AD 1220–1430, which is consistent with associated porcelains dating to the fourteenth to sixteenth centuries.

Gujangan shipwreck (Philippines), fifteenth to sixteenth centuries

The Gujangan shipwreck, located in the southern Sulu Sea off Gujangan Island in the Philippines was heavily looted in the 1990s (Cuevas et al 2004). The National Museum, collaborating with a private group headed by Brian Homan, attempted to examine the site more closely, though they were not successful (Brian Homan, personal communication 2011), and no official reports of the activities have been found. The site's location in a part of the country that has considerable security concerns must have contributed to the failure, and this still prevents archaeologists from revisiting the site today.

A number of looted objects, including Chinese trade porcelains dating to the fifteenth to sixteenth centuries, as well as several poorly preserved pieces of timber, were confiscated by authorities and are now stored at the National Museum. The timbers do not appear to have undergone any sort of conservation treatment. They are highly degraded and warped. They still provide, however, very clear evidence that the Gujangan vessel was a lashed-lug and dowelled boat. The holes in the one of the lugs are similar those of the Butuan Boat 5, that is, it drilled through from either side (Figure 5-27). This lug is carved in the form of a triangular prism, similar to Butuan Boat 5's plank 8. Another lug has holes that are drilled from the side and the top, similar to the rest of the lashed-lug Butuan Boats (Figure 5-28). The Gujangan timbers species have not been identified to date, and their level of deterioration today makes this problematic.

Figure 5-27. Gujangan shipwreck plank fragment with a lug drilled from side to side. Photograph by author.

San Isidro shipwreck (Philippines), sixteenth century

The San Isidro shipwreck was located in a 1996 magnetometer survey conducted by the National Museum and FEFNA in the waters of Playa Honda, San Isidro town,

Figure 5-28. Gujangan shipwreck plank with a rectangular lug and lashing holes drilled from the side to the top. Photograph by author.

Zambales, Philippines. It was found at a depth of 46 m below sea level and under more than 50 cm of sand, broken coral and volcanic deposits. The Chinese ceramic cargo recovered from the site was identified by ceramicists as typologically dating to the sixteenth century (Cuevas et al. 2004; Goddio et al. 1996).

Reports containing descriptions of the vessel and its construction are unclear and not easily understood, and it has been labelled both as a Southeast Asian vessel showing a Chinese influence in construction, and as a Chinese junk, in the same report (Goddio et al. 1996). The San Isidro shipwreck's hull was described as having "shallow lugs" as well as dowels (Santiago 1997). At the same time it was also reported that the vessel exhibited clinker construction (Santiago 1997), which is incompatible with dowelling; dowelling is used for edge-joining flush-laid strakes, while clinker construction by definition is made by overlapping strakes. Photographs of the site taken in situ seem to confirm both plank construction methods—in one picture it appears that two planks overlap with each other, while an adjacent plank also exhibits what appear to be dowel holes (Figure 5-29). The

Figure 5-29. San Isidro planks, overlapping in the foreground; a plank with a dowel hole in the background. Photograph courtesy of the National Museum of the Philippines.

San Isidro shipwreck then may very well show a variation of what has been described in Scandinavian watercraft construction as “half-carvel”, wherein the lower planks of the hull are joined by overlapping, and the upper strakes are edge-joined. While clinker construction is known in Southeast Asia, it is also not very common. It is more widely reported in South Asia (McGrail 2001; McGrail et al. 2003).

Though shallow lugs were said to be present on the keel and planks, photographs and drawings suggest that a continuous ridge, similar to that on the keel plank of Butuan Boat 5, was used only on the keel of the San Isidro hull. However, unlike Boat 5 where the ridge was the shape of a rectangular prism, the ridge of the San Isidro is a triangular prism (Figure 5-30; Goddio et al. 1996). No photographs or drawings depict lugs on other planks.

Wood samples from the San Isidro shipwreck were identified at FPRDI. Two samples from the keel timber were identified as *narra* (*Pterocarpus indicus*), while seven samples from an unspecified number of planks were identified as *molave* or *Vitex parviflora* (Goddio et al. 1996).

Fragmentary evidence of lashed-lug watercraft

The two examples below, from Thailand and Malaysia, are of lashed-lug vessels. But because of their fragmentary nature, their manner of plank fastening cannot be

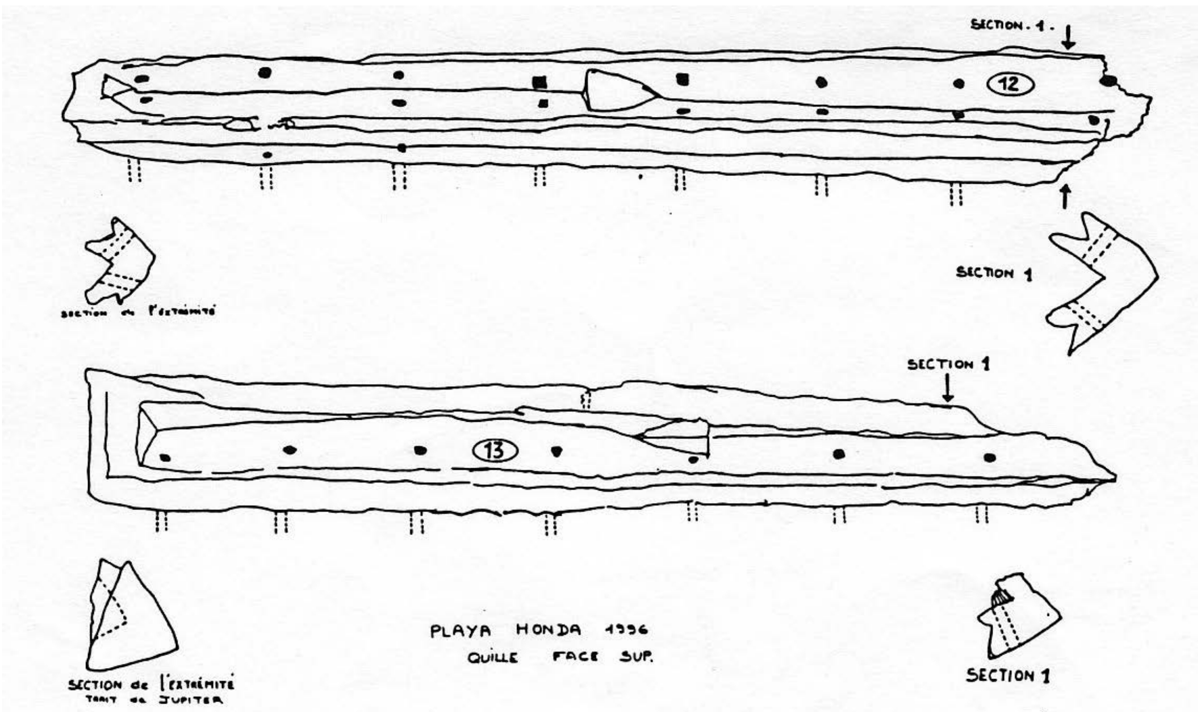

Figure 5-30. Triangular lug on San Isidro shipwreck planks (Goddio et al. 1996).

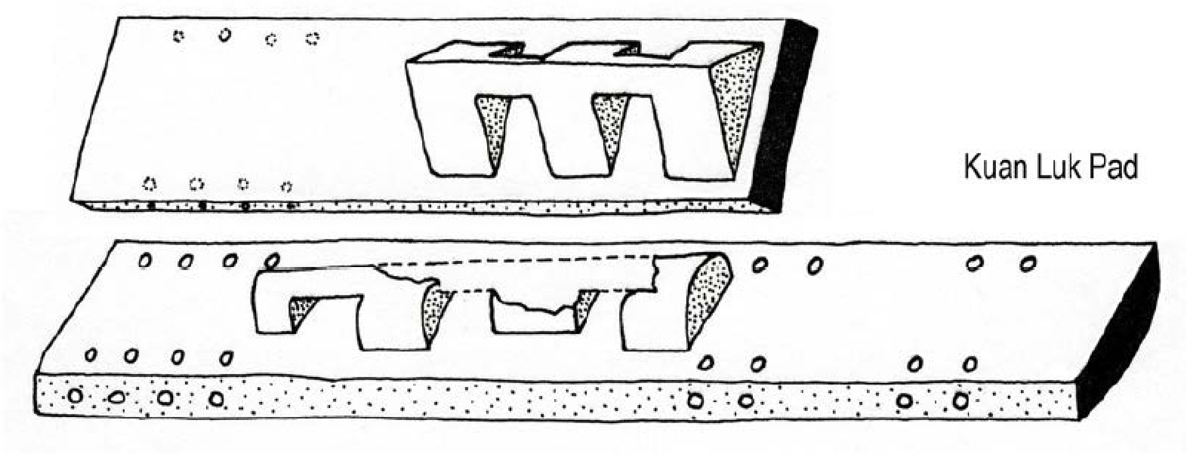

Figure 5-31. Kuan Luk Pad planks (Manguin 2012:Figure 2).

determined. One shows evidence of lacing, and the other shows dowelling. Both are dated to the middle of the first millennium. The presence or absence of supplementary fastening could have otherwise provided significant confirmation for or against prevailing thought regarding the development of planking techniques in Southeast Asia.

Kuan Luk Pad timbers (Thailand), fifth to sixth centuries

The badly degraded parts of at least one lashed-lug boat are stored at the Wat Khlong Tom site museum. These were examined by Manguin (2012) in 1985. The timbers, composed of plank fragments and a paddle, were said to have been recovered from the Kuan Luk Pad site in the Thai-Malay peninsula. The site is believed to be a bead production site dating between the fifth to sixth centuries. The lugs of this vessel are similar to the Pontian boat lugs. An illustration of two of the plank fragments shows one lug as shaped as a half-oblong cylinder with three large carved-out holes (Figure 5-31; Manguin 2012:Figure 2). This lug is narrower than the Pontian Boat lugs. The lug on another plank fragment, which is wider and shorter than the first, is in the shape of a triangular prism with two large holes carved out. There is no evidence of dowelling on the surviving fragments, though it is difficult to say with certainty given the small number of highly deteriorated planks. The only plank fastening shown in Manguin's (2012) drawing is of L-shaped lacing holes that pass from the side to the inner surface of the planks (2012). The plank with the rounded lug has four lacing holes to one side of the lug, and on the other side are two lacing holes, a gap, then another two lacing holes. The plank fragment with the triangular lug has four lacing holes set at a distance from the lug.

Jenderam Hilir timbers (Malaysia), fifth to seventh centuries

Loose fragments believed to be from two boats were found in a tin mining site in Salangor, Malaysia. One of the fragments showed evidence of dowelling, while another fragment exhibited lugs and dowelling. The first fragment (I-10757) was dated to 1470 ± 90 B.P. or cal. A.D. 465–665 (Manguin 2012; McGrail 2001).

Conclusion

While this chapter has demonstrated the inconsistencies in the quality of recording and reporting of Southeast Asian planked watercraft forming part of the archaeological record, it is also quite clear that the limited evidence points to related regional boatbuilding practices that are at the same time quite diverse. Edge-joined planks were fastened by a combination of lacing and dowelling, exclusively by dowelling, and in some cases with mortise and tenon joining. The lashed-lug tradition has been shown to take a variety of forms, with shapes and lashing holes differing, sometimes quite widely, from vessel to vessel. In the case of the Punjulharjo boat where a great many ligatures have survived, lashing could also be considered a form of plank fastening, in addition to securing frames, thwarts, and other boat components.

Chapter 6 Results of new research

Introduction

This chapter presents data collected during the 2013 fieldwork in the Philippines. The recovered Butuan Boats 1, 2 and 5 were measured and documented as they were exhibited or stored in Manila and Butuan. The fieldwork also allowed for observing the ongoing excavation of Boats 4 and 9. Archival photographs and drawings taken from previous research were consulted when needed. Gujangan Shipwreck planks, stored in Manila were also examined.

The account of the information follows certain conventions (Figure 6-1). None of the boats were intact, but in some cases one end of the keel plank (KP) was. It remained uncertain which side of the keel planks corresponded to port and starboard. In these cases, the intact keel piece was used as the zero point, with all longitudinal measurements taken from here. Keel plank lugs were used as references, by numbering them in rows sequentially from L1, onwards. On the planks presented in this chapter the individual lugs are numbered according to the row in which they align with the keel plank lugs. For example, L-7 in Figure 6-1 refers to a lug in the seventh row when counting from the intact end of the keel plank.

Strakes were assigned a side, either A or B; side A strakes (STR-A) were always those drawn below the KP, while side B strakes (STR-B) are above the keel plank in the timber plans. The strakes are further numbered relative to their position from the KP. The designation STR-B2, for example, refers to the second strake drawn above the keel plank (Figure 6-1). The lugs on the keel planks of Boats 1 and 2 were made up of sets comprising of one, two, or three protrusions. In case there are more than one protrusion in one particular lug on the keel plank, then they are numbered from the lower side of the drawing, up. To distinguish between them, they are counted from the bottom, up (in relation to the drawing). For example, KP-L5-3 refers to the fifth lug on the keel plank and the third protrusion from its lower side. All lashing holes on the lugs were measured from the end of the lug closest to the zero point, to the approximate centre of the hole (Figure 6-2).

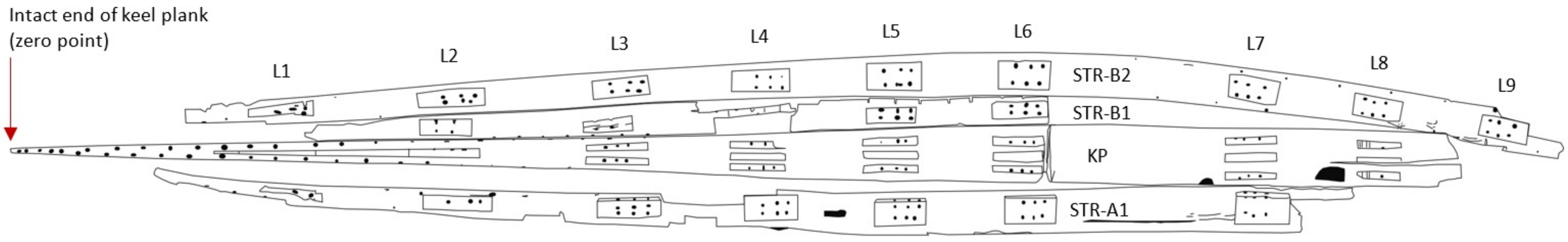

Figure 6-1. Strake and lug labelling conventions. Illustration by author.

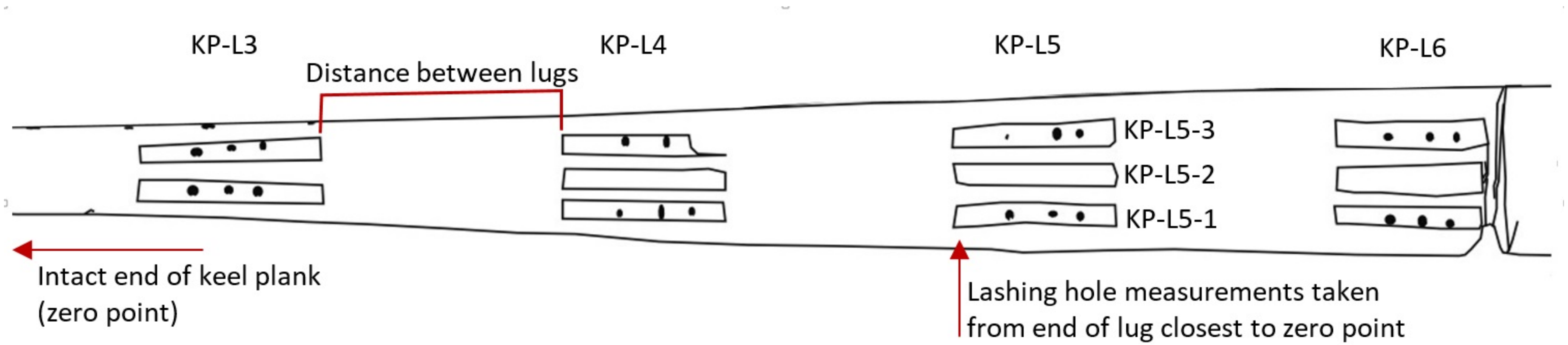

Figure 6-2. Keel plank lug and lashing holes measurement conventions. Illustration by author.

When the boats were recorded, Butuan Boat 1 was drawn with the intact keel plank end on the left, so measurements and lug sequences were taken from left to right with A-side strakes below and B-side strakes above the keel plank. Boat 2 was drawn with the intact end on the right, so measurements and lug sequences are numbered from right to left. But sides are treated the same: A-side strakes are drawn below the keel plank and B-side strakes above it. This however created an inconsistency in the recording of Boats 1 and 2 that were purposely not corrected at the time it was detected in order not to confuse timber sampling labels, field notes and other records. The collected and processed wood samples were labelled using the aforementioned timber plans and correcting the drawing so that zero points always started on the left would have led to errors elsewhere. Especially since the samples, using these numbers and records, were processed and analysed at two independent laboratories, the drawings were not amended. The results of wood identification and radiocarbon analyses are included below.

It must be noted that certain words are used with a specific meaning in mind. An "end" refers to a longitudinal termination of the boat, while a "side" refers to right or left side of the vessel in relation to its keel plank. Using "left" or "right" when referring to the timber plans is purposely avoided so as not to confuse readers who might understand these to mean "port" and "starboard" of the vessel. Instead, the admittedly more cumbersome terms such as "towards" or "away from" a particular reference point are used. "Amidships" and "midships" in this chapter refers to the broadest part of the hull, rather than middle of the vessel. In addition to construction features, this chapter will discuss the various tree species identifications from the Butuan Boats, their timber procurement areas, species distribution, characteristics, and common uses.

Butuan Boat 1

Recorded in 2013 at the Balangay Shrine, Butuan Boat 1 is composed of a keel plank with a wing end dowelled to its intact end. There is a single strake on one side, referred to here as STR-1A, and two strakes on the other, STR-B1 and STR-B2 (Figures 6-3). STR-1A and STR-1B are purposely not referred to as garboard strakes due to their possible rearrangement since excavation (as discussed in Chapters 2 and 5). Eight badly degraded and disarticulated fragments will not be discussed in depth, but their photographs are included for reference (Figure 6-4). It is also worth noting that some of the lashing holes

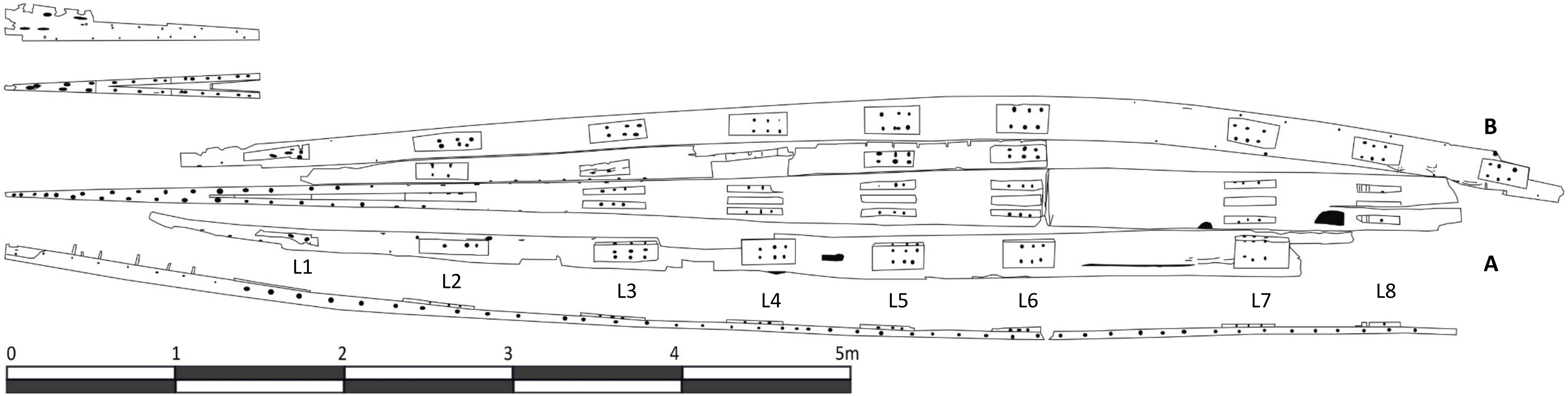

Figure 6-3. Butuan Boat 1 timber drawing from 2013. Illustration by author.


Figure 6-4. Butuan Boat 1 plank fragments. Photograph by author.

		L1			D	L2			D	L3			D	L4			D
		L	W	T		L	W	T		L	W	T		L	W	T	
KP	3	n.a.												41	4~5	1.6	57
	2	n.a.								37	4~6	1.5	54	41	4	1.6	57
	1	41	1	1	55	42	4~6	2	62	37	3~4	1.5	54	41	4~ 4.5	1.6	57
STR-A1		37	3~6	3	60	41	9	2~2.5	62	38	11	2.5	57	40	21	1.5	56
STR-B1		n.a.				31	10~ 11	n.r.	66	29	7~ 10	n.r.	56	39	4~5	n.r.	n.a.
STR-B2		38	6~9	2.5~3	61	40	9~ 11	3	63	34	12	3~ 3.5	53	43	14	3	52

		L5			D	L6			D	L7			D	L8			D	L9		
		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T
KP	3	39	4~5	1.6	56	37	5.5~6	1.5~2.5	131	39	5	2.5~3	64	43	3.5~5	2~ 2.5	n.a.			
	2	39	4	1.6	56	37	5.5~ 7.5	1.5~ 2.5	131	39	5~6	2.5~3	64	43	3.4~4	2~ 2.5	n.a.			
	1	39	4~ 4.5	1.6	56	37	4~5	1.5~ 2.5	131	39	5	2.5~3	64	43	4~6	2~ 2.5	n.a.			
STR-A1		37	15	3~3.5	58	38	17	3~ 3.5	130	41	17	3	n.a.				n.a.			
STR-B1		36~ 37	10	n.r.	56	42	11	n.r.	n.a.											
STR-B2		41	18	3	56	38~ 39	18~ 19	3	130	37~ 39	18~ 19	3	57	36	15	3	59	32	15	3.5

Table 6-1. Butuan Boat 1 lug dimensions (length [L], width [W], thickness [T]) and distance to next lug[D], measured from closest lug ends, in cm.

on the badly degraded lugs were made in pairs, which is in contrast to most of the other Boat 1 lashing holes, as discussed in this section. The manner in which the planks were displayed at the Balangay Shrine in 2013 differs from the original drawing that has appeared in several published papers (Peralta 1980a:44–45; Scott 1981:37). In the original drawing, the planks of two strakes are in different locations (Figure 2-7). A closer examination of the alignment of the lugs and dowel holes can help to confirm the original plank configuration. This was not attempted, however, due to time constraints. Regardless of the plank configuration, its keel plank suggest that Boat 1 is pointed and longer at one end, and shorter and broader on the other end. Using the plank configuration seen in 2013, the Boat 1 remains measure 10.2 m in length. What follows are more detailed descriptions of major Boat 1 components (measurements are also provided in Table 6-1).

Keel plank

The keel plank consisted of one single timber, is broken at one end, and measures 9.74 m in length. A sample from the keel plank, labelled OZQ841, was one of two collected from Boat 1 for radiocarbon analysis. The result was 1145 ± 25 B.P. ($\delta^{13}C$=-24.9 ± 0.4 ‰), or cal A.D. 777–947 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977). Carved from a tree of the *Shorea* genus (FPRDI sample WS-13-645), the keel plank's intact end is pointed, measuring 3 cm in width and 9.1 cm in thickness. It is rectangular in cross section, though it tapers slightly towards the bottom. It gradually broadens to a maximum of 38 cm in width, before slightly tapering to about 36 cm where it is broken. The keel plank's thickness at its edges, on the other hand, increases to 9.4 cm before gradually decreasing to an average of about 4.5 cm. A minimum of 3.8 cm in thickness was measured between KP-L4 and KP-L5 (Figure 6-3). The outer portion of the keel plank is convex, so it is slightly thicker at the centre than at the sides. Because the bottoms of the all planks were inaccessible, however, these measurements could not be taken. The inner surface is for the most part flat, except near the intact end, where it is carved to make a V-shaped section, and where the first lug is carved to make a W-shaped section (Figure 6-5). The keel plank has a slight rocker. It is most apparent from the third lug where it curves up almost 10 degrees to the intact end. The opposite broken end

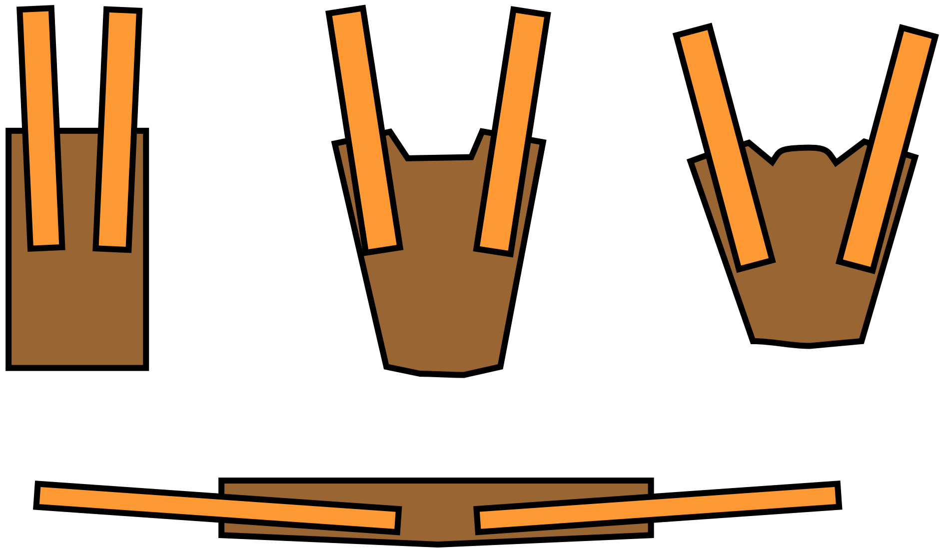

Figure 6-5. Sections of Butuan Boat 1 keel plank from the intact end until after the first lug (not to scale). Illustration by author.

shows much deterioration, as well as damage from hacking and chipping that probably occurred when pothunters unearthed the vessel. It is split longitudinally from just before the seventh lug to the far end. There is also a considerable fracture at KP-L6, across the width of the keel plank, as a result of hacking.

The keel plank of Butuan Boat 1 is rectangular in cross-section amidships, though it tapers slightly towards the bottom. Its top surface has two ridges making a W-shape, while its bottom surface was rounded and had no rabbets. Instead, the top of the keel plank had chamfered corners to seat the garboard strake (Figure 6-6).

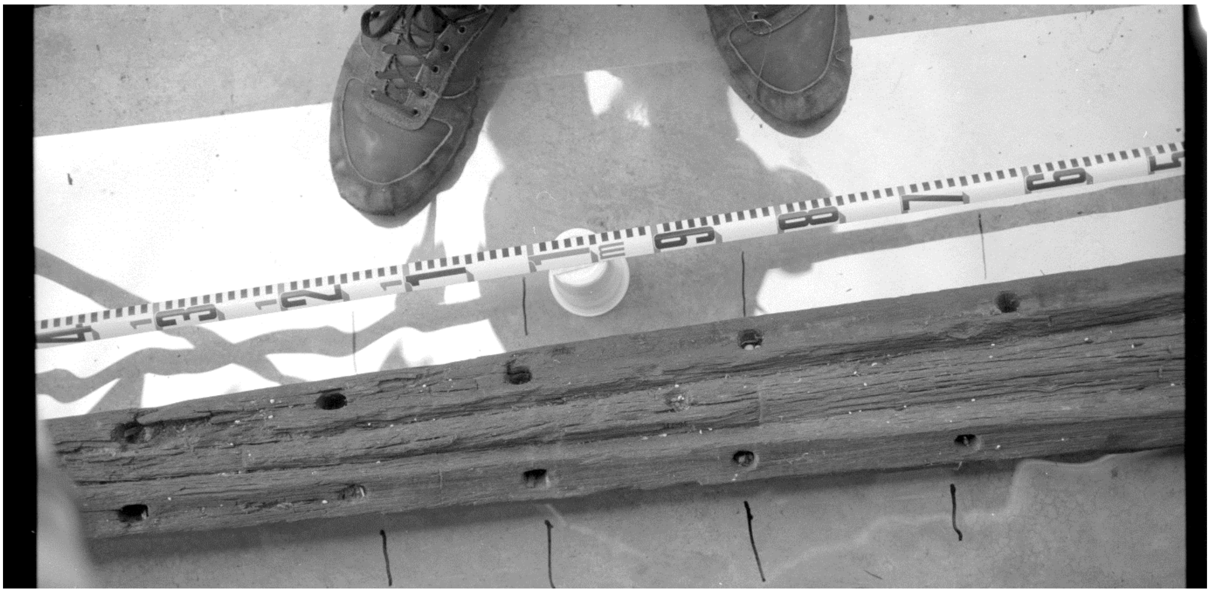

Figure 6-6. Butuan Boat 1 keel plank at Lug 1 showing the longitudinal ridges. Photograph courtesy of the Western Australian Museum.

The garboard strakes of Butuan Boat 1 were set flush to the keel, and edge-joined with wooden dowels. The shape of the keel plank changes from its rectangular cross section amidships towards the intact end; it first changes into a Y-shaped section with chamfered rabbets and then to a rectangular shape without chamfered edges at its very extremity where it meets the wing end. It was here that the wing end piece was fastened to the keel plank.

At the intact end, for about the first 50 cm, dowel holes measuring about 3 cm in diameter were drilled vertically down from the top of the keel plank. Then, as the keel plank widens, and splays outward into a Y-shaped section, the dowel holes were drilled diagonally into the keel plank. Their directions then become nearly horizontal as the chamfered edges of the keel plank gradually widen and flatten after the first lug, i.e. where the keel is rectangular in section. The first five dowel holes on top of the keel plank are spaced 5 to 7 cm apart. The next dowel holes transition from the top to both side edges of the keel plank. These are generally 16 cm to 21 cm apart, but at times as much as 28 cm, and as little as 9 cm. It does not seem that the boatbuilders used a template for positioning them. Neither does there appear to be a correlation between dowel holes and the position of the lugs. The dowel holes on either edge of the keel plank are mostly staggered, but some are just barely so. Roughly one-third of the dowel holes were locked by pins, and again, it does not seem that a pattern was used for this, either.

Figure 6-7. Examples of worn and damaged lugs and lashing holes on Butuan Boat 1. Photograph by author.

The dimensions and descriptions of the keel plank lugs present their preserved dimensions because many of them are badly worn (Figure 6-7). Thickness and lashing hole measurements reflect this especially. The lashing hole positions are measured from their centre to the end of the lug or protrusion that is closer to the intact keel plank end. Regarding the keel plank lugs with three protrusions, the middle ones were carved along the centre of the keel plank, while the two outer protrusions were set 4 cm to 8 cm from the edges of the keel plank.

Moving from the intact end of the keel plank are six sets of lugs, KP-L1 to KP-L6, that are spaced between 54 cm to 64 cm when measured from the closest ends of adjacent lugs (Figure 6-2). The boatbuilders left a 1.31 m gap between KP-L6 and KP-L7 near the widest part of the keel plank, which measures about 40 cm in width. KP-L7 and KP-L8 are spaced about 60 cm apart. At this point the keel plank is about 35 cm in width.

KP-L1 is situated 1.35 m from the end of the intact end of the keel plank. It is a single, narrow, and shallow lug measuring about 41 cm in length, 1 cm in thickness and 1 cm in width on one end and 3 cm in width on the other. KP-L1 has a dowel hole measuring about 2 cm in diameter, located 35 cm from the outer end of the lug.

The next keel plank lug, KP-L2, is 55 cm from KP-L1. It is also a single lug, is 42 cm in length, 4 cm in width at one end, 6 cm in width at the other, and 2 cm in thickness. Three lashing holes measuring about 1.5 cm in diameter on KP-L2 were drilled from side to side. The lashing holes here and on all other lugs are not evenly arranged or centred but instead favour the end away from the wing end. They were drilled at distances of 16.5 cm, 27.5 cm and 34 cm from the end of the lug.

KP-L3 is 62 cm from KP-L2. It is composed of two protrusions that are set side-by-side. They measure 37 cm in length and 1.5 cm in thickness. One of the protrusions, KP-L3-1, is slightly narrower, measuring 3 cm and 4 cm in width compared to KP-L3-2, that measures 4 cm to 6 cm in width. Both protrusions are drilled with three L-shaped lashing holes that pass from the top and outer sides of the lug. KP-L3-1 lashing holes are drilled at 11 cm, 18.5 cm and 24 cm from the end while KP-L3-2 lashing holes are 11 cm, 18.5 cm and 25 cm from the end. All KP-L3 lashing holes are about 1.5 cm in diameter.

The succeeding keel plank lugs are composed of three protrusions, each generally measuring the same length and thickness, but with varying widths. They were also drilled with three pairs of lashing holes from the sides and tops of the outer protrusions (Figure 6-8).

Figure 6-8. Example of Butuan Boat 1 keel plank lugs with three protrusions and three pairs of L-shaped lashing holes. Photograph courtesy of the Western Australian Museum.

KP-L4 is 54 cm from KP-L3. It is 41 cm in length and 1.6 cm in thickness. KP-L4-1 is 4 cm to 4.5 cm in width. The first two lashing holes are completely worn through the protrusion. The third lashing hole is preserved and measures less than 1.5 cm in diameter. The lashing holes are positioned 14.5 cm, 25 cm and 32.5 cm from the end of the lug. KP-L4-2 is 4 cm in width. KP-L4-3 is 4 cm to 5 cm in width, with the farther end no longer intact. All three of its lashing holes are worn through. These are positioned at 15 cm, 25.5 cm and 34 cm along the lug.

KP-L5 is situated 57 cm from KP-L4. It is 39 cm in length and 1.6 cm in thickness. KP-L5-1 is 4.5 to 5 cm in width. The lashing holes, which are all intact, are 1.5 cm to 2 cm in diameter and positioned at 18.5 cm, 24.5 cm and 31.5 cm, respectively. KP-L5-2 is 5 cm in width. KP-L5-3 is 4 cm to 5 cm in width. The lashing holes are 1.5 cm to 2 cm in diameter and are situated 18 cm, 26 cm and 32 cm on the protrusion.

KP-L6 was carved 56 cm from KP-L5. It is 37 cm in length and between 1.5 cm to 2.5 cm in thickness. KP-L6-1 is between 4 cm and 5 cm in width. None of its lashing holes, measuring about 2 cm in diameter and positioned at 18 cm, 21 cm and 27 cm along the protrusions, are intact. The second and third lashing holes, however, extend towards the

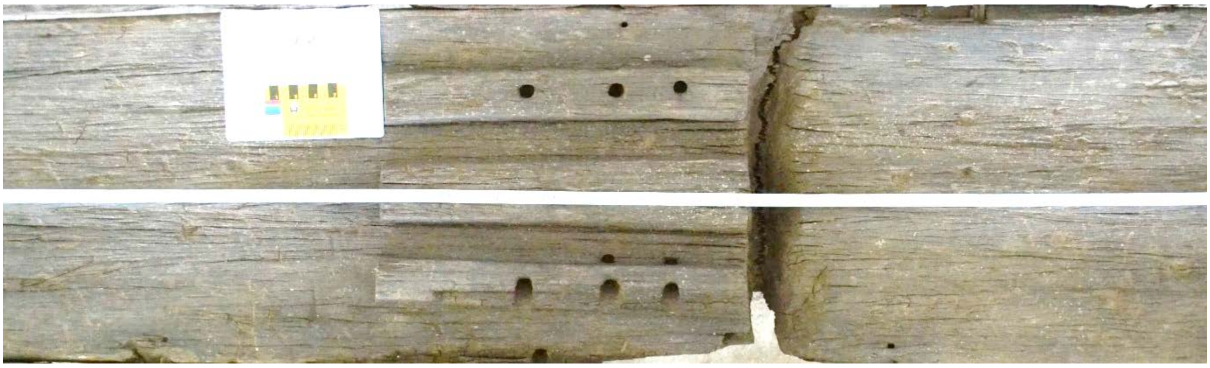

Figure 6-9. Lashing holes on Butuan Boat 1 keel plank lug 6 (KP-L6). Photograph by author.

centre of the keel plank from the sides (Figure 6-9). KP-L6-2 is between 5.5 cm and 7.5 cm in width. KP-L6-3 is between 5.5 cm and 6 cm in width. The intact lashing holes are about 1.5 cm in diameter and located at 13 cm, 23 cm and 30 cm from the end of the lug.

KP-L7 is 1.31 m from KP-L6. It measures 39 cm in length and between 2.5 cm to 3 cm in thickness. KP-L7-1 is 5 cm in width. The first lashing hole is worn through the side of the protrusion, but the second and third lashing holes have been preserved. They are 2 cm in diameter and situated at 12 cm, 19 cm, and 26 cm. KP-L7-2 is 5 cm to 6 cm in width. KP-L7-3 is 5 cm in width. All of the original lashing holes, measuring 1.5 cm in diameter, are damaged, but the second and third lashing holes were extended to the inner side of the protrusion and can still be utilised (Figure 6.10). The holes are located at 7.5 cm, 15 cm, and 26.5 cm along the lug.

KP-L8 is badly damaged, as is much of the surrounding portion of the keel plank. It is 64 cm from KP-L7, is 43 cm in length and between 2 cm to 2.5 cm in thickness. KP-L8-1 is 4 cm to 6 cm in width. The first two lashing holes, positioned at about 6 cm and 15 cm are completely worn through at either edge of the protrusion, leaving 4 cm and 2 cm breaks. The third lashing hole, at 25 cm, is about 2 cm in diameter. KP-L8-2 is 3.4 cm to 4

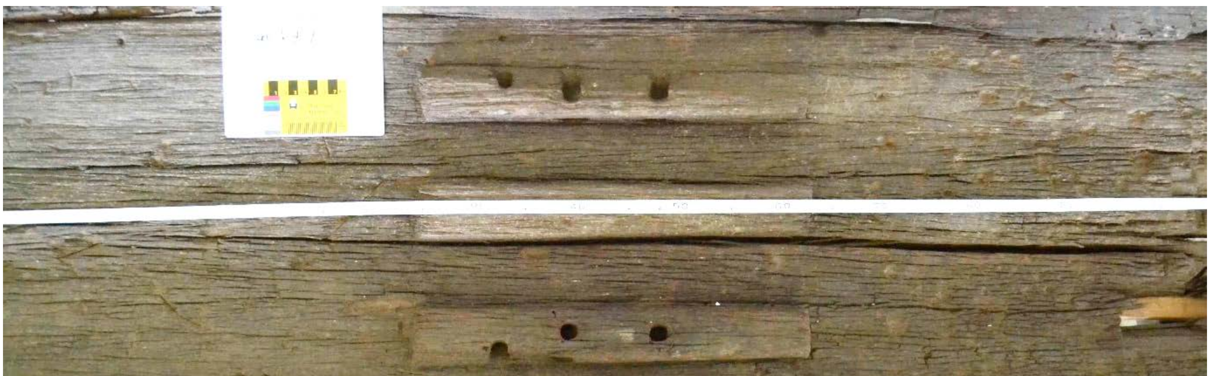

Figure 6-10. Lashing holes on Butuan Boat 1 keel plank lug 7 (KP-L7). Photograph by author.

cm in width. KP-L8-3 is 3.5 cm to 5 cm in width. The lashing holes are at 7.5 cm, 15.5 cm and 25 cm, with the first two completely worn through the width of the protrusion and leaving breaks of 2 cm and 3 cm. The third lashing hole, which is 2 cm in diameter, is almost worn completely, and also extends through the entire width of the protrusion.

The keel plank lugs of Butuan Boat 1 were fashioned as relatively narrow protrusions. The first lug with a single protrusion was not used for lashing but did have a dowel or treenail hole, the purpose of which has not been determined. The remaining lugs were drilled with three pairs of L-shaped lashing holes on the outside edges of the protrusions. The middle protrusions of lugs L4 to L8, thus do not seem to serve a specific purpose other than as seating or support for frames.

Strake A1 (STR-A1)

Strake STR-A1 is the bottom-most strake fragment as depicted on the timber plan. It is unknown if this timber is in fact the garboard strake, or was positioned elsewhere in the hull. This strake consists of one plank with seven lugs and measures 8.12 m in length. It tapers in width towards its end and seems to curve away from the keel plank. There may be a recess between L3 and L4 but that cannot be determined. The timber was identified as a *Shorea*-species tree (WS-13-646). Much of the strake is damaged and degraded, especially at the ends. STR-A1 was carved to between 3.2 cm to 4 cm in thickness. Near the first lug, STR-A1-L1, it appears the strake was prepared with a scarf to join either the next strake (possibly STR-A2), or a drop strake (Figure 6-11). Dowel holes along the edge of the strake are generally positioned between 16 cm to 20 cm apart, but some are as close together as 10 cm, while others are as far as 23 cm. Only a small

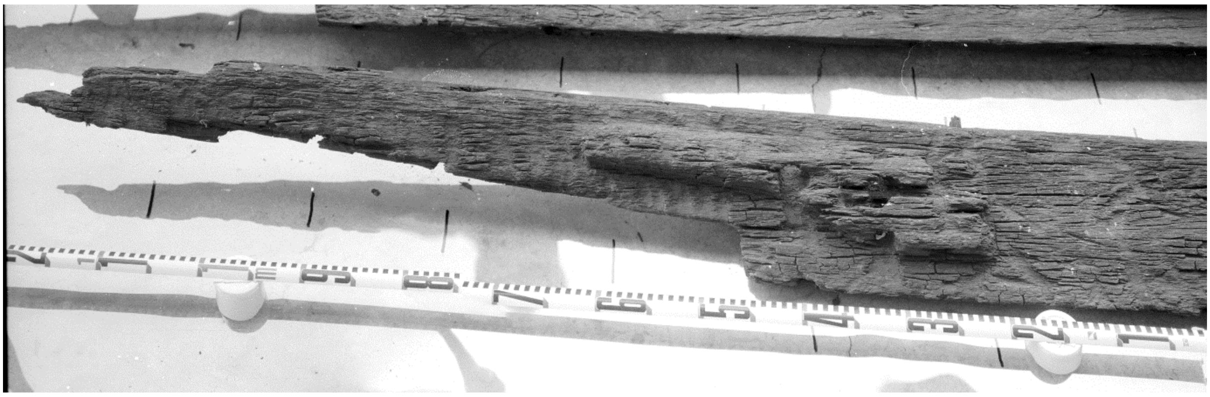

Figure 6-11. Butuan Boat 1 Strake A-1 (STR-A1) possible scarf end. Photograph courtesy of the Western Australian Museum.

number of the dowels were locked in place by pegs, similar to the pegged mortise-and-tenon joinery seen in ancient Greek and Roman ships (Steffy 2012:39–78, 276, 297).

About half the length of the first lug STR-A1-L1 is along the aforementioned scarf seam, and its shape is adjusted to accommodate the scarf in the timber. The lug is located on the interior surface of the strake 65 cm from its end. The lug measures 37 cm in length, its width is 3 cm to 4 cm on one end, 6 cm on the other, and 3 cm in thickness. It has two badly damaged lashing holes, both drilled from the top, as well as completely through both sides, that are 3 cm to 4 cm in diameter. They are situated 22 cm and 33 cm along the lug, respectively.

STR-A1-L2 is 60 cm from the first lug. It is 41 cm in length, 9 cm in width, and 2 cm to 2.5 cm in thickness. It has three lashing holes, which are drilled from the top and through both sides. Lashing holes are located at 15 cm, 28 cm, and 34 cm along the lug and measure about 2 cm in diameter.

STR-A1-L3 is situated 62 cm from the second lug. It is 38 cm in length, 11 cm in width and 2.5 cm in thickness. Three pairs of L-shaped lashing holes with a diameter of about 2 cm are placed at 12 cm, 21.5 cm, 30 cm along the lug.

STR-A1-L4 is 57 cm away from the third lug. It is 40 cm in length, 21 cm in width, and 1.5 cm in thickness. Three pairs of lashing holes, all 1.5 cm in diameter, were drilled at 12.5 cm, 24cm , and 30 cm along the lug.

STR-A1-L5 is 56 cm from the fourth lug. It is 37 cm in length, 15 cm in width, and 3 cm to 3.5 cm in thickness. This lug also has three pairs of lashing holes, all 1.5 cm in diameter, that were drilled onto the lug with the last pair misaligned. The first two pairs of holes were drilled at 15 cm and 24.5 cm from the end of the lug. The first of the third pair (bottom hole in timber plan) the is 33 cm from the end of the lug, while the other is at 29 cm.

STR-A1-L6 was carved 58 cm from the fifth lug. It is 38 cm in length, 17 cm in width, and 3 cm to 3.5 cm in thickness. The three pairs of lashing holes, measuring 1.5 cm in diameter, are misaligned. The three on the side farther from the keel plank measured 13 cm, 21 cm, and 27.5 cm from the end of the lug, while the other three were drilled 14 cm, 22 cm, and 29 cm. away.

STR-A1-L7 is 1.3 m from the sixth lug. It is 41 cm in length, 17 cm in width, and 3 cm in thickness. The three pairs of lashing holes, measuring 1.5 cm in diameter, are spaced 8 cm, 14 cm, and 23 cm from the end of the lug. The three lashing holes closer to the keel plank were drilled from the top just 1 to 1.5 cm from the edge.

Strake B1 (STR-B1)

The strake referred to as STR-B1 in the timber plan is comprised of two separate planks. The first of these is unquestionably displayed in the wrong location. This is because its lug dimensions and number of lashing holes do not align or match with those on the keel plank and other strakes. It is also unlikely to have joined together with the second plank in the same strake, as the two were fashioned from different tree species. For the purpose of this project, and until their proper positions are determined, the labelling of this strake and its lugs will adhere to the current museum exhibit. The first plank fragment, closer to the intact end of the keel plank, is made from a *Vatica*-species tree, locally known as *narig* (WS-13-700). It is poorly preserved, with many cracks along the surface. Its measures 36 cm in length. One end of the plank is 11 cm in width, though this part is damaged. It reaches a maximum of 24 cm in width near the opposite end, where it is also broken, leaving a narrow strip of timber that includes a fragmentary lug, STR-B1-L4. This portion of the plank measures only 4 cm to 5 cm in width. Dowel holes were drilled between 14 cm and 20 cm apart, and there is no evidence that the dowels were locked in place with pegs. There are three lugs on this plank, each of which has only two pairs of lashing holes.

The first lug on this plank fragment is STR-B1-L2 (because it is aligned with the second lug of the keel plank). It was carved 68 cm from the preserved end of the plank. It measures 31 cm in length, and 10 cm to 11 cm in width. Two pairs of L-shaped lashing holes are 9 cm and 19 cm from the end of the lug. The two holes on the side away from the keel plank are worn completely through, while the other two are badly damaged but still intact. The lashing holes have a diameter of about 1.2 cm.

STR-B1-L3 was fashioned 66 cm from the first lug, STR-B1-L2. It is 29 cm in length and 7 cm to 10 cm in width. Two pairs of lashing holes are 8 cm and 16 cm from the end of the lug. As with the first lug, the lashing holes on the side away from the keel plank are completely worn, and the original surface of the lug has been chipped off.

STR-B1-L4 is located 56 cm away from the previous lug, and its length of 39 cm survives along the narrow remains of the broken plank. Its width is the same as the plank at this point, which is 4 to 5 cm., with a large crack that partially splits through its length. The two lashing holes, which are about 2 cm in diameter, are worn through from both sides and are located 8 and 17 cm from the end of the lug.

The second planking fragment of STR-B1 is 1.9 m in length and 18 to 20 cm in width. It is made from a different species than the other fragment in this strake, as this timber comes from *Shorea*-species tree (WS-13-647). The dowel holes of this plank are spaced between 16 cm and 22 cm apart. Most of the dowel holes on the edge of the lug that faces away from the keel plank have worn through the inner surface of the plank. Because of this, the frequency of locking pegs or their holes cannot be determined. On the opposite edge, evidence for locking peg holes is obvious on the first, fifth and seventh of the nine dowel holes.

STR-B1-L5 was carved about 55 cm from the edge of the plank. The lug measures 36 cm to 37 cm in length and 10 cm in width. Three pairs of L-shaped lashing holes were drilled 10 cm, 23 cm and 33 cm from the end of the lug, and are about 2 cm in diameter. The first two lashing holes on the edge facing away from the keel plank are completely broken, while the third is very nearly so.

STR-B1-L6 is 56 cm from the previous lug, L5. It measures 42 cm in length, and 11 cm in width, though it, and the plank it was carved from is broken at this end. The three pairs of lashing holes have survived, and were drilled at a distance of 14 cm, 25 cm and 35 cm from the end of the lug. The lashing holes measure about 2 cm in diameter.

Strake B2 (STR-B2)

According to the identification of a sample (WS-13-648) from STR-B2, it was fashioned from a tree known as *toog*, or *Petersianthus quadrialatus*, as was a dowel (WS-13-650) taken from next to STR-B2-L8. The plank measures 9.46 m in length, and has a pronounced curvature (Figure 6-3). When its lugs are aligned with the keel plank lugs, it is offset 1.03 m from the intact keel plank end. Here it is 9 cm in width, and 3.6 cm to 3.8 cm in thickness. This end near the first lug appears to have been prepared as either a flat or hook scarf, to join with a component towards the keel plank. It is more deteriorated than the rest of the plank. Dowel and locking peg holes are extremely worn here. Otherwise, this is the best preserved piece of Boat 1. Further down the plank, dowel holes measuring 1.5 cm to 2 cm in diameter are spaced between 20 cm to 23 cm apart, with evidence for locking pegs on almost half of them.

Figure 6-12. Butuan Boat 1 STR-B2-L1 on scarf end. Photograph courtesy of the Western Australian Museum.

As mentioned previously, STR-B2-L1 is badly damaged. Its shape was made to accommodate the flat or hook scarf form the plank takes at this point (Figure 6-12). It was carved 32 cm from the end of the plank, measures 38 cm in length, 6 cm to 9 cm in width, and 2.5 cm to 3 cm in thickness. It has four oddly-arranged lashing holes that measure 2 cm to 3 cm in diameter. The first is 18 cm from the lug end. The next two were originally carved side by side, both at 26 cm from the lug end. The next lashing hole is closer to the edge facing the keel plank at a 33 cm distance from the end of the lug, while the last is at a distance of 34 cm.

STR-B2-L2 is 61 cm from STR-B2-L1. Its dimensions are 40 cm in length, 9 cm to 11 cm in width and 3 cm in thickness. It has three pairs of L-shaped lashing holes, measuring 2 cm to 3 cm in diameter that are poorly aligned (Figure 6-13). The first pair are both 26 cm from the end of the lug, the next pair are along 37 cm and 36 cm, while the last pair are at 31 cm and 34 cm.

STR-B2-L3 is 63 cm from the previous lug. It measures 34 cm in length, 12 cm in width and 3 cm to 3.5 cm in thickness. Its three pairs of L-shaped lashing holes are about 2 cm in diameter. They are situated along the lug at 10.5 cm and 10 cm, 20 cm and 22 cm, and 26.5 and 29 cm, respectively.

STR-B2-L4 is 53 cm from STR-B2-L3. It was carved to a length of 43 cm, a width of 14 cm and a thickness of 3 cm. The L-shaped lashing holes are about 1.5 cm in diameter.

Figure 6-13. Butuan Boat 1 STR-B2-L2 misaligned lashing holes. Photograph by author.

The first pair of lashing holes is along 18 cm of the lug length, the second pair are at 29 cm, while the last pair is at 34 cm.

STR-B2-L5 is 52 cm from the preceding lug. Its length is 41 cm, width 18 cm, and thickness 3 cm. The lashing holes measuring 1.5 cm to 2 cm in diameter are likewise in three-pair sets. They were drilled along the following lengths of the lug: 13 cm and 11 cm, 22 cm and 25 cm, and 31 cm and 33 cm, respectively.

STR-B2-L6 was carved 56 cm away from STR-B2-L5. It measures 38 cm to 39 cm in length, 18 cm to 19 cm in width, and 3 cm in thickness. The first pair of lashing holes were prepared at 21 cm and 22 cm from the end of the lug. Of these, the hole facing away from the keel plank has worn through the edge of the lug. The second and third pairs were drilled at 21 cm and 24 cm, and 31 cm and 33 cm along the lug length, respectively.

STR-B2-L7 follows 1.3 m after the previous lug. It was carved to a length of 37 cm to 39 cm, a width of 16 cm, and a thickness of 3 cm. The three lashing hole pairs measure 6 cm and 4 cm, 15 cm and 13 cm, and 23 cm and 26 cm along the length of the lug. Their diameters were measured to between 1.5 cm to 2 cm.

At 57 cm from the seventh lug, STR-B2-L8 was prepared to the following dimensions: 36 cm in length, 15 cm in width, and 3 cm in thickness. The lower-right corner of this lug is poorly preserved and splintered. The three pairs of lashing holes measuring 1.5 cm to 2 cm in diameter are best aligned than on other lugs from this plank. They were drilled at 7.5 cm, 15 cm and 24 cm, respectively.

The final lug, STR-B2-L9, is situated 59 cm away from the previous lug. It measures 32 cm in length, 15 cm in width and 3.5 cm in thickness. The lashing holes are between 1.5 cm to 3 cm in diameter. The first pair of lashing holes is nearly aligned at about 7 cm from the end of the lug. The second and third pairs are misaligned. They are situated at a distance of 15 cm and 13 cm, then at 22 cm and 26 cm from the lug end.

At this end of the plank, a preserved flat scarf follows the shape of the lug, rather than the other way around, as was done on the opposite end.

Wing end

The wing end, fashioned from a *Shorea*-species tree (WS-13-649), is 1.5 m in length (Fig. 6-14). Its bottom surface was fastened to the top of the keel plank with 19 dowels, all but one of which were locked into place with pegs (18 locking pin holes were counted). The dowel holes are about 2.5 cm in diameter, but some of them have elongated cross-

Figure 6-14. Butuan Boat 1 wing end. Photograph by author.

sectional shapes, i.e., they are not perfectly circular. Along its top surface are 24 dowel holes, some of which overlap, that were used to join it to either another end piece (as with Boat 5, see below), or with planking, as with the stemless planked watercraft described by some authors (Burningham 1990; Horridge 1986). At least 14 of the dowels were locked by pegs. The 8 dowel (or mortise) holes near the tip of the wing end are badly worn, and perhaps as a result of wearing their shapes are more oblong than round. Their dimensions range from 4 cm to 5 cm by 2 cm to 3 cm in section. The remaining holes are about 2 cm in diameter. A sample from the wing end was extracted for radiocarbon dating (OZQ842). The result was 1130 ± 30 B.P. ($\delta^{13}C$=-25.0 ± 0.1‰), or cal A.D. 777–988 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977).

Quarter rudder

On display with Boat 1 is the blade part of a quarter rudder (Figure 6-15). A National Museum accession code written on the rudder blade (X-86-I_2-1) suggests that it was recovered from a site in the Philippines' administrative Region X. This region included Butuan until 1995, after which, it became part of the newly created Region XIII. The "86" on the code indicates it was found at a site that was identified or reported in 1986, the same year that the ASEAN project took place in Butuan. For example, the Butuan Boat 5 site was first identified in 1985, and its site reference code is X-85-T_2. As for X-86-I_2,

Figure 6-15. Quarter rudder blade exhibited with Butuan Boat 1. Photograph by author.

records at the National Museum list this site as a gold-panning area. Peralta (1980b), however, reported that a paddle was recovered by the looters who unearthed Butuan Boat 1. This paddle may in fact be rudder X-86-I$_2$-1. A sample from this artefact was identified as *tambulian*, or *Eusidederoxylon zwageri*. The quarter rudder blade is about 1.4 m in length and has a maximum width of 28 cm. Six fastening holes, measuring about 1.2 cm in diameter, were drilled through its thickness and were used to fasten to a rudder shaft.

Butuan Boat 2

The reassembled Butuan Boat 2, as exhibited in 2013, closely corresponds to the drawing and photomosaic made in 1988 of the disassembled timbers (Figure 2-8; Clark et al. 1993). Many of the shorter timbers on one end of the boat, however, were not included in the 2013 display. This includes a small keel plank fragment with one set of double lugs. It was later learned that these additional pieces were in storage, but they have yet to be examined. According to measurements made in 2013, the remains of Butuan Boat 2 are at least 12.4 m in length (Figure 6-16). The display included a long portion of the keel plank, two strakes on one side and five strakes on the other, in varying degrees of intactness and preservation. The first two strakes on either side of the keel plank are the most complete. Because of the way Boat 2 has been reassembled, it was often difficult to take certain measurements of plank thickness, while dowel hole diameters and their arrangement were at times inaccessible. Some lashing holes were partially or completely blocked from view, but based on those that were visible, as well as older photographs, they are in generally much better condition than those on Butuan Boat 1. Except for some lashing holes on the keel plank lugs, most were drilled to make L-shaped holes measuring 1.5 cm in diameter.

There is no evidence that locking pins were used on Boat 2, with the exception of the wing end fastenings. Even here these are scarce. The keel plank, that likely includes the portion attached to the wing end, and all other planks, were fashioned from a tree known locally as *manggachapui* from the *Hopea* genus (WS-13-651–663, 665). The wing end was carved from a narra tree, or *Pterocarpus indicus* (WS-13-664). As discussed earlier, the conventions used for labelling Boat 2 components differ somewhat to that of Boat 1. The strake sides A and B are the same, indicating below and above the keel plank on the timber plan, respectively. The lugs, however, were numbered sequentially from

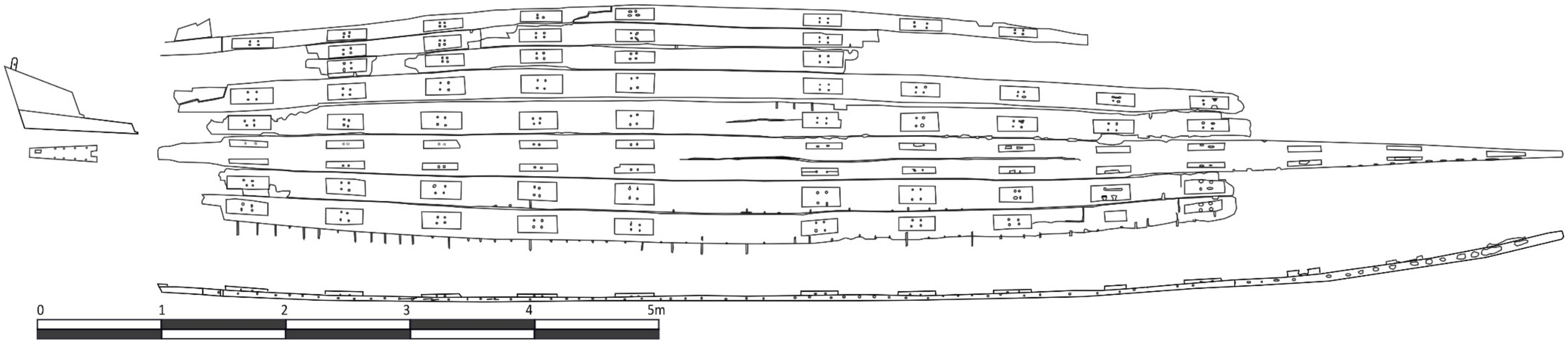

Figure 6-16. Butuan Boat 2 timber drawing. Illustration by Antonio Peñalosa and author.

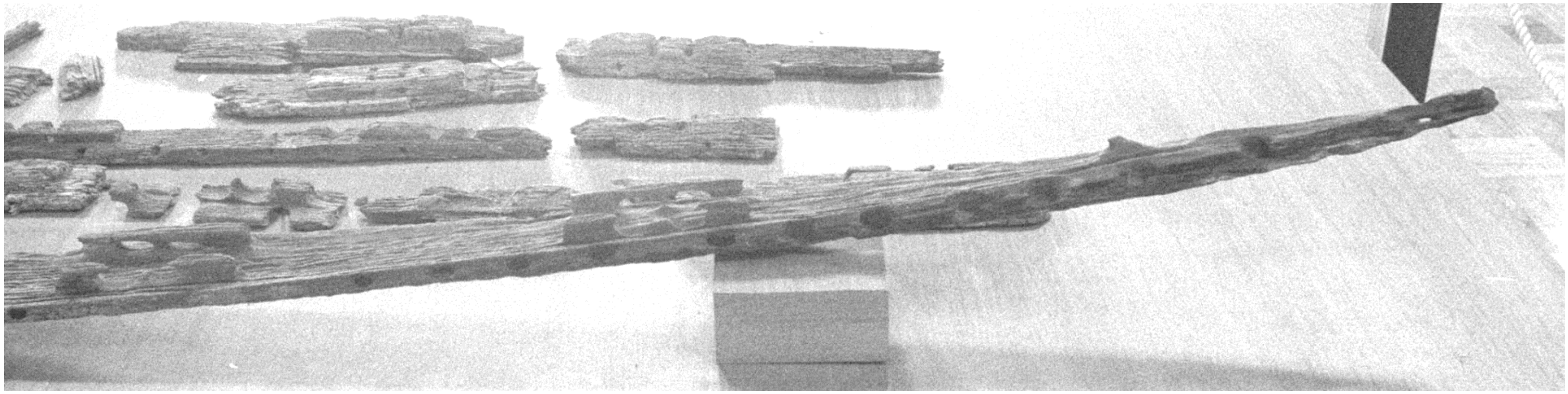
Figure 6-17. Fastening marks and recesses on the intact end of the Butuan Boat 2 keel plank. Also note the oblong-shaped lashing holes on the lugs. Photograph courtesy of the Western Australian Museum.

		L13			D	L12			D	L11			D	L10			D	L9			D	L8			D
		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T	
KP	2	32	4~5	3	46	31	6	3	46	29	6	3	49	30	5~6	2.5~3	46	31	6	3.5	120	29	4	2.5	46
	1	32	3~4	3	46	31	5	3	46	30	5	2.5	49	30	5~6	2.5~3	46	33	6	3.5	120	30	5	3	51
STR-A1		34	9	3	46	32	10~11	3.5	44	32	12	2.5	46	31	12	2.5	47	31	11	3	120	31	14	2.5	48
STR-A2		33	9~11	2.5	47	30	11~12	3	42	32	12	2.5	45	32	12	2.5	46	31	11	3	119	30	10	2.5	48
STR-B1		34	10	2.5	46	29	11	3	47	32	12	2	47	31	12~13	2.5	47	30	13	3	121	31	11	3	48
STR-B2		34	11	2.5	44	31	11	3	49	32	11~12	2	44	34	13	2.5	43	31	13~14	3	121	32	11	3	47
STR-B3		n.a.				31	9	3	(47)	32	8~9	2	45	34	10	2.5	43	32	8~9	2	120	31	11	2	n.a.
STR-B4		n.a.				31	8	3	46	30	8~9	2	(46)	34	8~9	2.5	44	32	8	2	120	31	11	2	n.a.
STR-B5		34	7	3	43	32	7	3	46	32	6~7	3	46	34	7	3	(43)	32	8	2.5	120	34	8	3	47

Table 6-2a. Butuan Boat 1: Lug dimensions (length [L] x width [W] x thickness [T]) and distance to next lug [D], measured from closest lug ends, in cm (continued next page).

		L7			D	L6			D	L5			D	L4			D	L3			D	L2			D	L1		
		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T		L	W	T
KP	**2**	29	5	3.5	52	28	4~5	3.3	50	28	5	4.3	48	30	4	3	50	27	4	4	52	28	2	3	n.a.			
	1	27	4	3.5	52	28	4~5	3.3	50	28	5	4.3	48	30	4	3	50	27	3	4	52	28	2	3	52	31	2.5~ 4.5	2.5
STR-A1		20	12~ 13	2.5	52	27	11	2.5	46	32	11	3	45	32	6~7	3	n.a.											
STR-A2		30	10	2.5	47	31	10	2	59	18	7	3	48	30	6~7	2	n.a.											
STR-B1		31	12~ 13	2.5	48	32	10	3	45	33	9~10	3	46	33	8	3.5	n.a.											
STR-B2		31	10	3	49	31	10	3	46	31	8	3	47	31	8	3	n.a.											
STR-B3		n.a.																										
STR-B4		n.a.																										
STR-B5		34	8~9	3	46	31	6	3	n.a.																			

Table 6-2b. Butuan Boat 1: Lug dimensions (length [L], width [W], thickness [T]) and distance to next lug [D], measured from closest lug ends, in cm (continued from previous page).

the intact part of the keel plank, or right to left of the drawing; their dimensions are provided in Table 6-2. The measurements of the lashing holes are also reported from right to left.

Keel plank

A sample from the keel plank (OZQ844) was radiocarbon dated to 1200 ± 30 B.P. ($\delta^{13}C$=-25.5 ± 0.1‰), or cal A.D. 715–940 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977). Consisting of a single timber, its condition is fairly degraded, and a substantial crack runs down the middle of it from KP-L5 to just before KP-L9. It is broken at one end, close to where the aforementioned keel plank fragment and the wing end were located in the excavation. It measured 11.3 m in length. The narrow, intact end is 4 cm in width and 6 cm in thickness, and curves upward at an angle of 9.4 degrees. The other end, where it is 4 cm in thickness and increases to 20 cm in maximum thickness, is slightly rockered and rises to just over 3 degrees. From about the fourth lug, the keel plank gradually widens. It reaches a maximum width of 33 cm just before the ninth lug. The keel plank's minimum thickness of 2+ cm at the edge is found between the eighth and twelfth lugs. Like Boat 1, however, the thickness at the centre of the plank was inaccessible, but is most probably thicker than the edges and has a convex bottom surface.

The intact end of the keel plank was difficult to assess in the exhibit. It appears to have traces of oblong-shaped depressions on its edges, rather than dowel holes. It also does not appear to have dowels on its top surface, nor other fastenings that may suggest it was joined to a wing end or an end post. Old photographs confirm this observation (Figure 6-17). Farther down at the part near the KP-L1 and KP-L2, the keel plank edge exhibits the same type of relatively large oblong-shaped recesses 4 cm to 5 cm wide, 2 cm to 3 cm high, and 2 cm to 3 cm deep. These were presumably fashioned to fix additional components by tenons. The recesses become progressively smaller near KP-L3 and KP-L4, where the plank thickness was reduced to 3 cm to 4 cm. Here, they appear more like dowel holes, but it is difficult to discern because they are badly worn. Near KP-L4, the edge becomes obscured by strake STR-A1 for most of the remainder of the keel plank's length, until after KP-L13. Here there are two broken dowels with a diameter of 1.5 cm, inserted through the 5.5 cm thickness of the keel plank. These dowels are angled slightly up from horizontal. Where the keel plank is broken, it has a width of 8 cm. The maximum width of 33 cm was reached near KP-L9.

Out of at least 14 original lugs, the keel plank that was on display in 2013 had 13 lugs—eight from the intact end, separated by a gap, then another five towards the opposite end. These are double-protrusion lugs, with the exception of the first, that is a single protrusion. The double lugs were carved approximately 4 cm from the edges of the keel plank, though this space at times was as little as 2 cm. Many of the lugs on the keel plank are badly degraded and lashing holes are sometimes obscured by frames that were specially fashioned for the exhibit (Figure 6-18). Where visible, most of the lashing holes on the keel plank lugs were drilled in a manner similar to the lugs of the Boat 1 keel plank, that is, L-shaped, drilled from the outer side and top surfaces. A considerable number, however, were drilled straight through either side of the lugs, and were rather large oblong holes (Figure 6-17). Unlike Boat 1, the lashing holes in Boat 2 were in sets of two per lug, rather than three. Lugs KP-L1 to KP-L8 are spaced approximately 50 cm apart. As with Boat 1, there is a gap along the widest part of the boat. In Boat 2, the gap is about 120 cm between lugs 8 and 9. The lugs KP-L9 to KP-L13 are spaced about 45cm apart.

Figure 6-18. Frames partially obscuring the lugs and lashing holes of Butuan Boat 2. Photograph by author.

KP-L1, a single lug, is badly damaged. In its current state, it measures 30 cm from the end of the keel plank, has a length of 31 cm, a width of 2.5 cm to 4.5 cm, and a thickness of 2.5 cm. Its lashing hole is not preserved, but it appears to have been a single large oblong-shaped hole (Figure 6-17).

KP-L2 is 52 cm from KP-L1. As with all the lugs that follow on the keel plank, it is composed of two protrusions. It is also badly damaged, and both protrusions had two oblong-shaped holes carved through them for lashing. Both protrusions share roughly the same dimensions of 28 cm in length, 2 cm in width and 3 in cm thickness. They are set 4 cm to 6 cm apart from each other. The next lug that follows this is KP-L3, 52 cm away.

The two protrusions of KP-L3, which are spaced 6 cm to 7 cm apart, measure 27 cm in length and 4 cm in thickness. KP-L3-1, the lower protrusion in the timber plan, is 3 cm in width, while KP-L3-2 is 4 cm in width. Two oblong-shaped lashing holes were carved through both protrusions and are now badly worn.

KP-L4 was measured at a distance of 50 cm from the previous lug. Both protrusions are about 30 cm in length, 4 cm in width, and 3 cm in thickness. They are set 7 cm to 9 cm from each other. The two oblong lashing holes that pass through each of the protrusions are about 4 cm in width.

KP-L5 is 48 cm from KP-L4. Its two protrusions were carved 9 cm to 10 cm from each other. They share the following dimensions: 28 cm in length, 5 cm in width, and 4.3 cm in thickness. The lashing holes were also rather large oblong shapes carved through both pieces.

The boatbuilders left a space of 50 cm before the two protrusions of KP-L6. These are situated 10 cm to 11 cm from each other, and share a length of 28 cm, a width of 4 cm to 5 cm, and a thickness of 3.3 cm. The oblong lashing holes pass through the sides of both protrusions, and range in size from 2 cm to 5 cm in thickness.

KP-L7 follows 52 cm after KP-L6. The two protrusions are set 13 cm apart and measure 3.5 cm in thickness. KP-L7-1 is slightly smaller at 27 cm in length and 4 cm in width, compared to KP-L7-2 which is 29 cm in length and 5 cm in width. The lashing holes of KP-L7-1 have a 2 cm diameter, and are L-shaped, drilled from the top and to the side. KP-L7-2 is badly preserved, and it is difficult to discern if the lashing holes were once L-shaped, or drilled straight through.

The protrusions of KP-L8 are slightly misaligned (Figure 6-19). KP-L8-1 is cracked, partially splitting through the centre of its lashing holes. It is 51 cm away from the previous lug, measures 30 cm in length, 5 cm in width and 3 cm in thickness. Its L-shaped lashing holes are 11 cm and 19 cm away from the lug end, and are about 1.5 cm in diameter. KP-L8-2 is 14 cm away from KP-L8-1, but offset towards the previous lug-pair KP-L7, only 46 cm away from it. It is 29 cm in length, 4 cm in width and 2.5 cm in thickness. Its L-shaped lashing holes, which are 2 to 3 cm in diameter, do align with those on the adjacent protrusion. These were drilled 11 cm and 20 cm away from the protrusion's edge.

A space of about 1.2 meters then separates KP-L9. KP-L9-1 is 33 cm in length, 6 cm in width and 3.5 cm in thickness. The inner left corner of this protrusion on the timber plan has been trimmed off. Its L-shaped lashing holes measure 1.5 cm in diameter and were drilled at 13 and 19 cm from the end of the lug. Spaced 12 cm across is KP-L9-2, which was carved to a length of 31 cm, a width of 6 cm, and a thickness of 3.5 cm. The L-shaped lashing holes have a diameter of 1.5 cm and were set from the end of lug at 13 cm and 18 cm.

The KP-L10 protrusions are set about 46 cm away from KP-L9, and 11 cm from each other. They are both 30 cm in length, 5 cm to 6 cm in width, and 2.5 cm to 3 cm in thickness. The L-shaped lashing holes measuring 1.5 cm to 2 cm in diameter were drilled 13 cm and 18 cm from the end of KP-L10-1, and on KP-L10-2 at 14.5 cm and 19 cm.

The pair of protrusions of KP-L11 follows the previous lug after 49 cm. They are set about 11 cm from each other. KP-L11-1 is 30 cm in length, 5 cm in width and 2.5 cm in

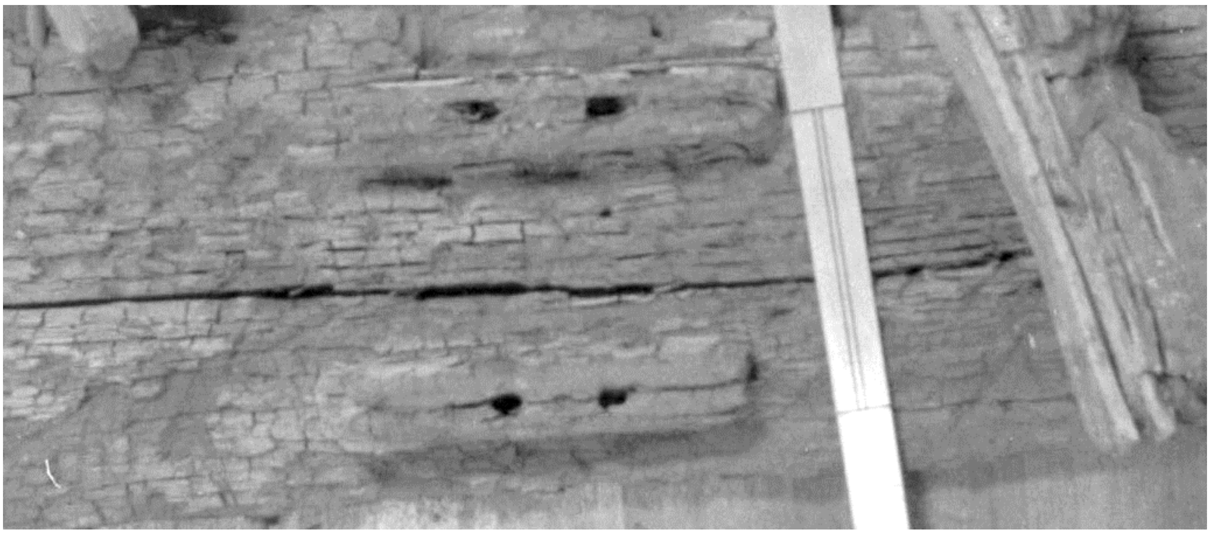

Figure 6-19. Butuan Boat 2 misaligned lug 8 on the keel plank (KP-L8). Photograph courtesy of the Western Australian Museum.

thickness. Its lashing holes are positioned along its length at 11 cm and 20 cm. KP-L11-2 is 29 cm in length, 6 cm in width and 3 cm in thickness. Its lashing holes were obscured from view and could not be measured.

KP-L12 is 46 cm away from KP-L11. KP-L12-1 is 31 cm in length, 5 cm in width and 3 cm in thickness. Its L-shaped lashing holes measured 1.5 cm in diameter and were drilled 13 cm and 18 cm along its length. Set 9 cm to 10 cm next to this is KP-L12-2, which shares the same length and thickness, but is 6 cm in width. The lashing holes here are obscured from view.

KP-L13 was the last keel plank lug pair in the exhibit, distanced 46 cm from KP-L12, and 58 cm from the broken end of the keel plank. The protrusions were carved to a length of 32 cm and a thickness of 3 cm. KP-L13-1 is 3 cm to 4 cm in width, while KP-L13-2 is 4 cm to 5 cm in thickness. None of the lashing holes on this lug pair could be accessed for measurement.

Strake A1 (STR-A1)

The garboard strake STR-A1 is composed of a single plank fragment that measures 8.25 m in length. It reaches a maximum of 24 cm in width, measured between the eighth and ninth lugs. It has ten lugs, with the first corresponding to the fourth lug of the keel plank. The inner corner of the plank on this end appears to have been intentionally cut, or prepared as a flat or hook scarf; the remainder of the plank at this end was broken off (Figure 6-20). The same was observed on the opposite end, but in that case, the scarf faces away from the keel plank. The thickness of the plank ranges between 2 cm to 4 cm. Lashing holes on the lugs all appear to have been fashioned in an L-shape.

Where STR-A1-L4, the first lug of this plank is situated, 6 cm from broken end, the plank measures 17 cm in width, and 3.5 cm in thickness. The lug STR-A1-L4 is 32 cm in length, 6 cm to 7 cm in width, and 3 cm in thickness. Through it are two pairs of L-shaped lashing holes, drilled 13 cm and 20 cm from the lug end. Three of them are worn and widened from use. The fourth measures about 1.5 cm in diameter.

STR-A1-L5 was carved 45 cm from SR-A1-L4. It measured 32 cm in length, 11 cm in width, and 3 cm in thickness. The two pairs of L-shaped lashing holes were drilled 13 cm and 21 cm from the end of the lug.

The next lug, STR-A1-L6, is 46 cm from STR-A1-L5. It measures 27 cm in length, 11 cm in width and 2.5 cm thick. The lug’s lashing holes were fashioned 10 cm and 14 cm

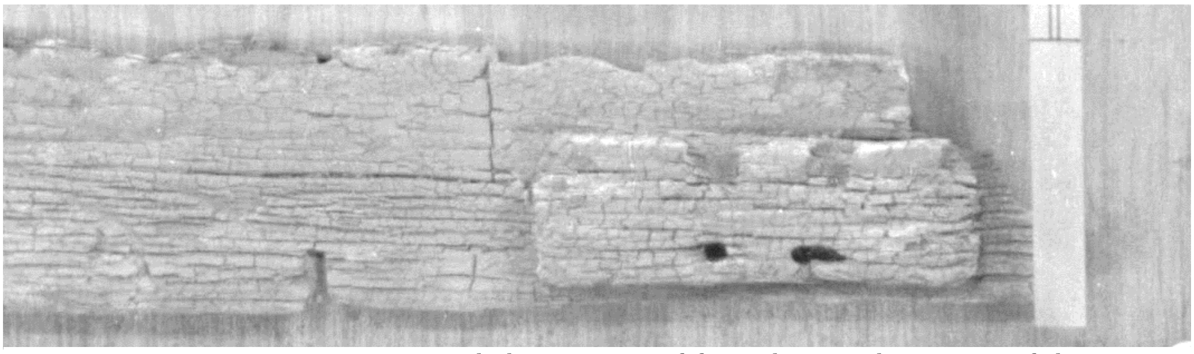

Figure 6-20. Butuan Boat 2 STR-A1 end showing a scarf face. Photograph courtesy of the Western Australian Museum.

from the end of the lug.

STR-A1-L7 is 52 cm further down. It measured 20 cm in length, 12 cm to 13 cm in width, and 2.5 cm thick. The two pairs of lashing holes measured 12 cm and 19 cm from the end.

STR-A1-L8 was 48 cm away, with a length of 31 cm, a width of 14 cm, and a thickness of 2.5 cm. The two pairs of lashing holes were measured from the end of the lug at 11 cm and 18 cm.

Between this and the next lug is a gap of 1.2 m. It is here that the plank reaches its maximum width of 23 cm. Its thickness here is only about 2 cm. STR-A1-L9 is a lug that measures 31 cm in length, 11 cm in width, and 3 cm in thickness. The two pairs of lashing holes were drilled 11 cm and 18 cm along the length of the lug.

The next lug along the plank was carved 47 cm farther down the keel plank. STR-A1-L10 has the following dimensions: 31 cm in length, 12 cm in width, and 2.5 cm thick. The two pairs of lashing holes are situated 12 cm and 19 cm from the end of the lug.

STR-A1-L11 is positioned 46 cm from the previous lug. It has a length of 32 cm, a width of 12 cm, and a thickness of 2.5 cm. The two pairs of lashing holes are spaced a little unevenly from the edge of the lug. The two holes facing away from the keel plank were drilled at 14 cm and 20 cm, while the other two are at 12 cm and 21 cm from the end of the lug.

STR-A1-L12 was fashioned 44 cm from STR-A1-L11. It measures 32 cm in length, 10 cm to 11 cm in width and 3.5 cm thick. The lashing holes are also uneven on this lug. The two holes facing away from the keel plank 12.5 cm and 20 cm from the end of the lug, while the other two were measured at 14 and 20 cm (Figure 6-21).

The final lug on this plank fragment is STR-A1-L13. It was set at a distance of 46 cm from the previous lug, and measures 34 cm in length, 9 cm in width, and 3 cm thick. The lashing holes here were completely blocked from view by framing in the 2013 exhibit, but 1988 photographs show them to be in good condition (Figure 6-21). This part of the plank, which is broken 9 cm from the lug, is 19 cm in width and 3.5 cm in thickness. There is also some damage to the plank on either side of the lug.

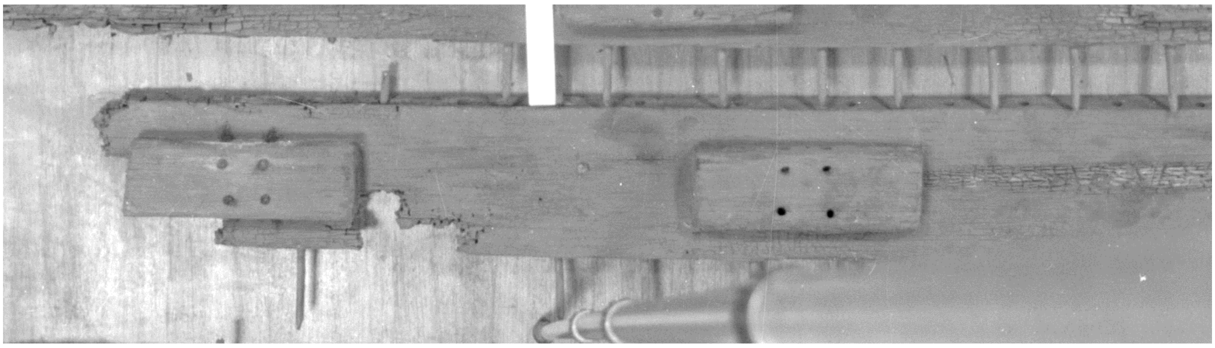

Figure 6-21. Butuan Boat 2 STR-A1-L13 (left) and STR-A1-L12 (right). Photograph courtesy of the Western Australian Museum.

Strake A2 (STR-A2)

The dowel holes on STR-A2 were the only ones accessible for measurements in 2013. They are about 1.5 cm in diameter and spaced 10 cm to 15 cm apart. The total length of this strake, composed of a single plank broken at both ends, is 8.37 m. The end closer to the first lug, STR-A2-L4, is 15 cm in width and 3 cm in thickness.

STR-A2-L4 is 11 cm from the end of the plank. Its dimensions are 30 cm in length, 6 cm to 7 cm in width, and 2 cm in thickness. The badly worn remains of two pairs of lashing holes were placed at 8 cm and 17 cm from the end of the lug.

STR-A2-L5 is 48 cm from SR-A2-L4. Only half of the lug has survived, the other half appears to have been carved or scraped off (Figure 6-22). What remains measured 18 cm in length, 7 cm in width and 3 cm in thickness. This surviving lug fragment has one pair of lashing holes, but these were blocked from view in 2013. Between this and the next lug, is a considerable crack that runs more than half the plank width, then down to the next lug.

STR-A2-L6 was carved 59 cm away from the previous lug. It is 31cm in length, 10 cm in width and 2 cm in thickness. Its lashing holes are 10 cm and 18 cm from the end of the lug.

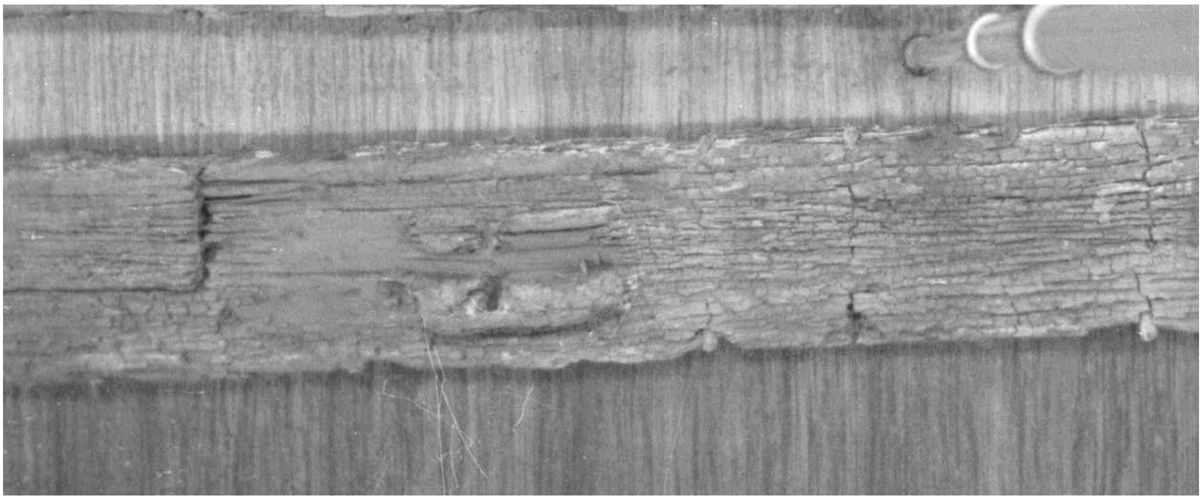

Figure 6-22. Butuan Boat 2 damaged STR-A2-L5. Photograph courtesy of the Western Australian Museum.

The next lug, SR-A2-L7, was carved after a space measuring 47 cm. It is 30 cm in length, 10 cm in width and 2.5 cm in thickness. The two pairs of lashing holes were set 12 cm and 19 cm from the end of the lug.

STR-A2-L8 was carved 48 cm away from the previous lug and has the following dimensions: a length of 30 cm, a width of 10 cm, and a thickness of 2.5 cm. Its lashing holes were drilled at 11 cm and 18 cm along the lug. The plank's maximum width is found between this and the next lug, where it measured 23 cm. The thickness here was between 2.5 cm and 3 cm.

STR-A2-L9 follows after a gap of 1.19 m. It has a length of 31 cm, a width of 11 cm, and a thickness of 3 cm. The two pairs of lashing holes measured 11 cm and 18 cm from the end of the lug.

The next lug, STR-A2-L10 is situated 46 cm farther down the plank, with a length of 32 cm, a width of 12 cm , and a thickness of 2.5 cm. The two pairs of lashing holes were drilled 12 cm and 19 cm from the end of the lug.

STR-A2-L11 was carved 45 cm from STR-A2-L10. It measured 32 cm in length, 12 cm in width and 2.5 cm in thickness, while its lashing holes were situated 13 cm and 19 cm along the length of the lug.

A further 42 cm down the plank is STR-A2-L12, a lug that is 30 cm in length, 11 cm to 12 cm in width, and 3 cm in thickness. The lashing hole pairs here are misaligned. The two lashing holes facing away from the keel plank are set at 11 cm and 17 cm from the end of the plank, while the other two holes are set closer to each other, or 12cm and 16 cm from the end of the plank.

STR-A2-L13 is the last lug of STR-A2. It was carved 47 cm from the previous lug, and has the following dimensions: a length of 33 cm, a width of 9 cm to 11 cm, and a thickness of 2.5 cm. The lashing hole pairs are slightly misaligned. The two facing away from the keel plank were measured 12.5 cm and 21 cm, while the other two were 13 cm and 20 cm away from the lug edge. At this point, the plank is 23 cm in width and 4 cm in thickness. In the 2013 exhibit, the plank terminates in a scarf, which is broken at the end and 20 cm from the last lug. Photographs taken in 1988 show an additional part of the plank partially dowelled to an adjoining plank by a hook scarf (Figure 6-23).

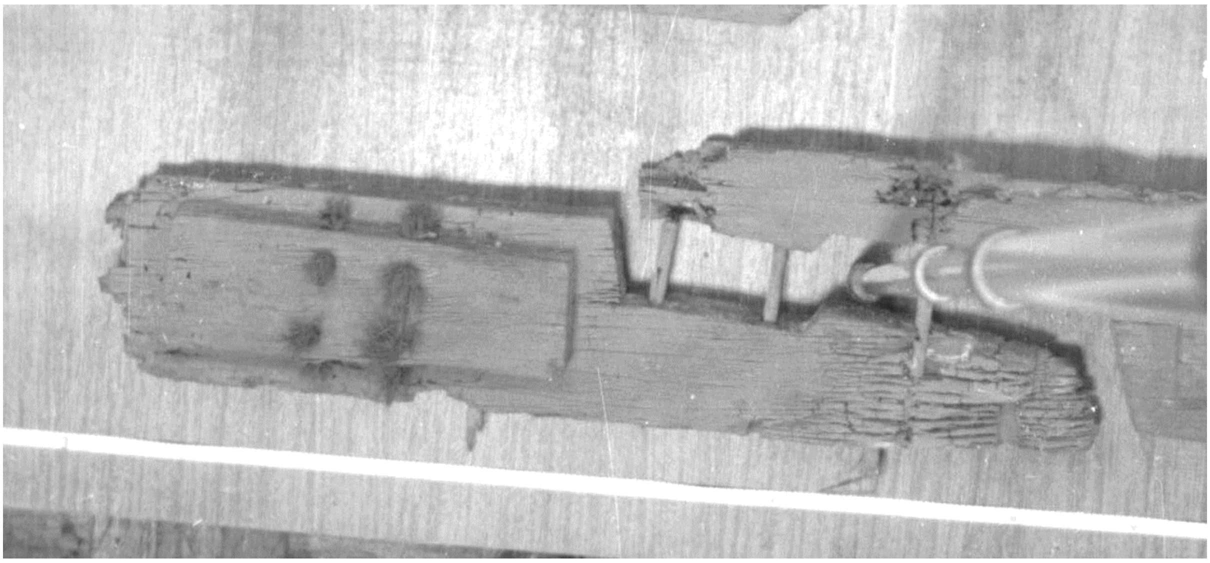

Figure 6-23. Butuan Boat 2 STR-A2-L13 with possible adjoining plank. Photograph courtesy of the Western Australian Museum.

Strake B1 (STR-B1)

The garboard strake STR-B1 is composed of a single plank 8.82 m in length. Near its first lug, STR-B1-L4, it measures 17 cm in width and 3.5 cm in thickness. Here, the outer corner of the plank exhibits a flat scarf that is broken at the end. The maximum plank width of 24 cm is found between the eighth and ninth lugs. The thickness here is between 3 cm and 3.5 cm.

Lug STR-B1-L4 was situated 17 cm from the end of the plank. It measures 33 cm in length, 8 cm in width and 3.5 cm in thickness. Its lashing holes are L-shaped and drilled to a diameter of 1.5 cm, and one of the the holes has been elongated by wear to about 4 cm.

Carved 46 cm down the plank is the next lug, SR-B1-L5. It is 33 cm in length, 9 cm to 10 cm in width, and 3 cm in thickness. The lashing holes were placed along the lug at 14 cm and 21 cm.

STR-B1-L6 was carved 45 cm away. It has a length of 32 cm, a width of 10 cm, and a thickness of 3 cm. Its lashing holes were drilled at 13 cm and 19 cm along the lug.

After a space of 48 cm is STR-B1-L7. It has the following dimensions: 31 cm in length, 12 cm to 13 cm in width, and 2.5 cm in thickness. Its lashing holes were drilled 14 cm and 19 cm from the end of the lug.

STR-B1-L8 follows after a space of 48 cm. It is 31 cm in length, 11 cm in width and 3 cm in thickness. Its lashing holes were placed 11 cm and 19 cm along the edge of the plank.

Following a gap on the plank of 1.21 m is STR-B1-L9. This lug has a length of 30 cm, a width of 13 cm and a thickness of 3 cm. Its lashing holes are situated along the lug at 15 cm and 19 cm.

STR-B1-L10 follows the previous lug after a 47 cm space. It was 31 cm in length, 12 cm to 13 cm in width, and 2.5 cm in thickness. Two pairs of lashing holes were drilled 14 cm and 18 cm from the end of the lug.

The next lug, STR-B1-L11 was carved 47 cm from the previous lug. It measures 32 cm in length, 12 cm in width, and 2 cm in thickness. Its lashing holes were 12 and 18 cm from the end of the lug.

STR-B1-L12 is situated 47 cm from STR-B1-L11. It was measured to the following dimensions: a length of 29 cm, a width of 11 cm, and a thickness of 3 cm. The lashing holes were drilled from the end of the lug at 12 and 16 cm. The part of the plank between this and the final lug of this plank, STR-B1-L13, has a considerable chunk of wood that is missing (Figure 6-24).

STR-B1-L13 is 46 cm from the previous lug. It measures 34 cm in length, 10 cm in

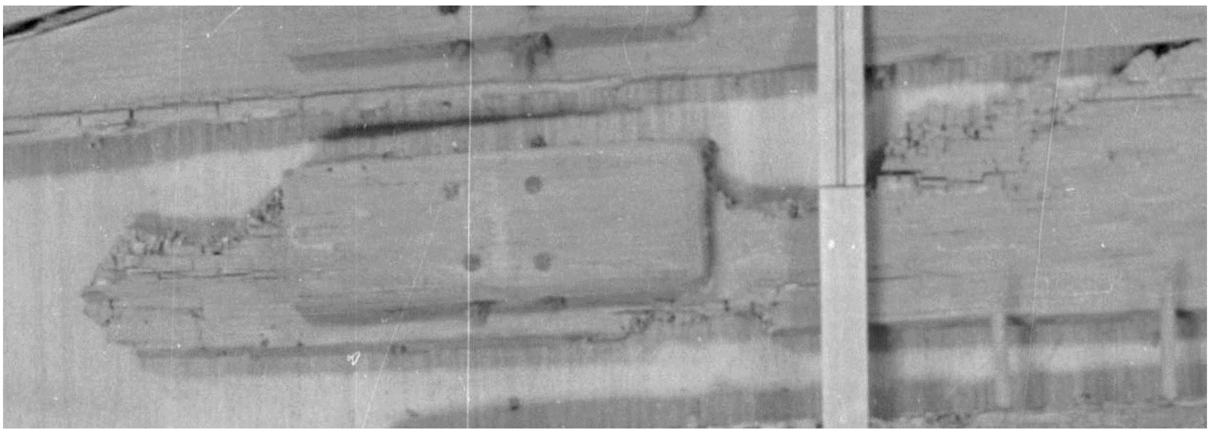

Figure 6-24. Butuan Boat 2 STR-B1 missing fragment near last lug. Photograph courtesy of the Western Australian Museum.

width and 2.5 cm in thickness. The first pair of lashing holes were drilled 14 cm from the end of the lug, while the second pair was measured at 20 cm and 21 cm. The plank then terminates in a break 18 cm from the lug.

Strake B2 (STR-B2)

STR-B2 is composed of two plank fragments scarfed together with a hook scarf. The first measures 8.61 m in length, and has a maximum width of 20 cm measured just before the ninth lug, where its thickness is 3.5 cm. Its width near the first lug, STR-B2-L4, is 14 cm and its thickness here is 3 cm.

Measured 11 cm from the end of this plank is STR-B2-L4. It is 31 cm in length, 8 cm in width, and 3 cm in thickness. Two pairs of worn lashing holes were situated 12 cm and 20 cm from the end of the lug.

The next lug, STR-B2-L5, was carved 47 cm down the plank. It measures 31 cm in length, 8 cm in width and 3 cm in thickness. Two pairs of lashing holes were set along the lug at 12 cm and 18 cm. Their original diameter appear to have measured around 1.5 cm.

The next lug, STR-B2-L6 was measured 46 cm away. It is 31 cm in length, 10 cm in width and 3 cm in thickness. The lashing holes were at a distance of 12 cm and 17 cm from the end of the lug.

STR-B2-L7 was carved 49 cm from the previous lug. It has a length of 31 cm, a width of 10 cm, and a thickness of 3 cm. The lashing holes were measured 13 cm and 19 cm from the end of the lug.

STR-B2-L8 is 47 cm further down the plank. It was measured to 32 cm in length, 11 cm in width, and 3 cm in thickness. The lashing holes were set at 11 cm and 19 cm from the end of the lug.

STR-B2-L9 was carved after a gap of 1.21 m. It has a length of 31 cm, 13 cm to 14 cm in width, and 3 cm in thickness. Its lashing holes were drilled along the length of the lug at 14 cm and 19 cm.

Carved 43 cm away is the next lug, STR-B2-L10 that measures to 34 cm in length, 13 cm in width and 2.5 cm in thickness. The two pairs of lashing holes are situated 14 cm and 20 cm from the end of the lug.

STR-B2-L11 follows the previous lug after a space of 44 cm. From it, the following dimensions were measured: 32 cm in length, 11 cm to 12 cm in width and 2 cm in thickness. The lashing holes were drilled at distances of 12 cm and 20 cm from the end of the lug.

STR-B2-L12 is set 49 cm from STR-B2-L11. It has a length of 31 cm, a width of 11 cm and a thickness of 3 cm. The two pairs of lashing holes are set along the lug at 13 cm and 19 cm from the end.

STR-B2-L13 is the last lug of this plank, carved 44 cm from the end of the previous lug. It has a length of 34 cm, a width of 11 cm and a thickness of 2.5 cm. Its two pairs of lashing holes are 14 cm and 20 cm from the end of the lug. The plank in this section is 18 cm wide and 3 cm thick. The end of this plank is intact, with a hook scarf still dowelled to an additional plank fragment that measures 42 cm in length (Figure 6-25).

Figure 6-25. Scarf joint at end of Butuan Boat 2 STR-B2. Photograph by author.

Strake B3 (STR-B3)

Strake STR-B3 has two fragments that may or may not belong to one plank. The first has a length of 3.64 m. Its maximum width of 15 cm was measured between STR-B3-L8 and STR-B3-L9, where it is poorly preserved. The thickness here was between 3 cm and 3.5 cm. The end of the plank near the first lug, STR-B3-L8, is 17 cm in width and 3.5 cm in thickness. This end was prepared with a scarf (Figure 6-26).

STR-B3-L8 was carved 12 cm from the end of the plank. It has the following dimensions: 31 cm in length, 11 cm in width, and 2 cm in thickness. The two pairs of lashing holes were drilled along the lug at 11 cm and 18 cm.

The next lug was carved 1.2 m down the length of the plank. STR-B3-L9 measures 32 cm in length, 8 cm to 9 cm in width, and 2 cm in thickness. Two pairs of lashing holes were carved 16 cm and 21 cm from the end of the lug. The two lashing holes closer to the keel plank have worn through the lug.

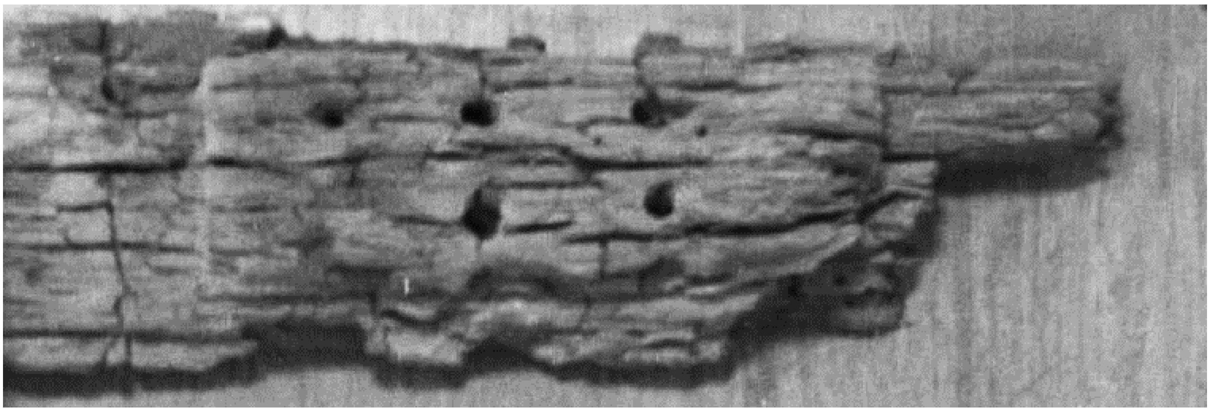

Figure 6-26. Butuan Boat 2 end of plank near STR-B3-L8. Photograph courtesy of the Western Australian Museum.

STR-B3-L10 is 43 cm further along the plank. It is 34 cm in length, 10 cm in width, and 2.5 cm in thickness. Two pairs of lashing holes were drilled 15 cm and 21 cm from the end of the lug.

Following 45 cm away, STR-B3-L11 is the last lug of this plank fragment. It measures 32 cm in length, 8 to 9 cm in width and 2 cm in thickness. Its two pairs of lashing holes are situated along the lug at 14 and 18 cm from the end. The width of the plank at this point is 14 cm, while its thickness is about 3 cm. The plank is broken 16 cm from lug STR-B3-L11.

If the reconstruction of the display is correct, a disarticulated plank fragment, with a length of 57 cm, a width of 13 cm and a thickness of 3 cm, contains the lug STR-B3-L12. In 1998, this loose fragment was associated with STR-A2 (Figures 6-27, 6-28). Its lug measures 31 cm in length, 9 cm in width, and 3 cm in thickness. Its two pairs of lashing holes were drilled 12 cm and 18 cm from the end of the lug. A portion of a flat or hook scarf extends 18 cm from the lug.

Figure 6-27. Butuan Boat 2 STR-B3 possible L12. Photograph by author.

Figure 6-28. Butuan Boat 2 STR-B3-L12 in 1988 was disarticulated but positioned next to STR-A2. Photograph courtesy of the Western Australian Museum.

Strake B4 (STR-B4)

Two plank fragments comprise STR-B4. The first is rather poorly preserved and measures 3.21 m in length, and has a maximum width of 16 cm. This was measured between the eighth and ninth lugs, where its thickness was found to be 3.5 cm to 4 cm. The first lug of this plank, STR-B4-L8, was 29 cm from the end of the plank fragment, that was prepared with a scarf, part of which is broken (Figure 6-29). The plank at this point is 12 cm in width and 4 cm in thickness.

STR-B4-L8 has the following dimensions: a length of 31 cm, a width of 11 cm, and a thickness of 2 cm. Two pairs of lashing holes were drilled 11 cm and 18 cm from the end of the lug.

STR-B4-L9 was carved after a gap of 1.2 m. This lug measures 32 cm in length, 8 cm in width, and 2 cm in thickness. Its two pairs of lashing holes were drilled along the lug at 15 cm and 20 cm.

The next and last lug of this plank fragment is STR-B4-L10 which follows after a gap of 44 cm. It has a length of 34 cm, a width of 8 cm to 9 cm, and a thickness of 2.5 cm. Two pairs of lashing holes are set 13 cm and 20 cm from the end of the lug. The plank width at

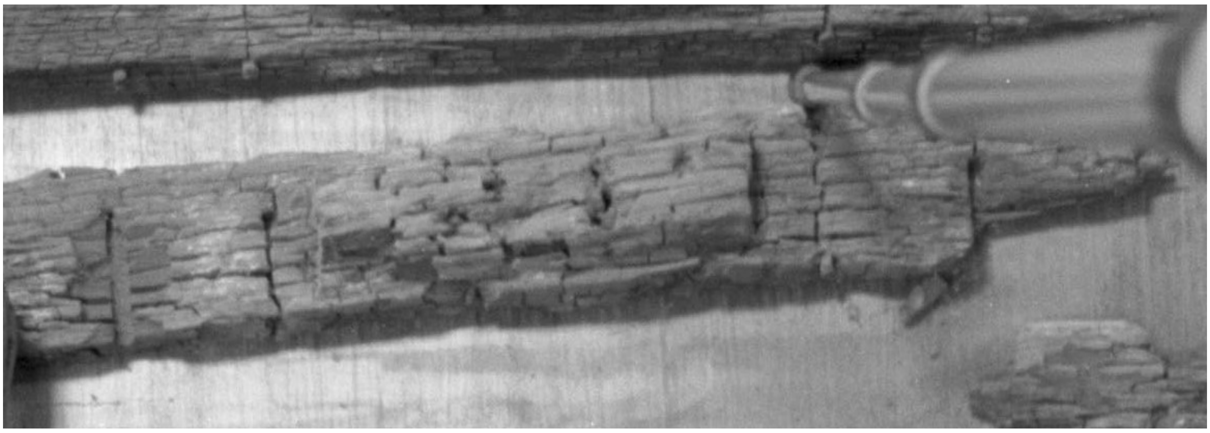

Figure 6-29. Butuan Boat 2 STR-B4-L8. Photograph courtesy of the Western Australian Museum.

this point is about 15 cm, while its thickness measures 2.5 cm.

Immediately following the lug is a break in the plank that appears to be the shape of a scarf, though its edge is too jagged to say this with certainty (Figure 6-30). It breaks completely 31 cm from the end of the lug. In 1988 photographs, a plank fragment with a single, badly preserved lug is set immediately after it (Figure 6-31). In the 2013 display, however, another plank fragment with two lugs is in this place; 1988 photos have that particular fragment set in line with STR-B3 (Figure 6-32). The end of this lug that is closer to the intact end of the keel plank appears to have a scarf, but is not connected to the preceding plank—the scarf fragment is also shorter than in 1988, with a portion that appears to have been sawn off. The corner of this end touches with the corner of the other plank fragment in the exhibit. As recorded in 2013, the plank fragment measures to a maximum 2.4 m in length, 11 cm to 14 cm in width, and 3 cm in thickness.

At 15 cm from this shortened end is the next lug, STR-B4-L11, which has the following dimensions: a length of 30 cm, a width of 8 cm to 9 cm, and a thickness of 2 cm. The two pairs of lashing holes were drilled 14 cm and 18 cm from the end of the lug.

The second and last lug of this plank fragment is STR-B4-L12, which has a length of 31 cm, a width of 8 cm and a thickness of 3 cm. Two pairs of lashing holes were set along the lug at 12 cm and 18 cm from the end. The plank breaks 18 cm from the lug, where it appears to be part of a scarf (Figure 6-33).

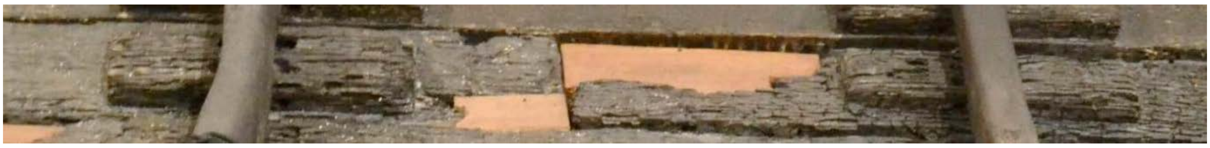

Figure 6-30. Butuan Boat 2 STR-B4 after L10. Photograph by author.

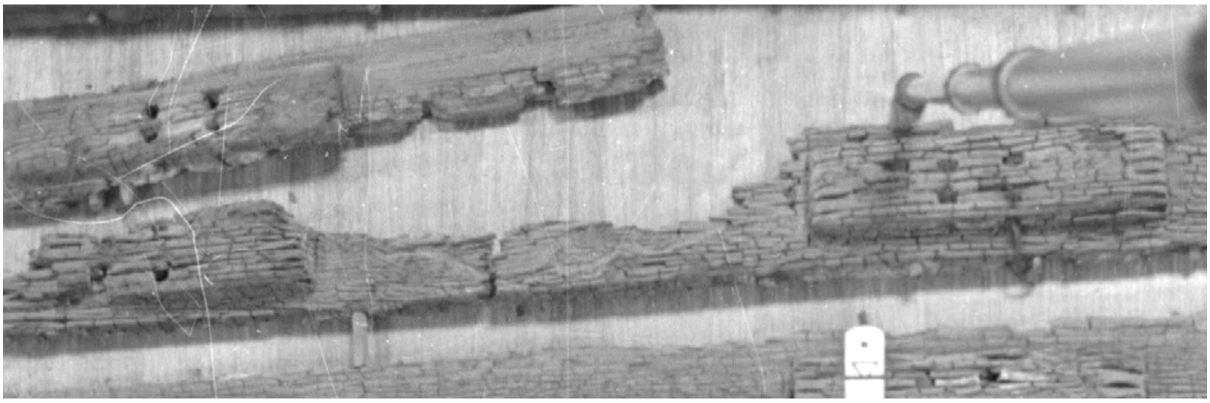

Figure 6-31. Butuan Boat 2 STR-B4 after L10 in 1988. Photograph courtesy of the Western Australian Museum.

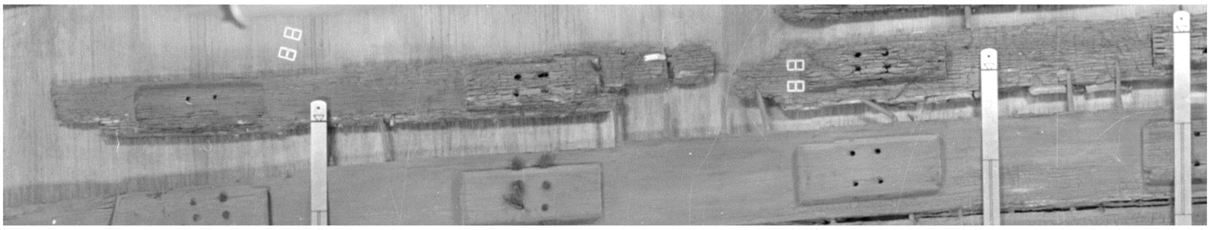

Figure 6-32. Second plank of Butuan Boat 2 STR-B4 aligned, but not joined, with STR-B3, in 1988 photograph, courtesy of the Western Australian Museum.

Figure 6-33. Second plank of Butuan Boat 2 STR-B4 near last lug. Photograph by author.

Strake B5 (STR-B5)

Strake STR-B5 is composed of two planks joined by a scarf. The first plank is 4.14 m in length and has a maximum width of 14 cm. This was measured between the eighth and ninth lugs, where it has a thickness of 3 cm to 3.5 cm. The broken end of the plank up to its first lug, STR-B5-L6, measures 40 cm.

STR-B5-L6 is 31 cm in length, 6 cm in width, and 3 cm in thickness. The two pairs of lashing holes were fashioned along the lug at 12 cm and 18 cm. Between this lug and the next, there appears to be a recess in the plank edge facing away from the keel plank.

STR-B5-L7 was carved 46 cm from the previous lug. It has a length of 34 cm, a width of 8 cm to 9 cm, and a thickness of 3 cm. Two pairs of lashing holes were set at 11 cm and 21 cm from the end of the lug.

The next lug, STR-B5-L8, is situated 47 cm farther down the plank. It was 34 cm in length, 8 cm in width and 3 cm in thickness. The two pairs of lashing holes were drilled 11 cm and 18 cm along the length of the lug.

Following a gap of 1.2 m is the next and last lug of this plank fragment, STR-B5-L9. It has a length of 32 cm, a width of 8 cm, and a thickness of 2.5 cm. The worn lashing holes, drilled in two pairs, were set 15 cm and 20 cm from the end of the lug. A scarf fashioned immediately after the lug appears to be a combination of a flat scarf and a Z-scarf (Figure 6-34).

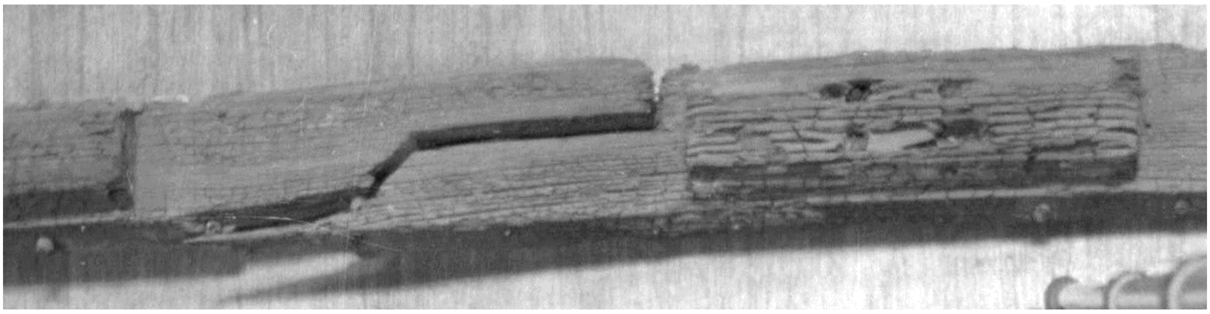

Figure 6-34. Butuan Boat 2 STR-B5 scarf joint. Photograph courtesy of the Western Australian Museum.

The adjoining plank, as measured in 2013, is 3.5 m in length, 10 cm to 11 cm in width and 2.5 cm to 3 cm in thickness. What appears to be another plank butt-joined to the end appears in 1988 photographs to be part of the same plank, which must have been broken or fractured by the time the exhibit was set. This part measures to approximately 1.14 m, and ends in a sharp point (Figure 6-35). There are four lugs on the plank fragment.

Figure 6-35. Butuan Boat 2 STR-B5 end of second plank. Photograph by author.

The first lug, STR-B5-L10 was carved 40 cm from the end of the scarf. It measures 34 cm in length, 7 cm in width, and 3 cm in thickness. The first pair of lashing holes are misaligned, drilled at 15 cm and 14 cm from the end of the lug. The second pair are situated 20 cm from the end.

STR-B5-L11 is set 46 cm farther down the plank. It has the following dimensions: a length of 32 cm, a width of 6 cm to 7 cm, and a thickness of 3 cm. Two pairs of lashing holes were set along the lug at 15 cm and 19 cm from the end.

STR-B5-L12 was carved 46 cm from the previous lug. It measures 32 cm in length, 7 cm in width and 3 cm in thickness. The two pairs of lashing holes are set 14 cm and 19 cm from the end of the lug.

The last lug of this plank is STR-B5-L13, situated 43 cm from STR-B5-L12. It is 34 cm in length, 7 cm in width and 3 cm in thickness. The lashing holes were drilled along the lug at 11 cm and 19 cm from the end.

Attached to one side of STR-B5, about 5 cm from the fractured edge of the second plank, is a piece that might be a drop strake, or part of a sixth strake (Figure 6-36). It measures 31 cm in length and 13 cm in width. The edge that faces away from the keel plank has a surface similar to a hook scarf. Neither the exhibit, nor the 1988 pictures reveal how this piece was joined to STR-B5, but it was probably done with dowels.

Figure 6-36. Butuan Boat 2 fragment joined to STR-B5. Photograph by author.

Wing end

The wing end was still attached by dowels to what is most likely a keel plank fragment measuring 90 cm in length (Figure 6-37). The wing end itself measures to about 65 cm in length, while its maximum width is 12 cm. On its upper surface, which measures 55 cm in length and 7 cm to 12 cm in width, are dowels that are mostly broken, as well as a locked mortise-and-tenon joint. The tenon is situated 4 cm to 8 cm from the point of the wing end. Four pairs of dowel holes, each 1.5 cm in diameter, line the sides of this surface at 20 cm, 28 cm, 37 cm, and 46 cm from the wing end point. A sample from the wing end (OZQ845) was radiocarbon dated to 1230 ± 30 B.P. ($\delta^{13}C$=-25.3 ± 0.1‰), or cal A.D. 669–

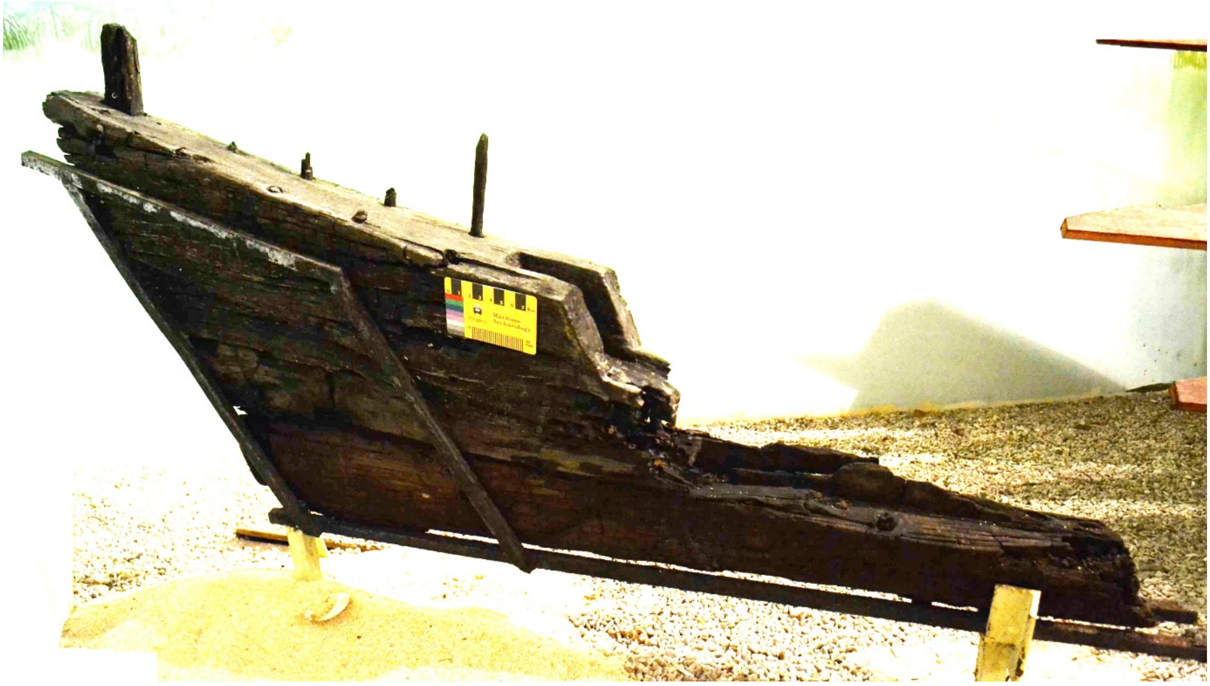

Figure 6-37. Butuan Boat 2 wing end. Photograph by author.

882 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977).

Butuan Boat 5

In 2013, when Butuan Boat 5 was re-examined, its disarticulated timbers that were kept in open storage had deteriorated significantly, and exhibited more severe warping than it did when was last examined and photographed in 1992 (Green et al. 1995). The wing end and frame fragments were generally better preserved than the hull pieces. As observed by Green and his colleagues, the keel plank of Boat 5 differs from those of the other boats, for it has a continuous ridge along its centre and no individual lugs or protrusions (Figure 6-38; Green et al. 1995:185–186). The lashing holes are also

Figure 6-38. Butuan Boat 5 keel plank ridge. Photograph courtesy of the Western Australian Museum.

Figure 6-39. Example of typical Butuan Boat 5 lashing holes on plank lugs. Photograph courtesy of the Western Australian Museum.

different; they are drilled through to both sides of the ridge rather than in an L-shape as is generally the case with the other boats. The lashing holes on the keel plank are irregularly spaced, usually in pairs of holes 4 cm to 6 cm apart; the paired sets are 75 cm to 80 cm apart. There are also single holes along the keel plank ridge that do not follow a discernible pattern, and their purpose is undetermined.

The lugs on the planking also have lashing holes that extend from side to side, with two holes per lug in contrast to six lashing holes per lug on Boat 1 and four lashing holes per lug on Boat 2 (Figure 6-39). Several lugs also exhibit additional unusual patterns of lashing holes, including some that are formed from the top of the lug, as well as the sides (Figure 6-40). It is notable that even as the hull timbers are in poor condition, the lashing

Figure 6-40. Example of unusual lashing hole and pattern on Butuan Boat 5 lug. Photograph courtesy of the Western Australian Museum.

holes on Butuan Boat 5, on both the keel plank and the planking, have largely been preserved, even if they show signs of wear, i.e. enlarging from ligature tension. Where the lashing holes have not survived, however, the damage to the lugs is significant (Figure 6-41).

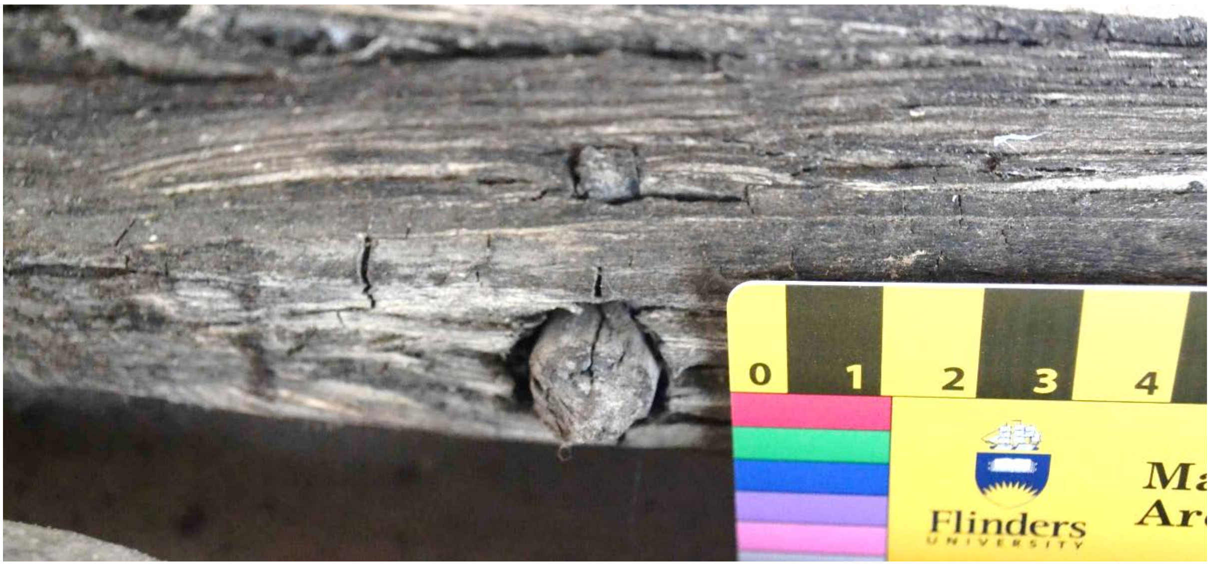

Figure 6-41.Wooden peg locking dowel in place in Butuan Boat 5 planking Photograph by author.

The dowel holes, which have a diameter of about 2 cm to 3 cm, do not follow a recognisable pattern. They are generally spaced 10 cm to 15 cm apart. A number are, however, quite closely spaced, at just 4 cm apart measured centre-to-centre. A number of dowels were locked by pins, but again this was not done with any regularity other than in some sections where they occur on every third dowel (Figure 6-42).

Because the timbers of Boat 5 are fragmentary, disarticulated and warped, the 1986 site plan was used for determining plank and lug configurations (Figure 2-9). The keel plank appears to have been fashioned from a single piece of wood. At one end of the boat (left side in the site plan) is a wing end. From this end six rows of lugs are spaced about 60 cm apart, then there is a 1-m gap at the widest part of the vessel, and another three rows of lugs. The drawing depicts seven preserved strakes on one side of the keel plank. The opposite side is harder to discern and shows either seven or eight preserved strakes (the possible seventh strake is fragmentary).

For wood identification, samples were collected from the keel plank, 10 plank fragments, both portions of the wing end, and all frame pieces. The keel plank (WS-13-678) and all plank samples (WS-13-680 to 689) were identified as *sangilo*, or *Pistacia chinensis*. A dowel collected from the keel plank was identified as a tree from the *alupag*

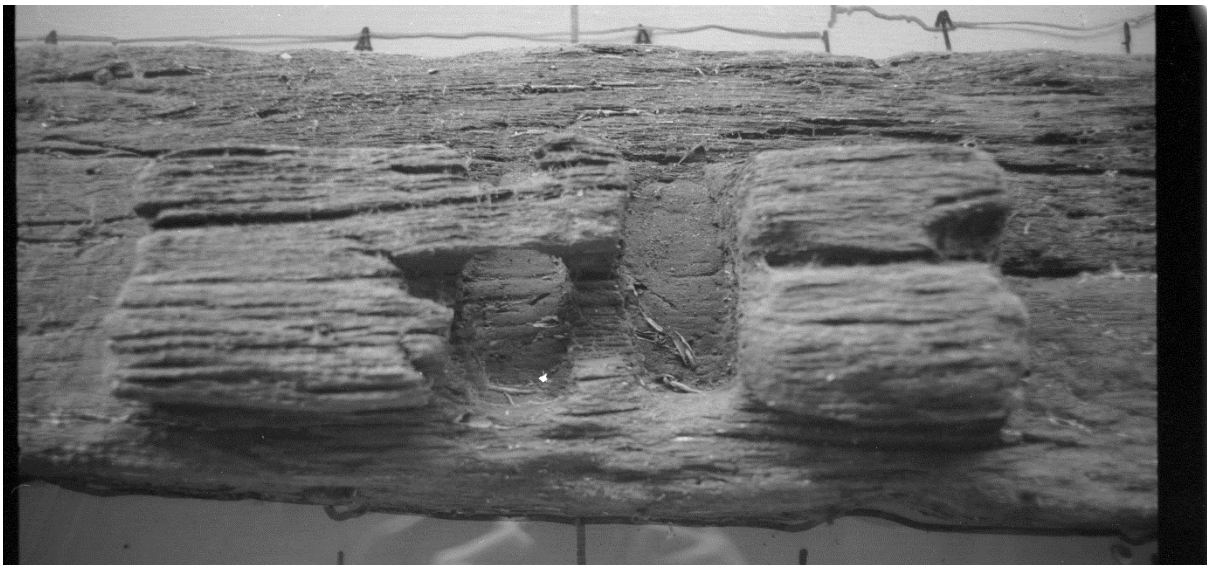

Figure 6-42. Poorly preserved lug and lashing holes on Butuan Boat 5. Photograph courtesy of the Western Australian Museum.

species, which are *Dimocarpus*-genus timbers. Both wing end portions (WS-13-697[client codes 53 and 54]) were made from narra, or *Pterocarpus indicus*, the same as the Boat 2 wing end. Frame samples 1, 4 and 6 (WS-13-690, 693, and 695) were hewn from *molave*, or *Vitex parviflora*, while frame samples 2, 3, 5 and 7 (WS-13-691, 692, 694, and 696) were made from the *alupag* group. A sample from the keel plank (OZQ848) was radiocarbon dated to 1150 ± 30 B.P. ($\delta^{13}C$=-25.5 ± 0.3‰), or cal A.D. 776–971 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977).

Wing end

The wing end is composed of two sections. The smaller one, that measures a maximum 74 cm in length, attached to the keel plank by its bottom surface. This surface measures 68 cm in length, 21 cm in height, and 1 cm in width at its end, to a maximum 10 cm in width (Figure 6-43). The underside has three dowel holes drilled roughly along its centre at 6 cm, 9 cm, and 11 cm measured from the end. These are followed by three pairs

Figure 6-43. Underside of the smaller Butuan Boat 5 wing end portion that fastens to the keel plank. Photograph by author

of dowel holes each drilled along the sides of the surface, measured at 28 cm, 41 cm, and 55 cm from the end. Their diameters were between 1.5 cm and 2 cm. At least two of these holes have corresponding locking peg holes across them, but it is difficult to tell if this is the case with others due to the worn condition of the wood.

The upper surface of this piece increases from a width of 4 cm at its end to a maximum of 15 cm (Figure 6-44). This surface also has three dowel holes drilled along its approximate centre, and another three pairs along both sides. These were measured from the end at 4 cm, 11 cm, 15 cm, 19 cm, 42 cm, and 56 cm. The one surviving "wing", or forked piece, has a single dowel hole drilled 63 cm from the end. This measures 1.5 cm in diameter. The measurements on the upper side of this piece are mirrored on a portion of the bottom surface of the larger wing end piece.

Figure 6-44. Upper surface of the smaller Butuan Boat 5 wing end portion that fastens to the larger wing end portion. Photograph by author.

The larger piece of the wing end has a maximum length of 1.16 m. The underside has an additional pair of dowel holes located 71 cm from the end, then another three along the extensions of each side (Figure 6-45). They were fashioned at 88 cm, 96 cm, and 1 m from the end. Seven of the dowel holes on this surface have corresponding locking

Figure 6-45. Underside of the larger Butuan Boat 5 wing end portion that fastens to the smaller wing end portion. Photograph by author.

pin holes. Where the first dowel hole is situated is a 6-by-6 cm portion that protrudes by about 1 cm. The matching depressed portion on the smaller wing end piece is less obvious.

The upper surface of the larger wing end piece has at least two badly worn dowel holes near its end, between 2 cm and 14 cm along its centreline (Figure 6-46). These are followed by 11 pairs of dowel holes that run along either side at 21 cm, 35 cm, 52 cm, 65 cm, 74 cm, 79 cm, 84 cm, 94 cm, 97 cm, 1.06 m, and 1.1 m. They measure 2 cm to 2.5 cm in diameter.

Figure 6-46. Upper surface of the larger Butuan Boat 5 wing end portion. Photograph by author.

Frames

The moulded dimensions of seven frame timbers were recorded (Figure 6-47). The first, Frame 1 is an incomplete floor timber, with one side broken. Its maximum length is 95 cm. It is thickest at its base, measuring 15 cm. The intact end has a hook or notch, likely intended to receive ligatures for lashing. The ends extend from the base at roughly a 35-degree angle. Or, using a baseline with zero set at the bottom surface of the frame, the end measures 50 cm offset from 60 cm on the baseline.

The Frame 2 fragment has a maximum length of 96 cm and a maximum moulded dimension of 10 cm. Assuming the thickest part is its base, it curves from here to about 15 degrees; this translates to an offset of 41 cm measured from the baseline at 60 cm.

The Frame 3 timber is probably a floor that measures to maximum length of 50 cm, and a maximum thickness of 11 cm. It curves upwards at about 35 degrees from its apparent base. Along 13.1 cm off the baseline, it measures up to 20 cm.

Frame 4 measures to a maximum of 1.54 m in length and 10 cm in thickness. It is probably a floor, but is quite broad, opening from the base to a 20-degree angle; at 80 cm on the baseline, a 35 cm offset was measured. One end of this timber is carved to a hook, or was perhaps a lashing hole that has since opened from use.

Frame 5 is a gently curving timber, reaching 2.13 meters in length with a maximum 10 cm thickness.

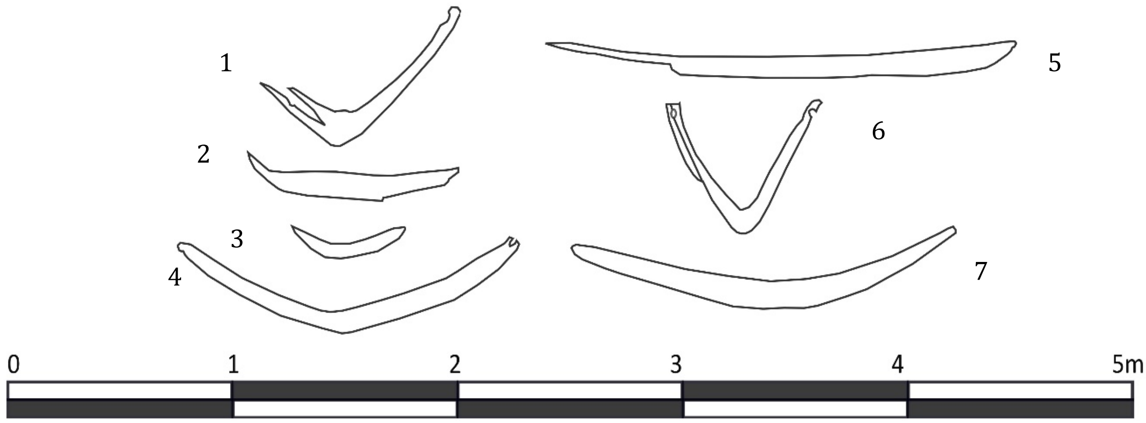

Figure 6-47. Butuan Boat 5 frame drawing

Frame 6 is a V-shaped floor timber. It reaches a maximum length of 7 cm and a thickness of 9 cm. From 35 cm on the baseline, the highest point measures to a 55 cm offset. This is about a 50 cm angle from the base.

Frame 7 is a 1.75 cm timber, with a maximum width of 12 cm. It is probably a floor timber at the midships, as it is quite broad. From 80 cm on the baseline, it rises only 26 cm, or an angle of just over 10 degrees.

Butuan Boat 4

The excavation of Butuan Boats 4 and 9, with the latter found partially overlapping the former, commenced in 2012 in the same vicinity as Boats 2 and 3. The excavation has taken place over several seasons during the driest times of the year in Butuan. The author was present to observe much of the 2012 and 2013 field seasons, between May to July of both years.

An open pit, approximately 1 meter in diameter and 40 cm in depth, was found at the site. According to a local resident hired to assist with the archaeological excavation, this was the result of looting activities in the 1980s. The archaeologists extended the pit until the incomplete wooden remains of Butuan Boat 4 were unearthed, in a north-east to south-west orientation. It is composed of a keel plank, six strakes on the north-west side of the keel plank and three strakes in the south-east side of the keel plank. Because of the difficult excavation conditions, precise measurements have yet to be taken. Thus, those provided offer only general descriptions.

The keel plank of Boat 4 is about 22 cm in width and is similar to the keel plank of what is thought to be Boat 3 (see Chapters 3 and 5). It has single lugs measuring between 25 cm and 30 cm in length and 10 cm in width, as well as a continuous narrow ridge measuring about 4 cm in width that runs through the centre of each lug and for the length of the keel plank (Figure 6-48). Two pairs of lashing holes are drilled in an L-shape from the side to the top of the lugs, as with Boats 1 and 2. Some lashing holes also appear to have been drilled across the ridge at some points. The section of the boat at the northeast portion of the excavation has not been exposed. It is located next to a creek that would overflow and cause the northeast wall to collapse if excavated further. At the opposite end, the keel plank is sawn off cleanly at approximately 4.2 m from the excavation wall, which is presumably the work of the treasure hunters. A sample from the keel plank (OZQ846) was dated to 1150 ± 35 B.P. ($\delta^{13}C$=-25.4 ± 0.2‰), or cal A.D. 715–940 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977).

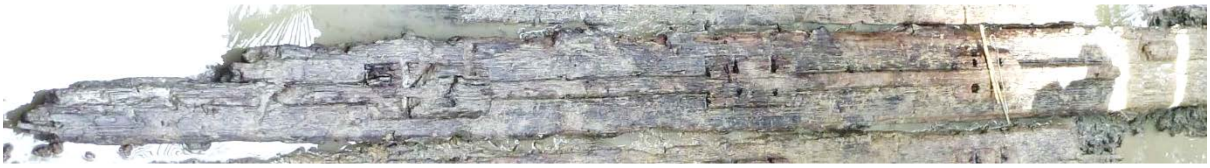

Figure 6-48. Butuan Boat 4 keel plank lugs and ridge. Photograph by author.

The other strakes are broken off at various lengths towards the middle of the boat and range in width between 12 cm and 20 cm. Towards the end of the boat on the northeast end of the excavation are two strakes, each composed of two planks joined by scarfing between the first and second lugs. The lugs of the Boat 4 planks are about 25 cm in length and between 8 cm and 12 cm in width. Many of the lugs are degraded and worn almost to the surface of the planks, leaving two channels that cut through the width of the lugs (Figure 6-49). These are similar to the damage seen on some Butuan Boat 5 lugs and suggest that some lashing holes may have been drilled straight through the width of lugs. The planking lugs that are slightly better preserved, however, are the ones similar to the Boat 2 plank lugs: they have two pairs of L-shaped lashing holes. This leads to an interesting observation that the lashing holes drilled through the sides of the Boat 4 lugs are less durable than L-shaped holes.

Assessing the exposed and surviving remains of Boat 4 as recorded in July 2013, the

Figure 6-49. Butuan Boat 4 worn lug holes. Photograph by author.

hull remains have at least seven rows of lugs (Figure 6-50). The first six rows of lugs toward the northeast part of the site are spaced between 60 cm and 65 cm apart. There is then about a 95 cm gap between the sixth and seventh lug. Even with the portion of the boat in the southwest part of the site missing, it is apparent that as with the other lashed-lug Butuan Boats, lugs were purposefully left off the middle or widest portion of the vessel, leaving a gap. At this stage of the research, where neither end of the vessel has been exposed, it is unknown if end posts or wing ends were used on Boat 4.

A timber, the function of which has not been determined, was found underneath Boat 4 near amidships, and on top of the wing end of Boat 9 (Figure 6-50). A sample from this timber (WS-13-677) was identified as *Pometia pinnata* or *malugai*. It measures more than 4 m in length and about 30 cm in width.

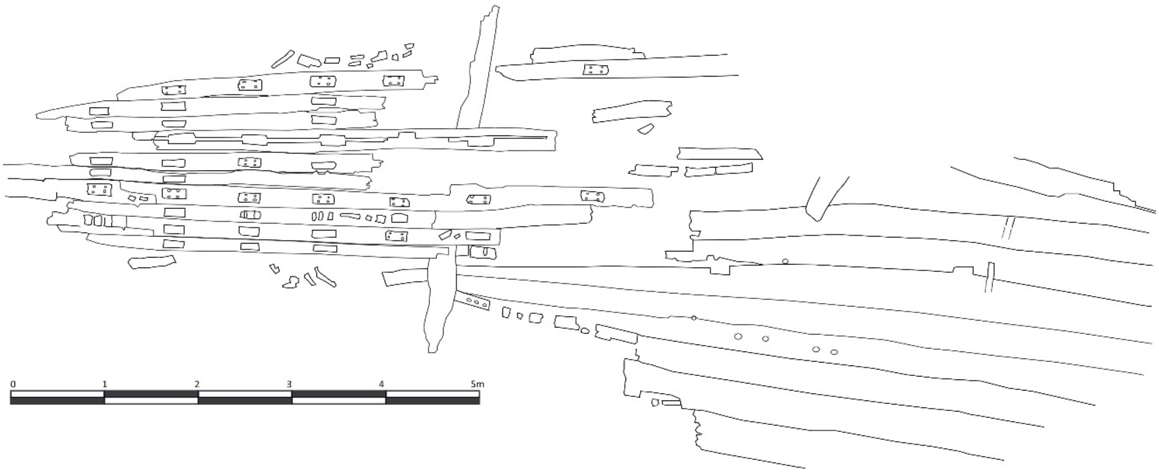

Figure 6-50. Site plan of Butuan Boats 4 and 9. The two vessels are separated by a timber lying underneath Boat 4 and on top of Boat 9's wing end. Illustration by Jose Santiago, Antonio Peñalosa and author.

Butuan Boat 9

Overlapping with the timbers of Boat 4 are the remains of another boat, now known as Butuan Boat 9. This vessel was found with a north-east to south-west orientation, just slightly askew of Boat 4 (Figure 6-50). As with Boat 4, the excavation of Boat 9 has yet to be completed. The most obvious attributes of Boat 9 are its size and construction. It appears to be at least twice as long as Boat 4. There is also no evidence of lugs on its badly degraded planks. It has at least one wing end, the only obvious similarity to the other Butuan Boats. A sample from this wing end (WS-13-699) could not be identified due to advanced deterioration. A sample was collected from what appears to be the keel or keel plank, and was identified as coming from the *narig* group, or *Vatica* genus (WS-13-701). Another sample from the keel (OZQ846) was dated to 1150 ± 35 B.P. ($\delta^{13}C$=-25.4 ± 0.2‰), or cal A.D. 715–940 (calibrated at 2σ with the program OxCal 4.2; Stuiver and Polach 1977). There are least 10 strakes to the south-west side of the keel and six strakes on the opposite side.

Gujangan shipwreck planks

Four poorly preserved plank fragments from the Gujangan Shipwreck were examined for clues regarding their fastenings. It will be recalled that this shipwreck was associated with cargo dated to the fifteenth to sixteenth centuries. Because the site was looted, other information is limited. None of the fragments have undergone examination to identify their timber species—they are now too deteriorated for such analysis.

Plank fragment 1 has a maximum length of 78.5 cm, a width of 13.5 cm, and a thickness of 3.5 cm (Figure 6-51). It has a single lug with the following dimensions: a length of 25 cm, a width of 8.5 cm, and a thickness of 2.5 cm.; there are two pairs of L-shaped lashing holes with a diameter of 1.5 cm. They are situated a distance of 6 cm to 17.5 cm from the end of the lug (left side in Figure 6-51). Three dowel holes were drilled

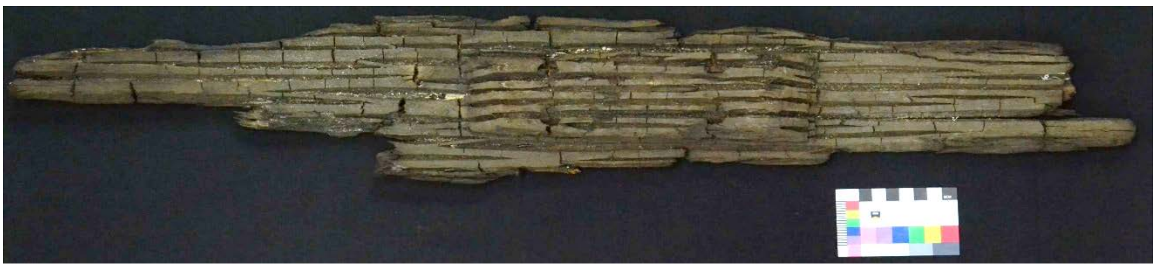

Figure 6-51. Gujangan shipwreck plank fragment 1. Photograph by author.

on one side of the plank. They are spaced 11 cm and 11.5 cm apart, and have diameter measurements of 0.8 cm, 1.3 cm, and 1 cm. The other side of the plank has two dowel holes, spaced 11.5 cm apart, both with a diameter of 1 cm.

Plank fragment 2 measures 35 cm in length, 10 cm in width, and between 0.5 to 2.5 cm in thickness (Figure 6-52). It has two badly degraded dowel holes that have caused cracks to the surface of the plank. One pierces through the entire width of the plank, while the other, spaced 12 cm from the first, is drilled just through more than half the plank. They are approximately 1 cm in diameter.

Figure 6-52. Gujangan shipwreck plank fragment 2. Photograph by author.

Plank fragment 3 is part of a flat or hook scarf that has a maximum length of just under 23 cm, a width of 7 cm, and a thickness of 3 cm (Figure 6-53). It has three dowel holes, two of which are spaced 3 cm apart, while the last is 8 cm from the second dowel hole. They measure between 1 cm to 1.5 cm in diameter, though the first hole could not be properly measured as the plank was broken through it. The third hole was drilled through the entire width of the plank.

Plank fragment 4 is 51 cm in length, 18.5 cm in width, and 1.5 cm in thickness (Figure 6-54). It appears it may have had a single dowel hole measuring 1 cm in diameter drilled through its width, but has split along the outside edge of the plank. The plank has

Figure 6-53. Gujangan shipwreck plank fragment 3. Photograph by author.

Figure 6-54. Gujangan shipwreck plank fragment 4. Photographs by author.

a single lug that is triangular in section, with its peak favouring one side of the plank. It has the following dimensions: 24 cm in length, 16 cm in width, and 4 cm in thickness. Two lashing holes were drilled through both sides of the lug and are spaced 5.5 cm apart. One measures almost 3 cm in diameter, while the other is about 1.5 cm.

Summary of Butuan Boat wood species

In 2013, 58 wood samples measuring about 2 cm^3 were collected from the major timber components of all of the Butuan Boats. The samples were identified by FPRDI (Figure 6-55). Except for the Boat 9 wing end sample which was highly deteriorated, all samples were successfully identified to the level of genera. Of these, six were identified to specific species. In some instances, the FPRDI used the most common or popular commercial name in the market for a group of closely-related timbers that were not distinguishable on a macroscopic level, as explained by Jose A. Meniado and co-authors in the two editions of *Wood Identification Handbook* (Meniado et al. 1981:iii; Meniado et al. 1975:2). The information here regarding distribution, characteristics, and uses are from contemporary sources—botanical classification in Southeast Asia began quite late.

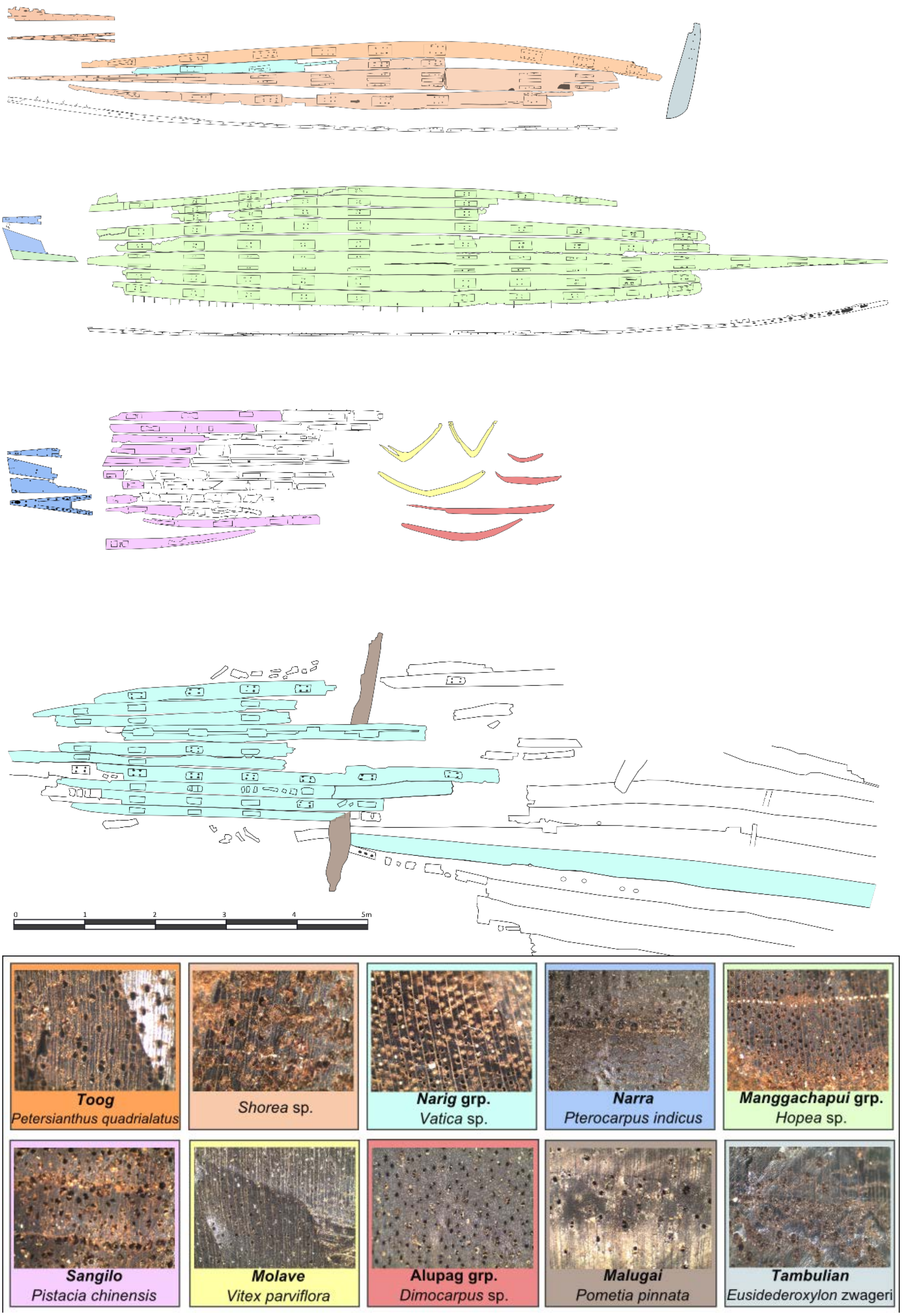

Figure 6-55. Butuan Boats wood identification guide. From top, Butuan Boats 1, 2, 5, 4 and 9. Illustrations by author, photographs by FPRDI.

Lists of commercial Philippine woods were made for the first time early in the twentieth century (Merrill 1903; Reyes 1938:27). Species classifications are also amended by botanists from time to time, so several sources for information are referred to (Jensen 2001; Meniado et al. 1981; Meniado et al. 1975; Merrill 1903; Reyes 1938; Salvosa 1963).

Petersianthus quadrialatus/toog/Philippine rosewood

A Boat 1 plank (WS-13-648) and dowel (WS-13-650 [Figure 6-55]) were identified as *Petersianthus quadrialatus*.

Known under the common name *toog* and the commercial name *Philippine rosewood*, the tree is found in the low altitude primary forests of the Philippine provinces of Sorsogon, Samar, Leyte, Masbate, Cebu, Surigao and Agusan (Meniado et al. 1981:65–66; Reyes 1938:351–352). Large quantities of the wood are obtainable in some locations, including Agusan and Masbate; it is a tall, straight tree reaching 40 m in height and a diameter of 1 m, but as much as 2 m in Agusan. It is comparatively "heavy, moderately hard, moderately strong", rather difficult to season and is likely to split and warp. It is moderately hard to work when thoroughly dry. It is durable for interiors, and moderately durable when exposed to weather or when in contact with the ground. When it is properly seasoned, it is a suitable material for beams, joists, and general construction; veneer and decorative plywood; pulp and paper; and charcoal (Meniado et al. 1981:65–66; Reyes 1938:351–352).

Shorea sp.

The following timbers were identified as *Shorea* species: two Boat 1 planks (WS-13-646, WS-13-647) and its keel plank (WS-13-645 [Figure 6-55]).

There are a variety of *Shorea* species trees in the Philippines and Southeast Asia. The *Shorea* species is referred to as *yakal* by Reyes (Reyes 1938:330) but within the *guijo* group. Meniado (1975:59–62) and his co-authors, however, described it as similar to *yakal* which is heavier and harder. *Philippine mahogany* is also loosely used to refer to various *Shorea* species. *Shorea* is fairly abundant and widespread. *Yakal* can attain a maximum diameter of 1.8 m, but is generally smaller. The trunk is cylindrical, straight, and short but often defective from butt rot. It is extremely durable when exposed to weather and moderately resistant to marine borers (Reyes 1938:330). It was once used for automobile and other vehicle bodies. Other uses include furniture- and cabinet-making, ship- and boat-framing, building construction frames, and other uses requiring hard, strong wood with a beautiful grain (Meniado et al. 1975:60). The wood is said to be difficult to work with hand tools due to its interlocking grains and high density (World Timbers 2008-2015).

Vatica sp./Vatica mangachapoi Blanco/narig

The following boat components were identified as *Vatica* species: A plank from Boat 1 (WS-13-700), all of the Boat 4 planks and its keel plank (WS-13-666 [Figure 6-55] to WS-13-676), and the Boat 9 keel plank (WS-13-701).

According to Luis J. Reyes (1938) there are several varieties of the *Vatica* species throughout the Philippines which vary in availability, with the *narig* group (*Vatica mangachapoi* Blanco) as the most common variety. *Narig* grows mostly in low to medium altitude primary growth forests up to 800 m. They are widely distributed throughout the country but found in limited amounts. It is a medium-sized tree with a maximum diameter of about 70 cm and a straight and cylindrical bole, 10 to 15 m in height. It is classified as "very hard, very heavy to extremely heavy", and it seasons well. The sapwood is relatively thick and is easily perishable. The tree resembles *molave* and is used similarly in fresh- and saltwater-exposed piling, as well as telephone and telegraph posts (Reyes 1938:331–336). In 1975, *Narig* species were described as scarce or obtainable in only limited quantities (Meniado et al. 1975:73–76). It was also used for bridge timber, wharf construction and railroad ties. The relatively thick sapwood was said to be prone to decay and insect borers and should thus be removed from the heartwood (Meniado et al. 1975:73–67; Reyes 1938:331–336).

*Pterocarpus indicus/*narra

The wing end of Boat 2 (WS-13-664), and both parts of the Boat 5 wing end (WS-13-697 [client codes 53 and 54; Figure 6-55]) were identified as *Pterocarpus indicus*, or narra.

It is found throughout the Philippines in flat, coastal plains behind mangrove swamps, along streams, on low hills near the coasts, and in open forests; it is scarce or absent in dense forests. *Narra* is fairly obtainable in the provinces of Cagayan, Mindoro, Palawan, Agusan and Cotabato (Meniado et al. 1975:189–190; Reyes 1938:143–145). It is also widely distributed throughout the rest of Southeast Asia, particularly in Myanmar, Thailand, Lao, Malaysia and Indonesia, in habitats with no pronounced dry season. Where it tolerates dry seasons, its quality is reduced (Jensen 2001:178–179). It is a large tree with an irregular, fluted trunk and prominent buttresses. It grows to a diameter of about 2 m and a height about 40 m, but is more commonly between 12 to 15 m in height and 70 to 80 cm in diameter. It seasons well with little degrading or shrinkage, is easy to work, very durable and not readily damaged by termites. It is used for high-grade furniture, decorative veneers and plywood, piano cases, and the interior finish of ships and vehicles (Jensen 2001:178–179; Meniado et al. 1975:189–190; Reyes 1938: 143–145).

Hopea sp./manggachapui

All Boat 2 planks (WS-13-652, to WS-13-663 [Figure 6-55 of WS-13-661]) including its keel plank (WS-13-651/BB1-K), and the lower portion of the wing end (now known to be part of the keel plank; WS-13-665) were identified as a *manggachapui* group wood from the *Hopea* sp.

Reyes (1938:297), cites *manggachapui* as the species *Hopea acuminata*. It is widely distributed throughout most of the country in low to medium altitudes up to 700 m, where it grows up to 35 m in height and 90 to 100 cm in diameter with a straight 20-m bole. It seasons well and degrades little. For a hard wood, it is considered easy to work and is durable when exposed to weather or when in contact with the ground, and is thus used in heavy construction such as bridges, or when strong woods are required, as in doors, window frames and sills, flooring boards, furniture and agricultural implements (Meniado et al. 1975:66). It is also used in high-grade construction and substituted for *guijo* (Shorea guiso; Reyes 1938:297–298) .

Pistacia chinensis/sangilo

All Boat 5 plank samples (WS-13-680, WS-13-681 [Figure 6-55] to WS-13-689) and the keel plank (WS-13-678) were identified as *sangilo*, or *Pistacia chinensis*.

In the Philippines, the tree is of limited supply from the Mountain Province (Benguet) and Ilocos Province, on open slopes between 700 and 1,000 m in altitude (Reyes 1938:210–211). It is the only *Pistacia* species found in the Philippines (Meniado et al. 1981:11; Reyes 1938:210). It grows more commonly in China and Taiwan. *Pistacia chinensis* is a small tree with a straight, short, and regular trunk that reaches a height of up to 20 m and a diameter of up to 40 cm. It seasons well, cracks little, but warps considerably if it is worked with a plane saw. For a hard wood, it is easy to work and very durable (Reyes 1938:210). It is used for wood carvings and novelty items, mirror frames, brush backs, walking sticks, rifle stocks, and smoking pipes (Meniado et al. 1981:12;

Reyes 1938:211). In China, it was a highly-prized timber for the manufacture of ships' rudder posts (Wilson 2011 [1913]:22).

Vitex parviflora/molave

Three frames of Boat 5 (WS-13-690, 693, 695 [Figure 6-55]) were made from *molave* or *Vitex parviflora*.

Molave is widely distributed throughout the country in lowland secondary and open primary forests on limestone or volcanic soils, but is limited in supply. It attains a diameter of up to 2 m (Jensen 2001:206–207; Meniado et al. 1975:359–360; Reyes 1938:435–437). It is also found in eastern Indonesia (Jensen 2001:206–207). Its bole is crooked, short and fluted, with a moderately large buttress. It is very heavy, very hard, and brittle. It seasons well with little shrinking. *Molave* is easy to work for a hardwood, and very durable under all conditions, except when exposed to marine wood borers. It is used for high-grade construction where strength and durability are required, such as in shipbuilding, posts, railroad ties, paving blocks, sculpture and carving (Jensen 2001:206–207; Meniado et al. 1975:359–360; Reyes 1938:435–437).

Dimocarpus genus/*alupag* group

Four frames of Boat 5 (WS-13-691, WS-13-692 [Figure 6-55], WS-13-694, and WS-13-696) and a dowel, also from Boat 5, (WS-13-698) were identified as *Dimocarpus* species or *alupag*.

Reyes (1938:219) classifies *alupag*, the timber's trade name, as *Euphoria didyma*. Meniado and his co-authors (1981:94), on the other hand, class it as part of the *Dimocarpus* and *Litchi* genera. *Alupag* is widely distributed throughout the country but is not abundant. It is a medium-sized tree with a diameter of about 80 cm and a trunk reaching 10 to12 m in height, is generally fluted and seldom straight. Its buttresses are thick but low. It is very hard and strong, and seasons well with little or no degrading. It is durable even under severe exposure, is moderately resistant to marine wood borers, but is difficult to work. It is used where a very hard and heavy wood is required, such as to make posts, window sills, beams, joists, rafters, flooring, burrs in native rice mills, the teeth of cogwheels in sugar mills, presses, bearings, wooden anchors, combs, treenails, harrow teeth and other parts of agricultural implements, mortars and pestles, saltwater piles, and the keels and keelsons of ships (Meniado et al. 1981:95–96; Reyes 1938:219–220).

Pometia pinnata/malugai

The unknown timber member between Boats 4 and 9 (WS-13-677[Figure 6-55]) was identified as *malugai*, or *Pometia pinnata*.

Malugai is common in Philippine forests usually near streams at low to medium altitudes. There is a fair supply, especially from the provinces of Mindoro, Tayabas and Palawan. The trunk grows cylindrical and straight to a height of 18 to 22 m. It is prone to excessive warping and shrinking so it must be seasoned with care. It is easily worked. *Malugai* is used to make boat frames, masts and spars, in house beams, joists, rafters, flooring, sheathing, ceiling and other interior finishing, in axe, pick, rake and hoe handles, levers, capstan bars, peavies, furniture, and sporting equipment including baseball bats, tennis rackets, and golf clubs, in airplane construction, bobbins, spindles and shuttles, cooperage, tripods, T-squares, and shipbuilding (Meniado et al. 1981:99–100; Reyes 1938:225–227).

Eusideroxylon zwageri/tambulian

The quarter rudder possibly from of Boat 1 (WS-13-679[Figure 6-55]) was identified as *tambulian* or *Eusideroxylon zwageri*.

Tambulian is endemic to Borneo, and is also referred to as Borneo ironwood (Reyes 1938: 96). Its availability was reported as sparse and limited only to Sulu and Jolo in the southern Philippines (Reyes 1938: 96-97). Recent data confirms that the wood is today only available in Indonesia (Richter and Dallwitz 2000 onwards). The tree is tall and straight with a diameter of up to 1.10 m. The timber is categorised between heavy and extremely heavy, between very hard and exceptionally hard, and very strong. It seasons well, with minimal warping, shrinking or checking. Its hardness makes it difficult to work, but is very durable and resistant to insects and marine wood borers. Because of this, the wood is used in wharf and bridge construction, and saltwater piling, as well as vehicle manufacture and railroad ties (Meniado et al. 1975:147–148; Reyes 1938:96–97).

Conclusion

The data collected and outlined in this chapter can be used in comparisons and in conjunction with results presented in previous chapters. Aspects of lashed-lug boat construction, the kinds of wood used, how these were shaped and fashioned, and details of their fastenings, as evidenced from the Butuan Boats and the Gujangan Shipwreck timbers, now add to the foundation in our knowledge of Southeast Asian boatbuilding practice. In the following chapter, archaeological and archival materials will be synthesised with the aim of forming a deeper understanding of the Southeast Asian lashed-lug boat.

Chapter 7 Analysis and discussion

Introduction

Available textual references of Southeast Asian watercraft, however sparse or vague, dating from the early centuries A.D., and extending into contemporary times, were presented in Chapter 4. The sources were written by Chinese and European observers who described vessels that were built in a range of sizes: those small enough for a single person to carry out of the water, and others large enough to carry more than 1,000 passengers and exceeding 50 m in length. The watercraft were referred to by different names, which at times depended on their size, and others on their function. None of the descriptions or illustrations could adequately provide precise classifications for these different types of boats, however. With hundreds of different languages spoken in maritime Southeast Asia alone, it is entirely likely that a particular type of vessel could be referred to by different names, depending on one's local language. Conversely, various language speakers could define a single term differently. A case in point are the Filipino words *balangay* and *barangay*. In various sources, they are used interchangeably as a generic term for a boat. Others make the distinction that a *barangay* refers to a Tagalog stitched and flat-bottomed boat, in contrast to Alcina's description of a dowelled and lashed-lug boat (Alcina 2005 [1668]:201–203; Cuevas et al. 2004:2). Another example is demonstrated with the words *jong*/*jonque*, and junk, also thought to have the same meaning, but which in fact refer to different types of vessels; the former means a Malay ship, while the latter, a ship from China (Manguin 1993:266; Pigafetta 1903–1905 [1525]-a:224–225).

Even the earliest writers of the briefest accounts remarked on a common trait of Southeast Asian vessels, from built-up dugout canoes to the multiple-sheathed sea-going traders. This common trait refers to a construction method where metal fastenings were not used. European observers began to detail specific boatbuilding techniques and features, which now included explicit accounts of lashed-lug construction. Many of these were and continue to be confirmed by archaeologists and ethnographers, as was shown in Chapter 5. The written and material evidence of edge-joined and lashed-lug watercraft that spans at least 1,500 years within the Southeast Asian and neighbouring regions, clearly point to the existence of an enduring boatbuilding tradition. Unfortunately, few researchers recognised the potential for examining the evidence beyond the obvious commonalities the watercraft shared with those described in historical accounts. As a result, the archaeological dataset of Southeast Asian watercraft has considerable gaps and inconsistencies. To address this, the timber remains of the Philippines' Butuan Boats and the Gujangan Shipwreck were re-examined and documented, with the results presented in Chapter 6.

The information provided in previous chapters is revisited and discussed here. With the examination of the Butuan Boats and regional watercraft for comparison, a clearer understanding of Southeast Asian lashed-lug boatbuilding can be reached. Answers to the research questions posed at the beginning of this dissertation are explored here so that they may be explicitly addressed in the next and final chapter.

Butuan Boats

The re-examination of the previously recovered Butuan Boats 1, 2 and 5 has helped to clarify earlier inconsistencies and errors with regards to measurements, dating, and timbers used. Along with the recently excavated Boat 4, they are a remarkable collection of similarly-constructed plank-built watercraft. These boats are all lashed-lug vessels, and their planks are all edge-joined solely with dowels. Their remains suggest an original length of more than 10 m, and less than 15 m. None were fitted with a true keel—they were instead designed with a keel plank that was left slightly thicker than the hull planking. This suggests that their use was limited to inland and coastal waters, as round or flat hulls would be inadequate for navigating open seas. Interestingly, and though most remains were found incomplete, among other Southeast Asian archaeological examples of lashed-lug craft, only the Cirebon shipwreck was described as having a true keel.

Boats 1, 2, 5, and even the much larger and non-lashed-lug Boat 9, were each found with a wing end. They were unearthed from roughly the same area: some 5 km inland from the northeastern coast of Mindanao, with no more than a one kilometre radius separating each other, and under the same conditions: waterlogged and buried beneath 1.5 m to 2 m of alluvium. Direct radiocarbon dating of samples collected from each of the boats' major timber components strongly suggest that they were constructed and used during the same period, with each of the calibrated ages consistently ranging between the late seventh to tenth centuries A.D. (Figures 7-1 and 7-2).

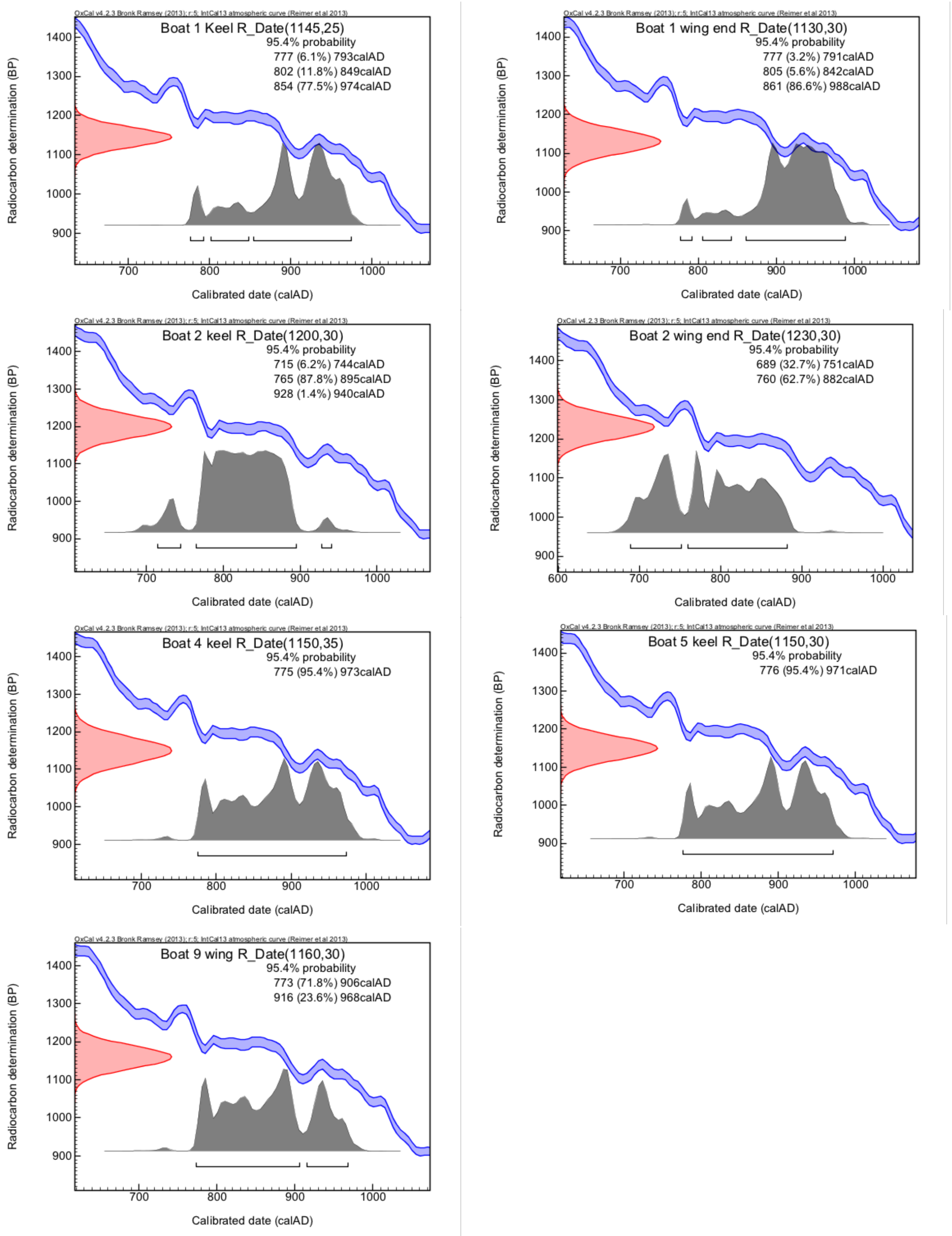

Figure 7-1. Results of the radiocarbon analysis performed on the Butuan Boats, calibrated using OxCal 4.2.

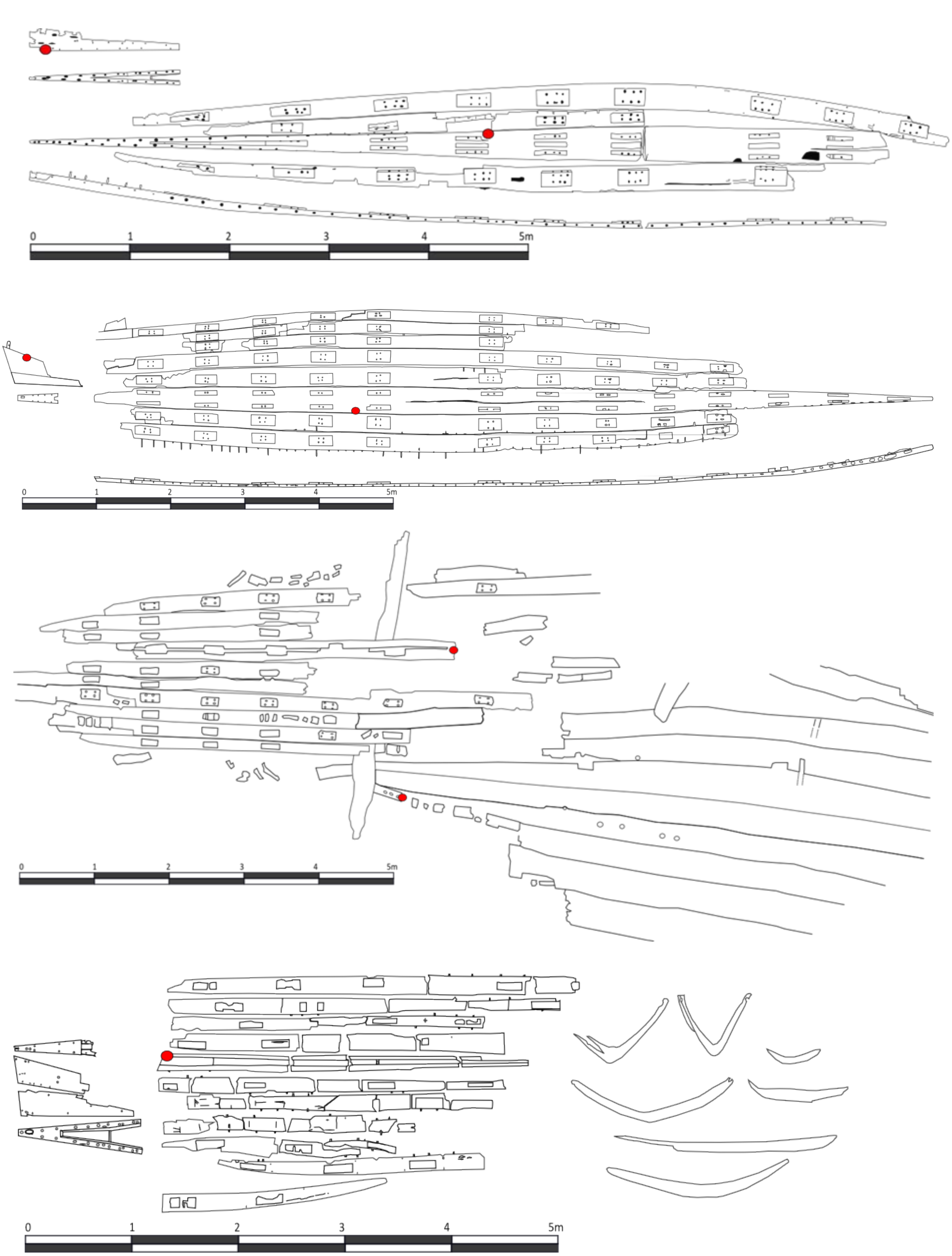

Figure 7-2. Locations of the samples collected from Butuan Boats 1, 2, 4, 9, and 5.

Regardless of their many resemblances and similarities, the results outlined in Chapter 6 clearly demonstrate that none of the boats are entirely the same. And even within individual vessels, their builders' obviously used a variety of techniques. Construction details, i.e., plank patterns, the number and placement of dowels, lug patterns, keel plank design, wing ends, frames, and the kinds of timber used are evaluated here, based not only on new results, but also on previous observations by other researchers, when relevant.

Plank patterns and fastening

Evidence from the Butuan Boats demonstrates that boatbuilders saw the use of a single piece of timber for the keel plank as an integral part of the vessel. The same was practiced throughout the region, until evidence to the contrary began to emerge in the twentieth century. Long pieces of timber were likewise used for the main planking of strakes, with shorter planks added near the ends of the vessel where a curvature was required. In the Butuan Boats, hooked scarfs were commonly employed for this purpose, but there were instances of flat scarfing. Like most lashed-lug boat remains from Southeast Asia, the longer, main planks have survived better in the archaeological record. This could be attributed to a structural weakness resulting from the closely-grouped scarfed joints, and especially in the upper part of the hull where more radical curves were necessary to close the vessel at both ends. This refutes an earlier hypothesis that considered the possibility that this manner of Southeast Asian plank joining was more durable (Clark et al. 1993). The survival of timber pieces would have also depended on site formation processes that acted on their remains after their deposition. A study of the vessels' deposition is unfortunately lacking to date.

The hull construction of the lashed-lug Butuan Boats was accomplished by edge-joining planks solely with the use of dowels that were cut to fit holes measuring 1.5 to 2 cm in diameter. With radiocarbon analysis suggesting that the timbers dated to between the late seventh and tenth centuries, the Butuan Boats are placed chronologically between the seventh- to eighth-century stitched and dowel-joined Sambirejo and Punjulharjo Boats; and the solely doweled ninth- to tenth-century shipwrecks of Chau Tan and Cirebon.

While most of the Butuan Boat dowel holes were difficult to access in 2013, there was no obvious pattern related to their positioning, unlike some of the vessels observed in Southeast Asia, such as the Pontian and Sambirejo Boats, as well as the Cirebon Shipwreck, where they could be related to lug positions (Liebner 2014:252; Manguin 2009:3, 6; 2012:Figure 2). It could be argued, in fact, that as wooden Southeast Asian boats were and still are built by eye, using a fixed pattern or prescribed measurements to position dowel holes would be a departure in the boatbuilders' practice. As well, dowel position patterns were not mentioned by any of the authors of first-hand boatbuilding accounts. The closest to doing so was Barnes (1996), who only stated that Lamalera boatbuilders were careful to stagger the dowels in an alternating pattern on opposite edges of planks. Nonetheless, the fact that an obvious pattern is not now easily discernible in the Butuan Boats does not mean that one was not used. It is worth recalling that the research of Clark and colleagues (1993:153–154, 158), by using carefully measured dowel spacing and statistical analysis of three Butuan Boat 2 planks, determined that dowelling was fashioned in groupings of six. As they suggested, this could have been achieved using some form of template, even if just a mental one, and executed by eye. Now that Butuan Boat 2 has been removed from exhibition and dismantled—this occurred in the last few months—dowel hole measurements can be taken from more planks to confirm previous findings. The future excavations of Boats 4 and 9 will also provide the opportunity to further study dowel patterns, as would the re-examination of other Southeast Asian lashed-lug boats.

Dowel fastenings were absent in a section near the intact end of Boat 2's keel plank, which has been theorised by Clark and co-authors to be the bow (Clark et al. 1993:154–155). Relatively shallow, oblong-shaped depressions carved into the sides of the keel plank were the only indication of fastening (Figure 6-17). These depressions rule out that the boat had a stem or wing end affixed to the keel's upper surface, as was the case on the opposite end of this keel plank (Figure 6-37). The fragmented and mostly missing planking at this end does not offer additional clues. Parallels are also absent from other sites and in written accounts. A possible solution might have been to fasten an altered form of wing end that fastened to the sides of the keel plank rather than to the top. Another option might have seen planks on either side enveloping the keel plank to close the end. The problem remains with how these might have been securely fastened, as there are no signs of locking peg holes. Perhaps internal lashings were employed to pull end components together. These and other possible arrangements need further clarification that may come from newer finds, such as with Butuan Boats 4 and 9, or, in the meantime, with additional experimental studies.

In the cases of Boats 1 and 5, a number of dowels were locked in place with wooden pegs inserted through the planks (Figure 6-41). These also helped to keep planks from coming apart, and were placed at a frequency of every other, or every two dowels. These are consistent with the historical and ethnographic first-hand boatbuilding accounts. Boats 4 and 9 must still undergo further examination to determine whether they utilised locking pegs. But Boat 2 shows that locking pegs were not necessarily an essential part of lashed-lug boat construction. While explanations that opposing compression forces would keep planks together while the vessel was in the water are reasonable, boatbuilders must have also had to foresee situations where additional security was required. Such situations include lifting the boat out of the water, or in sailing rough conditions where waves could crash beneath it. Lashed-lugs again, could have acted as the principal plank fastening in this instance.

The boat model construction experiments at the J. Richard Steffy Ship Reconstruction Laboratory at the Nautical Archaeology Program of Texas A&M University in College Station demonstrated that dowels without locking pins and frames lashed to lugs were insufficient for keeping planks together when force was applied to pull them apart. Conventionally, boatbuilders fastened the frames with ligatures in the aforementioned construction method to one specific lug (Figure 7-3). The addition of lashed thwarts, especially if placed on the sheer strakes of the vessel, could provide better security against plank separation, and thus act as an indirect plank fastening. But it is the Punjulharjo Boat, with many of its well-preserved ligatures still in place, that provides perhaps the simplest but best solution. On the Punjulharjo Boat was evidence of another lashing pattern not depicted in previous examples (Manguin 2012:Figure 6). Here, the boatbuilders secured the frames by passing the ligatures through not just one, but through two lugs from adjacent planks—essentially tying two planks together (Figure 5-22). This example makes a compelling argument for viewing lashed lugs as a separate form of direct plank fastening, and not merely for securing additional components. The practice of cross-lashing should receive more scrutiny as it may provide a new insight into Southeast Asian plank-built boat construction.

Lugs and lashing holes

With the exception of Boat 9, all of the examined Butuan Boats are lashed-lug boats. In a time-consuming procedure that involves considerable timber wastage, boatbuilders carved a series of protruding lugs from the inside of each plank so that when the hull was assembled, all the lugs were aligned transversely. Frames and thwarts could then be secured by ligatures to holes that were drilled through the lugs. These added strength to the boat structure using internal compression. Additionally, as shown earlier, they can be viewed as a separate form of plank fastening. A common pattern of lug arrangement is evident in the surviving lashed-lug Butuan Boats. Lugs were more or less evenly spaced from each other by about a half-metre, except for a noticeable gap of about one metre at the widest part of the boats. One end of the boats appeared to be invariably longer, more

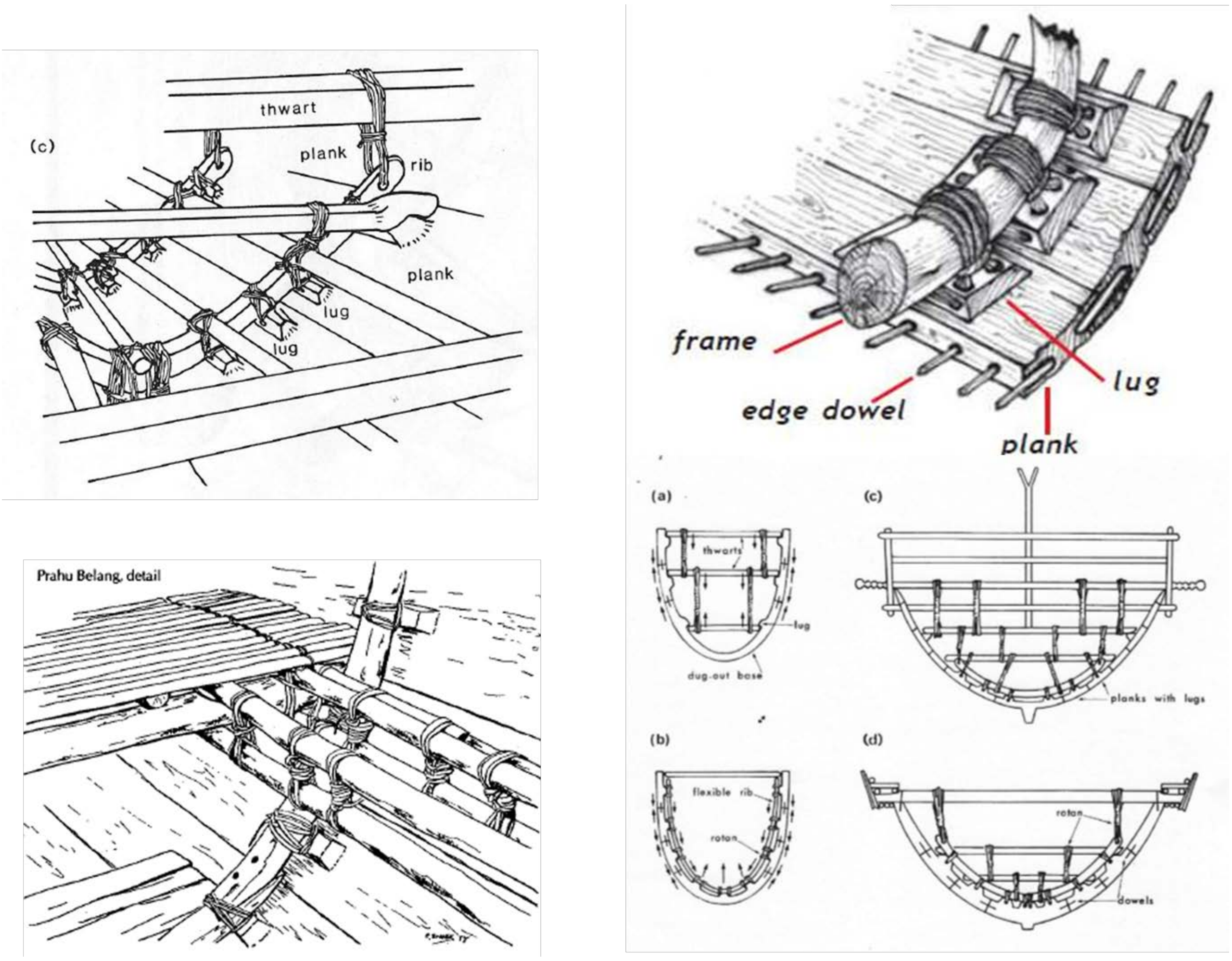

Figure 7-3. Depictions of lashing patterns and techniques by various authors based on Indonesian boats (upper-left, bottom-left and bottom-right; Horridge 1985:52, 53) and a hypothetical reconstruction of Butuan Boat 2 (upper-right; Cuevas et al. 2004:5).

pointed and having a greater number of lugs than the other shorter, more rounded end. Incomplete remains make it difficult to be certain of this, however. Still, the purpose of this gap can only be conjectured, especially as it does not always correspond with a complete gap on the keel planks.

Keel plank

In contrast to the similar lug patterns on the planks, each of the Butuan Boat keel planks' lug arrangements that were observed in 2013 are unique from one another (Figures 7-4 and 7-5). The builders of Boat 1 fashioned the lugs on the keel plank in sets of three individual and relatively narrow protrusions, except for the first two, which are single protrusions, and the third, which is a paired protrusion. The first lug, KP-L1, does not have lashing holes, but does have a single dowel or treenail hole. The second lug, KP-L2 has three lashing holes that were drilled through the width of the protrusion. The remaining keel plank lugs have three pairs of L-shaped lashing holes, drilled from either side of the outer protrusion to the top surface. A few of the holes also extended through the thickness of the lugs, creating inverted T-shaped holes. The three sets of lashing holes on Butuan Boat 1 are unusual in the material record, where sets of two are the norm. They were also crudely fashioned in regards to their positioning. Several of the hole pairings within a single lug were misaligned transversely, particularly on STR-B2, which

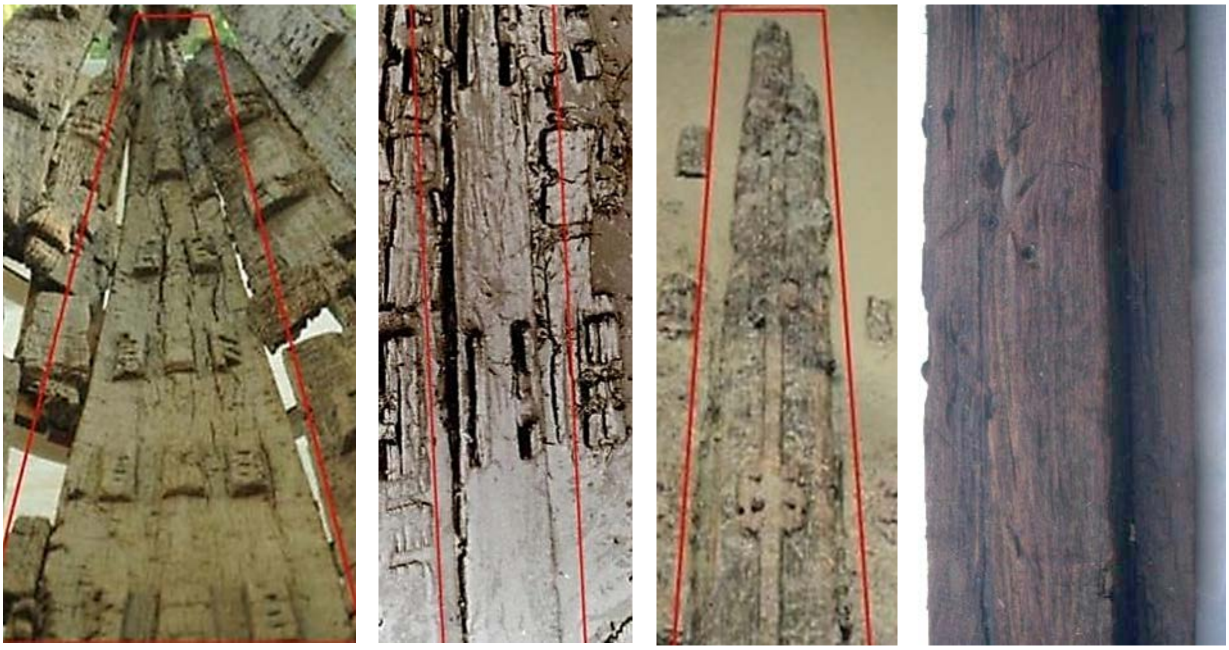

Figure 7-4. Keel planks of Butuan Boats 1 (photograph by author), 2 (photograph courtesy of the National Musem of the Philippines), 4 (photograph by author), and 5 (Photograph courtesy of the Western Australian Museum).

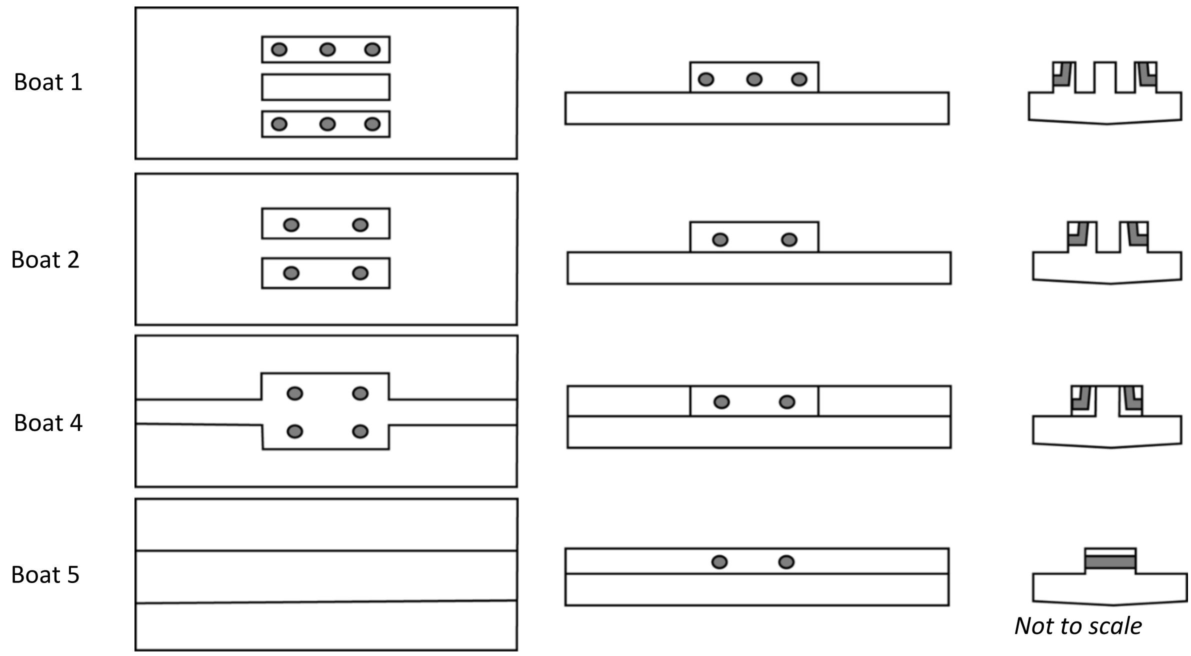

Figure 7-5. Lug arrangements on the Butuan Boat keel planks. Illustration by author.

would have been magnified across several planks (Figure 6-13). Or, on the lugs in which the lashing holes aligned with each other transversely, they often misaligned longitudinally. It is easier to believe that this was a result of careless or sloppy workmanship, rather than an intentional design. The middle protrusions in the lugs KP-L3 to KP-L8 have no obvious function.

The lugs on the keel plank of Boat 2 were generally carved in paired, narrow protrusions and drilled with two pairs of lashing holes, except for the first, KP-L1, a single lug with what appears to be a single oblong-shaped lashing hole carved across it, now badly damaged. Similar lashing holes were fashioned into the next five lugs, KP-L2 to KP-L6. On the remaining lugs, KP-L7 to KP-L13, boatbuilders drilled L-shaped lashing holes from the outer side of the lugs and from their tops.

Boat 4's keel plank was carved with single lugs, as well as a raised ridge that runs through the centre of each of the lugs and the entire length of what remains of the keel plank. While the lugs correspond with those on the planking and leave a gap, the ridge continues through it. Two pairs of lashing holes were drilled through from either side to the top of each lug. This type of keel plank lug arrangement appears similar to what was depicted in the photograph that is believed to show Butuan Boat 3 (Figure 2-6).

The keel plank of Boat 5 stands out from the other keel planks quite distinctly. Instead of individual lugs, it has a continuous raised ridge, with larger dimensions than the ridge on Boat 4. The lashing holes are drilled through the ridge, from side to side, and are mostly in pairs that presumably aligned with the lashing holes on the planking lugs. Single lashing holes were also drilled through the ridge, which like Boat 4, continues over the space that corresponds to where a gap was left by the absence of planking lugs.

That four different keel plank patterns were found on five of the lashed-lug Butuan Boats is surprising. This is especially so in a group of watercraft that were built in the same technical tradition. Keels and keel planks are the foundation of all plank-built watercraft, and the expectation would be that a single standard, rather than a variety of designs would be utilised. These differences may be the result of functional or aesthetic reasons. The four keel plank patterns on the Butuan Boats can then be divided into two different types. The builders of Boats 1 and 2 made use of multiple-protrusion lugs, while the builders of Boats 4 and 5 (and possibly Boat 3) utilised a continuous raised ridge. Boats 3 and 4 can then be considered to use a variation to the continuous ridge design, which is combined with individual lugs.

Multiple-protrusion lugs

The act of carving lugs from planks is time-consuming and labour-intensive. Why then, did boatbuilders add to this by further carving out multiple, narrow protrusions from a keel plank? A possible reason could be the reduced weight when compared to using a larger, single lug. This then leads to a further question of whether this weight reduction makes a significant difference to the vessel as a whole that makes the extra effort worthwhile. The middle protrusion in three-protrusion lug sets provide another puzzle as to their purpose. If they were intended to offer additional support for a frame, or strength to the keel plank, this could have been better achieved by using a wider pair of protrusions or a larger, single lug. There are then the negative consequences to using narrow protrusions that must be considered. Fashioning lashing holes, especially the L-shaped variety, with diameters that are only slightly smaller than the dimensions of the protrusions they are drilled through, must lead to an increased risk of ligatures completely "sawing" through a smaller segment of the lug. Occurrences of this are evident in many of the keel plank lugs of Butuan Boats 1 and 2. When this happens, the lashing hole then becomes effectively useless, and the main function of the lug is negated.

Continuous raised ridge

A continuous raised ridge runs along the centre of the keel planks of Butuan Boats

4, 5, and possibly 3. Besides the lashing holes that align with those on the rows of lugs on the hull planking, the ridge allows the drilling of supplementary lashing holes if needed. This was evident in both Boats 4 and 5, where single holes were found away from the regular frame-lashing pattern. The horizontal lashing holes drilled through the sides of the ridges are probably better-suited than L-shaped holes, given the dimensions of the ridges that were fashioned on these boats. Using L-shaped lashing holes here would create the same problems seen with Boats 1 and 2—faster wearing as a result of ligatures tensioned over a smaller surface area. Again, this is supported by evidence on Butuan Boat 5: despite the generally poor preservation of its timbers, and though the holes show signs of wearing, they have survived largely intact.

Butuan Boat 4 has individual lugs in addition to the continuous ridge, which align with planking lugs. The lashing holes on these lugs are formed in L-shapes. To compare with the Boat 5 keel plank ridge, the ridge on Boat 4 is shallower and less broad, and much of it after the third lug has been damaged. At this point it is difficult to ascertain the reason for the damage. It could have resulted from wearing, which would be expected based on its slight dimensions; or from the destructive digging activities of looters.

Apart from offering more choices for lashing hole locations, the ridge could also provide additional longitudinal stiffness as it effectively increases the thickness of the keel plank along its centre. This possible function can again be negated when ligatures that pass through their lashing holes eventually wear and split the ridge apart at sections. Worse, this would create specific weak points within the keel plank. Another possible function of the ridge was offered by Lamalera boatbuilders who explained to Barnes that the ridge running through the middle part of their keels protected the hull from being worn thin when bailing water (Barnes 1985:347; 1996:206). On the other hand, Clark and his co-authors (1993:155) reported that the midships portion of modern Indonesian boats is kept clear to facilitate bailing.

These technical and functional issues regarding keel plank lug patterns could be less relevant if the designs were purely based on the personal or aesthetic choices of the master boatbuilder. They of course could be a combination of form and function, though more evidence is needed before substantive answers are offered. Nevertheless, the small sample of Butuan Boat keel planks show a surprising variety of styles for such an integral boat component. Even more so since these are found within a specific boatbuilding tradition, and at a particular period in time.

Planks

All other planks of each of the Butuan Boats generally have lugs carved of single rectangular protrusions which were drilled with the same number and in the same fashion as the lashing holes of their respective keel planks' lugs. With some exceptions, the lugs on the planks of Boat 1 have three pairs of L-shaped lashing holes, while the Boat 2 planking lugs have two pairs of L-shaped lashing holes. Some of the badly degraded Boat 4 lugs have lashing holes that appear to also be L-shaped, but others seem to have lashing holes drilled transversely across the width of the lugs, much like most of the lugs on the planks of Boat 5. Again, Boat 5 has exceptions to this, with some holes also drilled from the top.

An apparent commonality between Butuan Boat lug patterns is the gap amidships that divides the lugs into forward and aft sections. While determining which is forward and aft on any of the boats is unresolved, one of these sections is longer and contains a greater number of lugs than the opposite section. The purpose of the gap dividing the two sections is also undetermined.

For properly securing frames with ligatures, lashing holes would optimally be spaced in such a way that they were located just outside the sided dimension of the frames. If they were more closely spaced, i.e., narrower than the frame thickness, the ligatures would wear and fray more easily from sitting between the lug and the frame, and receive direct pressure and friction from both. If they were set farther apart, then the lashing could not properly prevent the frame from moving, unless frapping or tightening turns were made with the ligatures. This hypothesis is difficult to confirm, as little direct evidence was found on the Butuan Boats; only a few frames were recovered with the remains, and of these only a small fragment was still attached by ligatures to Boat 2 lugs. The photograph of this frame fragment crudely lashed to the keel plank and garboard strake of Boat 2 is difficult to assess, but it appears that the lashing holes are spaced slightly narrower than the frame thickness (Figure 2-10). In the case of Boat 5, the frames were not recorded in situ, and so they could not be matched with the now disarticulated planks to which they were fastened. Their disarticulated planks likewise preclude the confirmation that lashing holes within rows of lugs were aligned. Then there are the cases of misaligned lashing holes within individual lugs on Butuan Boat 1. Again, the Punjulharjo Boat lashing can be reviewed for comparison (Figures 5-20 and 5-22). In this case, the lashing holes are slightly wider apart. Frapping turns were used at the top of the frame but not next to the lashing holes. Perhaps the Punjulharjo Boat builders intended to allow some slack into the frame fastenings.

Another aspect relating to lashing holes is the manner in which they were drilled. If done incorrectly, the holes can easily be worn or damaged to the point of becoming useless. And unlike ligatures, a lug cannot be renewed without replacing the plank that contains it. Thus, the holes must be spaced far enough from the edges of the lug. But with the Butuan Boats, many of the lashing holes were observed to be only marginally smaller in diameter than the thickness of the lugs that contained them. Particularly with the narrow protrusions of the keel plank lugs of Boats 1 and 2, the choice to fashion L-shaped holes is puzzling, especially as many of them had been worn completely through. The same goes for the relatively large oblong-shaped lashing holes on the first six lugs of the Boat 2 keel plank. Damage coming from the constant strains caused by tensioned ligatures could have been minimised by using smaller holes, or larger lugs. Lugs on the Punjulharjo Boat are examples of how lashing holes might be better executed, leaving enough play for wearing (Figure 5-22).

Frames

In the course of this research, only the seven frame fragments from Butuan Boat 5 could be accessed for study. None of these were recorded in situ, and excavation reports make no mention of them (ASEAN 1986). At least Frames 1 and 6 (and probably 4) were floor timbers. At least two, Frames 1 and 4, have surviving ends that were carved with hooks. These hooks, which may have originally been holes that were since damaged, were likely used for securing the frames by ligatures to lugs or other components.

Wing ends

The fore and aft ends, and therefore the port or starboard sides, of any of the Butuan Boats have been yet to be determined. A wing end, however, has been found on each the boats, with the exception of Boat 4, where the ends have yet to be unearthed. None of the Butuan Boats survived with both ends intact, so the manner in which these ends were closed can only be speculated. Besides also using a wing end, there are several other possibilities based on ethnographic and historical evidence. These include using an end post, or simply closing the planks by fastening them directly to each other.

The wing end of Boat 1 was fastened to the upper surface of the intact end of the keel plank with dowels, some of which were locked in place with pegs. The wing end of Boat 2 was fastened to a keel plank fragment with unpegged dowels, while a locked mortise-and-tenon, as well as unpegged dowels were used to fasten an additional component to its upper surface (Figure 6-37). These components could have been plank ends, or as with the case of Butuan Boat 5, another wing end piece. A hypothetical reconstruction drawing by Vosmer depicts one possible end pattern for Boat 2 (Figure 7-6; Clark et al. 1993). The two parts of the Butuan Boat 5 wing end were fastened to each other with dowels, most of which were locked in place by pegs (Figure 7-7). The wing end of Boat 9, on the other hand has yet to be fully unearthed, and thus still needs to be examined more closely. Dowels were apparently used to fasten additional components to its upper surface, according to preliminary observations (Figure 7-8).

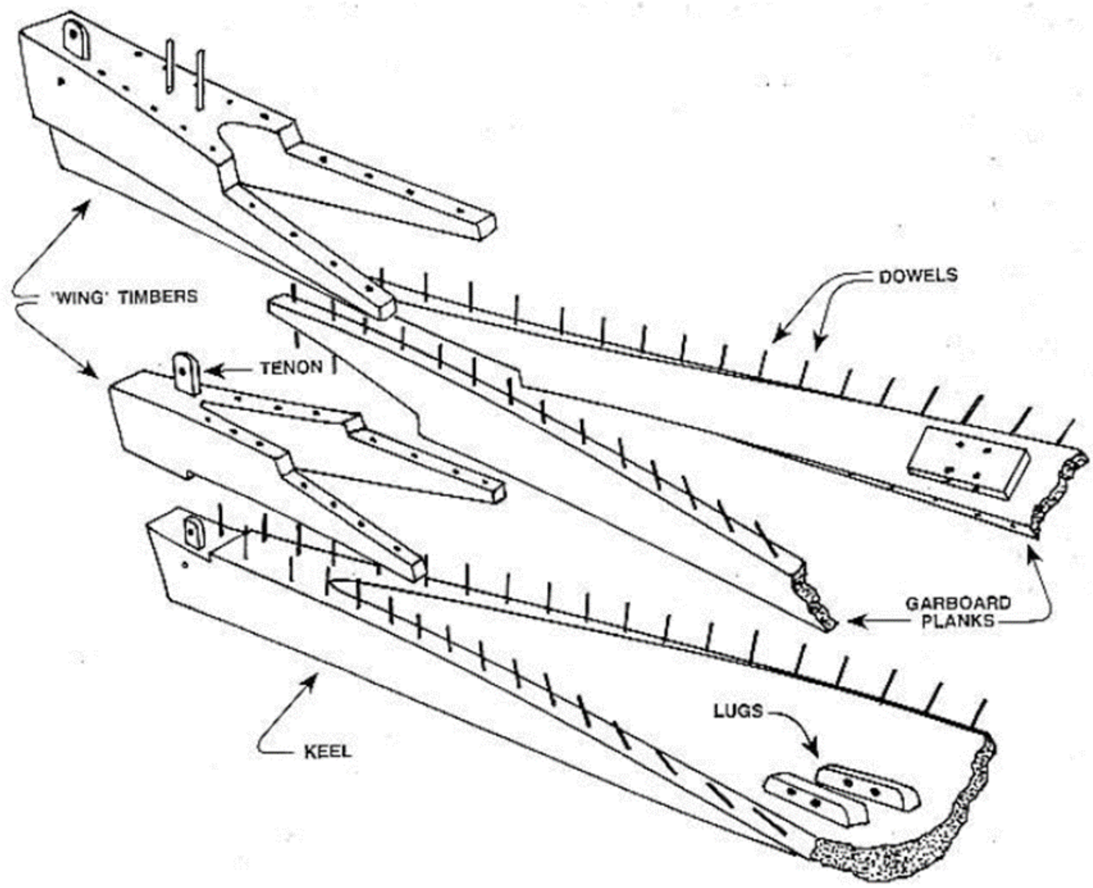

Figure 7-6. Hypothetical reconstruction of the Butuan Boat 2 wing end b Vosmer (Clark et al. 1993).

Figure 7-7. The two parts of the Butuan Boat 5 wing end assembled to a keel plank fragment. Locking peg holes are apparent on the sides of the wing end pieces. Photograph by Paul Clark, courtesy of the Western Australian Museum.

Timbers used

The characteristics and uses of the ten identified tree genera and species were described in the previous chapter. They are again reviewed here, but are evaluated according to the boat components for which they were employed.

Keel plank and planks

With the exception of Boat 1 (and possibly Boat 9, the planks of which are yet to be identified), the wood used to fashion the keel plank was the same used for their respective boat's planking. Four different species of trees were selected for the keel planks of five boats. The builders of Boat 1 used a timber identified as a *Shorea* species. The keel plank of Boat 2 was fashioned from a *Hopea* species timber. A *Vatica* species timber was chosen for the keel planks of both Boats 4 and 9. Finally, the keel plank of Boat 5 was produced from *Pistacia chinensis*.

Shorea species timbers, being fairly widespread and growing in abundant numbers throughout the Philippines in the twentieth century, also possessed properties that were suitable for boat and ship construction: it was known to resist marine borers, and as resilient in wet conditions.

The *Hopea*-species wood used for Boat 2 was not known for its use boatbuilding in contemporary times, but was used for heavy construction such as for bridges. The timber that was initially and mistakenly identified from Boat 2 timbers, *Heritiera littoralis*, was

Figure 7-8. Butuan Boat 9 wing end. Photograph by author.

noted for boat- and shipbuilding-use, as well as for pilings, posts, bridges, and wharf-construction, among others (Meniado et al. 1975:328).

Like *Hopea*, *Vatica* was not especially known for use in boatbuilding. Its other uses, however, such as in the construction of bridges, wharfs and especially saltwater piles, demonstrate its suitability for the marine environment.

The use of *Pistacia chinensis* is somewhat unusual. The tree is not readily available to Philippine coastal populations, as it grows at altitudes greater than 700 m, and even then, only sparsely in the country's northern regions. It is not widely distributed in Southeast Asia, but is more commonly found in China and Taiwan where its use for rudder post production was noted. *Pistacia chinensis* is not known as a boatbuilding timber in Southeast Asia, and in the Philippines the wood is used for making smaller carved craft items.

As noted above, the planks of the Butuan Boats were fashioned from the same trees as their keel planks, the exception being Boat 1. Three different tree varieties were used for its five planks that were identified: *Shorea* species, *Vatica* species (both already discussed), and *Peterianthus quadrialatus*. This tree grows abundantly in certain locations in the Philippines, including the Agusan province where Butuan is situated. While this wood is suited for use in the outdoors, its use for watercraft construction was not noted. It is prone to warping while being seasoned but if properly seasoned it is hard to work. This attribute of *Petersiantus quadrialatus* brings to mind Alcina's report that hull timbers were carved, formed, and assembled to five or six strakes while green, then left to dry for one to two months before being disassembled, reassembled, and completed

(Alcina 2005 [1668]:171). Barnes, on the other hand, stated that Lamalera boatbuilders preferred that wood to be used for hull planking be roughly formed in the forest just after their trees were felled, then brought back to the village to season, sometimes for years, before being utilised (Barnes 1985:353). It is likely that as with seventeenth-century Dutch shipbuilders, Philippine and Southeast Asian boatbuilders were aware of which timbers worked optimally for their purpose, whether green or well-seasoned (Van Duivenvoorde 2015).

Frames

Only Butuan Boat 5 frames were available for timber analysis. Three of these were identified as *Vitex parviflora*, while the remaining four were identified as *Dimocarpus* species. *Vitex parviflora* is found throughout the Philippines but in limited numbers. It possesses qualities that make it suitable for boat- and ship-building: it is a hard and durable timber that is easy to work. Its bole usually grows crooked and has large buttresses, so it is a good choice for builders that require naturally curving wood. It is susceptible to marine wood borers, though boat frames are better protected from such an infestation. This suggests that boatbuilders were aware of this property and thus intentionally chose to use this wood for frames. Interestingly, a *Vitex* tree (the species was unspecified) was favoured by Lamalera boatbuilders for their keels (Barnes 1985:347, 353); though the practice of regularly hauling their boats to shore would discourage infestation. The availability of *Dimocarpus*-species trees is similar to *Vitex parviflora*. It also generally shares the same attributes, with the exceptions being a moderate resistance to marine wood borers and that it is difficult to work.

Wing ends

Samples from the wing ends of Boats 1, 2, 5 and 9 were collected for identification. The wing end of Boat 1 was hewn from a *Shorea*-species wood. The wing ends from Boats 2 and 5 were fashioned from *Pterocarpus indicus*. The sample from Boat 9, however, could not be identified because of its poor condition.

Pterocarpus indicus is found through much of Southeast Asia. As it is considered a high-quality wood that is durable and moderately resistant to termites, its uses are mostly decorative. In twentieth-century shipbuilding, it was used for interior finishing, rather than for structural purposes. While it can grow to a considerable height, its trunk is irregular and fluted, but can grow to a diameter of 2 m. This irregularity in the trunk shape would preclude it from use for hull planking in the Butuan Boats where longer timbers were required. Lamalera boatbuilders, however, who used shorter planks of wood, preferred this timber for the lower hull planking of their whaling boats (Barnes 1996:211)

Dowels

Dowel sampling was minimal and insufficient for drawing any meaningful conclusions about preferred woods for this use. Only two dowels, one from Butuan Boat 1 and another from Butuan Boat 5, were identified as *Petersianthus quadrialatus* and a *Dimocarpus* species, respectively. Both woods were also used to hew components from their respective boats, namely a plank fragment in Boat 1 and four frame fragments in Boat 5.

Quarter rudder

The quarter rudder blade from a Butuan site was carved from *Eusidederoxylon zwageri*. The provenience of this artefact is uncertain, but it is possible that it was recovered by the looters who unearthed Boat 1. The wood's availability in the Philippines was limited to Jolo and Sulu in the south, but nowadays it is found in Indonesia. It is known to be durable, resistant to pests and marine borers, but difficult to work.

The variety of timbers utilised for the relatively small sample of surviving Butuan Boat remains make it difficult to reach any definitive conclusions regarding their use. Extending the sample to include identified timbers from other sites does not help as the variety of tree species is likewise broadened. Even general declarations regarding the use of preferred trees for specific boat components will have significant exceptions or qualifiers. This includes statements about the use of a single tree-type for the hull planking, including the keel plank, of individual boats. Butuan Boat 1, in particular, generally has a high ratio of the number of timber species identified to the number of samples that were analysed. This might be explained by repairs that required a replacement of planks. On the other hand, there is documented evidence in southern Taiwan where boatbuilders call for specific and different tree species for use in their planking patterns (Kano and Segawa:306, 314, 320).

Summary

From examining the Butuan Boats, this chapter has demonstrated that traditional

Southeast Asian plank-built and lashed-lug watercraft are complex in their diversity. Boatbuilders from this region undoubtedly adhered to uniform concepts of lashed-lug watercraft construction that persisted for at least 1,500 years: metal fastenings were not used, planks were edge-joined and carved with lugs, and the lugs were drilled with holes to secure frames, thwarts and other components with ligatures. But the manner in which these concepts were executed and implemented by the Butuan Boat builders were so varied that it might be suggested that using such a variety is part of their tradition. This and other observations that have come to light now help to address the research aims and questions in the next and final chapter.

Chapter 8 Conclusion

This dissertation set out to examine the nature of Southeast Asian watercraft construction, for which specific research aims and questions were put forward. In the course of seeking to address the aims of this research, historical, ethnographic, and archaeological evidence was sought in order to present an overview of the region's maritime history, show the early but vague accounts of watercraft used in the region, the later detailed accounts of boatbuilding, and finally the archaeological evidence of lashed-lug watercraft. The initial information presented, particularly the archaeological research of lashed-lug boats and their construction features, revealed a number of gaps and inconsistencies which needed to be clarified. To do this, the Butuan Boats that were first unearthed in the 1970s were re-examined. The results of new Butuan Boat research, which brought to light a great number of differences in otherwise similarly-built vessels, have aided in providing answers to the questions asked. At the same time, new issues were raised, and the potential for future and worthwhile research has arisen.

Research questions addressed

The three main research questions which guided this dissertation are repeated and addressed here. The first question was:

Can the archaeological and historical study of pre-colonial Southeast Asian plank-built boats contribute to identifying the existence or non-existence of a regional boatbuilding tradition?

Recalling the most basic definitions of the word, a tradition implies a cultural continuity and transmission of customs from one generation to the next (Shils 1981:12, 15). In boatbuilding, a tradition is perceived as a particular style that is seen within a certain region at a point in time, even among a great range and variety of styles found in one culture (Hocker 2004b:7–8; McGrail 2001:10; 2014:4).

Based on the above, the written and material record confirms the existence of an enduring technical tradition in the construction of plank-built watercraft in Southeast Asia. This is evident from the easily perceived diagnostic characteristics of edge-joined and lashed-lug construction techniques. This tradition, which for brevity is referred to as the "lashed-lug" tradition, entails an extremely involved process that begins with preparing the keel piece and hull planking with a series of protrusions, or lugs. When the hull is assembled by edge-joining with dowels, and sometimes in combination with lacing, the lugs align with each other in rows that run along the breadth of the vessel. The rows of lugs are drilled with holes and used primarily to fasten frames, thwarts and other vessel components, with ligatures to lash them together. Evidence from one site, in Punjulharjo, Indonesia, confirms that in addition to this, lashed lugs also acted as a plank fastening, to supplement dowels and lacing (Manguin 2009; 2012).

Based on the Pontian Boat, lashed-lug watercraft existed from the third to fifth centuries, at least a millennium before the arrival of European colonists to Southeast Asia (Booth 1984; Burleigh et al. 1977; Evans 1927; Gibson-Hill 1952; Goddio et al. 1996; Manguin 1985). Throughout the region, particularly in the maritime realm, the use of vessels built in this manner continued subsequent to that time as other material evidence, dating to nearly all centuries A.D., have been located in places such as Malaysia, Indonesia, the Philippines, Vietnam, and in neighbouring Hong Kong (Cuevas et al. 2004; Frost 1974; Ho and Ng 1974; Horridge 1978; Liebner 2014; Manguin 1989, 2009, 2012; McGrail 2001; Nishino et al. 2014; Santiago 1997). Historical accounts dating to the sixteenth, seventeenth and nineteenth centuries corroborate this. The authors of these accounts provided explicit descriptions of lashed-lug watercraft construction features in the Moluccas, eastern Indonesia and the central Philippines (Alcina 1960 [1668], 2005 [1668]; Rebello 1569; Wallace 2014 [1869]). While lashed-lug boat construction began to decline sometime in the nineteenth to twentieth centuries, ethnographers observed the persistence of the lashed-lug tradition well into the late twentieth and early twenty-first century, particularly in the whaling village of Lamalera, Indonesia (Barnes 1985, 1996; Horridge 1982; Hornell 1920, 1936). Also in the twentieth century, related traditions of edge-joined vessels with lugs (that were not always used for lashing) were also noted to extend geographically beyond Southeast Asia into Taiwan, the Solomon Islands in Oceania, and the Maldives in the Indian Ocean (Barnes 2002; Hornell 1936; Kano and Segawa 1956; Millar 1993).

The confirmation of such a boatbuilding tradition in Southeast Asia leads to certain issues raised by maritime archaeologists. These issues mainly relate to reconciling the perception of stasis that is linked with the concept of tradition, to the technological achievements and advancements that are associated with the development and construction of watercraft (Adams 2013; Muckelroy 1978). In the case of Southeast Asian lashed-lug watercraft, how do these seemingly incompatible concepts manifest in their construction? This is related to the second research question:

Can typical or atypical construction features of pre-colonial Philippine plank-built boat technology be identified?

From the time regional archaeologists became aware of their existence, lashed-lug watercraft were for the most part, seen as a convenient material representation of historical reports. In the Philippines in particular, Alcina's work was used as the main source of information in explaining Butuan Boat construction (Alcina 1960 [1668], 2005 [1668]). Reasonably enough, the direct confirmation of historical descriptions of lashed lugs and dowel-joined hull planking in the archaeological record was already sufficient evidence of a characteristic pre-colonial Philippine boat (Peralta 1980 a, b). Hence, the Butuan Boats were initially called *balanghai* after Pigafetta (1903–1905 [1525]-a, b), who only ever defined these craft as the larger Philippine boats. Other details and construction features that were described by Alcina, such as stems and peg-locked dowels, were assumed to be present in all Butuan Boats. In saying this, the lashed-lug Butuan Boats do share a number of obvious similarities. Besides the dowels and lashed lugs, their boatbuilders used no metal fastenings, and they endeavoured to fashion keel planks (and not true keels) from single pieces of wood. The same can be said for the main hull planking, where additional shorter pieces were only used when a curvature was needed to close the ends of the boats. All of the Butuan Boats with at least one end unearthed bore a wing end. Wing ends were not explicitly mentioned in the most detailed of sources of lashed-lug boat construction, which instead suggested that stems and stern posts were used. A common lug pattern was also observed on the boats. The midships area of each of the Butuan Boats were left with a space of about 1 m where lugs were absent. Otherwise, the lugs were spaced from each other at roughly regular distances of about 50 cm. The boatbuilders also fashioned one end of the boat on either side of the midships gap to be longer than the other side.

But as demonstrated in the Butuan Boat research conducted for this dissertation, a great many atypical features were also identified. This is also true for the commonly recognised typical features which are implemented in various fashions. The most glaring example of this is the use of four different types of lug patterns found on the four examined Butuan Boat keel planks. The Butuan Boat 1 keel plank generally has three protrusions within each lug set, except near the intact end where it is wide enough to accommodate only one or two protrusions. These protrusions are narrower than the lugs found on its planking. Out of the three-protrusion lug sets, the two outer ones were drilled with three lashing holes, generally formed from the outer surfaces to the top surfaces to make an L-shape. Some of the holes drilled from the sides, however, extended through the entire width of their protrusions, and formed an inverted T-shape.

On Butuan Boat 2, the keel plank was patterned with narrow paired-protrusion lug sets, except, again, near the intact end where only one protrusion could fit. The lashing holes on this keel plank were generally made in sets of two (there was only one on the single, first lug). These were fashioned in two different ways. On lugs KP-L2 to KP-L6, two oblong-shaped lashing holes were carved through the thickness of the lugs. On KP-L7 to 13, two pairs of L-shaped lashing holes were made, in the same manner as with Boat 1, that is, drilled from the outer surface to the top of the lugs.

Butuan Boat 4 was found with a keel plank consisting of singular lugs that were of a comparable size with planking lugs. The keel plank lugs, however, were linked by a raised ridge that ran continuously down the length and through the centre of the keel plank. Two pairs of L-shaped lashing holes were fashioned into the keel plank lugs of Boat 2. Additional lashing holes were also evident on the keel plank ridge, drilled through opposite sides. These might be assumed to be supplementary holes needed to secure additional components. The keel plank of Butuan Boat 3 may have been fashioned in the same manner, though this is based on the assumption that the boat was the subject of an unlabelled Butuan excavation photograph depicting poorly preserved timbers.

Finally, the Butuan Boat 5 keel plank has no lugs, only a continuous ridge that runs through the centre of the keel plank for its entire length. Pairs of lashing holes were drilled through its thickness at intervals that presumably coincided with the lashing holes on those of the planking lugs. And like Boat 4, single lashing holes were also found along the ridge.

Another example of divergent construction methods are seen in plank fastenings. Out of the three Butuan Boats that allowed for close examination, Boats 1 and 5 contained pegs that locked selected dowels into place within the planks, as was described in first-hand boatbuilding accounts (Alcina 1960 [1668], 2005 [1668]; Barnes 1985, 1996; Wallace 2014 [1869]). Boat 2 is the exception as no locking pegs are evident in any of its planking. While compression forces might have been enough to keep its hull from opening in ideal sailing conditions, it is difficult to imagine that its boatbuilders did not make provisions for additional plank security. Very little of the Butuan Boat 2 ligatures survived, but an assumption may be made that lashed lugs could have been intended by boatbuilders to act as primary plank fastenings with ligatures tying adjacent planks tightly together. The Punjulharjo Boat evidence clearly shows how this was achieved (Manguin 2012). In addition, placing thwarts on the upper hull or sheer strake, and lashing them to the lugs or frames in the lower hull, would also aid in plank fastening.

Also worth mentioning is the assortment of timbers used for the Butuan Boats. Ten timber varieties were identified from 58 wood samples (one of the samples, the wing end from Boat 9, could not be identified due to its poor preservation). Among just the keel planks of the four sampled lashed-lug Boats, four different types of timbers were used: a *Shorea* species for Boat 1, a *Hopea* species for Boat 2, a *Vatica* species for Boat 4, and *Pistacia chinensis* for Boat 5. The non-lashed-lug Boat 9 keel or keel plank was also fashioned from a *Vatica* species timber.

It could almost be said that hull planking was generally made from the same wood as their respective keel planks. This is true for Butuan Boats 2, 4, and 5—the hull planking timbers of Boat 9 have yet to be analysed. Boat 1, however negates the abovementioned statement. Out of the five hull fragment samples, including one from the keel plank, that were submitted for analysis, three different timbers were identified. If the Butuan Boat 1 builders chose different types of timbers intentionally, this would be comparable to the Yami boatbuilders in southern Taiwan (Kano and Segawa 1956). Another plausible explanation might be that repairs to Boat 1 were undertaken that required planks to be replaced using any adequate timbers that were available.

The assemblage of Butuan Boats built in the lashed-lug tradition share both considerable similarities and differences, as discussed here and in the previous chapter. It is now worth pondering how these Philippine lashed-lug boats, unearthed from generally the same area, in similar conditions, and dated to the approximately the same time period at least 1,000 years ago, fit in the context of Southeast Asian maritime history. To do so, the final question is posed:

What was the character of maritime contact during the pre-colonial period in the Southeast Asian region and how did this influence local boatbuilding practices?

The oldest evidence of hominins in Southeast Asia occurs in regions that were always isolated by water. *Homo Floresiensis* fossils found on Flores island in Indonesia were securely dated to 700,000 years ago (Brumm et al. 2016). A human metatarsal fossil dating to 66,700 years ago was recovered from Callao Cave, in the Philippines' Cagayan Valley (Mijares et al. 2010:3–4). Movements into Australia must have also passed through island Southeast Asia at least 50,000 years ago (Balme 2013; Bednarik 2003; Bellwood and Glover 2004; Détroit et al. 2004; Green 2006). Other scattered evidence for early human occupation in island Southeast Asian sites date from around 20,000 years ago and later (Bacus 2004; Bellwood and Glover 2004; Détroit et al. 2004; Lewis et al. 2008; Ronquillo 1998b).

But it was not until some 5,500 years ago with the movements of Austronesian-speaking peoples from Southern China and Taiwan into Southeast Asia, however, that a clearer picture of regional maritime networks began to take shape. Austronesian speakers covered vast distances over water—sailing through all of maritime Southeast Asia, west across the Indian Ocean to Madagascar, and east through the Pacific islands up to Easter Island—to make Austronesian the most widely used language family in world history (Bellwood 2004:25, 28; Blust 2011:539; Glover and Bellwood 2004:1; Ricklefs et al. 2010:4; Tyron 2006:19). Interactions between different Austronesian communities throughout the region was continuous, and this is supported by evidence of shared, multifaceted material culture that includes common practices in agriculture, animal husbandry and domestication, pottery-making, metallurgy, writing, religion, and of course, boatbuilding (Bellina and Glover 2004:68; Bellwood 2004:36; Bellwood and Glover 2004:4; Doran 1981; C. Higham 2004:57; Horridge 1982, 1995; Manguin 1993; McGrail 2001). There was also evidence of trade in items such polished and ground stone tools, red-slipped pottery, clay spindle whorls, stone barkcloth beaters, shell implements, glass beads, and exotic stone such as nephrite and obsidian (Bacus 2004:263; Bellwood 2006:98).

Chinese dynastic texts from early in the first millennium describe commercial contact with polities in Java, and by the tenth century, commerce had extended to much of the maritime realm of Southeast Asia (C. Higham 2004; Ricklefs et al. 2010; Scott 1989). In Philippine markets, Chinese items were sought after and traded for resins, aromatic woods, rattan, beeswax, cotton and other fabrics, civet, gold, pearls, sea cucumber, tortoiseshell, bird's nests, and slaves (Francia 2010; Scott 1984, 1989). Trading-and-raiding was a common maritime activity that was practiced in the archipelagos using sleek and fast outrigger boats known as *caracoa* or *kora-kora* (Scott 1982).

The continuous interactions throughout the Southeast Asian region that were carried out over water must have brought about a great deal of cultural influence to its participants. A shared boatbuilding tradition, of lashed-lug construction, in particular, can no longer be in doubt following the evidence presented. Lashed-lug boats were but one of many examples of a shared regional material culture. The reasons for its persistence long after contacts with foreign influences, from elsewhere in Asia, as well as Europe, are supported by accounts written by Alcina, Rebello and Wallace, who assert their admiration for the durability of lashed-lug boats, as well as their suitability in the island and coastal environs of Southeast Asia. The reasons for the eventual decline of lashed-lug boat construction may be attributed to the availability of suitable timbers—commercially-cut timbers became more easily obtained as suitable trees were likely scarce as a result of deforestation. A similar situation was described in the Maldives (Millar 1993). The same reasons could have also led Lamalera and Yami boatbuilders to use shorter timber segments in constructing their plank-built boats.

Less easily explained is the wide variety of building methods seen in the lashed-lug Butuan Boats, that were used (and possibly built) in the same locale and during the same period. Unfortunately, this cannot be answered with any certainty, especially at this point and until more detailed evidence from other regional lashed-lug boats begin to surface. Even that may only allow slightly more educated guesses than are offered here. Knowing with certainty the thoughts, motivations and intentions of a boatbuilder is of course unachievable. But it is worth repeating that a combination of material, technological, aesthetic and symbolic factors must have influenced a boatbuilder's choices.

Recommendations for future research

As it seems typical of any worthwhile research, the more that is learned reveals even more that remains unknown. The complexity of the construction of lashed-lug boats seems to have been taken for granted by most. As this research has shown, by looking a bit more closely at details with a critical eye, a considerable advancement in knowledge was achieved. This does not mean that Butuan Boat research is done and finished. One aspect of Butuan Boat construction that begs for explanation is the varied and distinct approaches used to implement the edge-joined and lashed-lug boat construction tradition. There is so far not enough data to be able to tell how normal or unconventional such a practice was. Great potential for further learning lies with the resumption of the archaeological excavations of Butuan Boats 4 and 9, and of course with the possible investigation of new lashed-lug boat sites that may yet be reported. But it is worth revisiting the recovered and re-examined Butuan Boats once more. Since Boat 2 was recently dismantled and removed from exhibition, there is now an opportunity to examine its fastenings more closely. The use of new technology must of course be utilised for recording the boats, with photogrammetry and laser scanning now more easily accomplished than in the past. Similar studies on other previously recovered lashed-lug boats in and around the region are strongly encouraged, in order to broaden the database so that meaningful trends throughout time and space might be seen more easily.

Another revelation gained from this study is how limited the formal knowledge of Southeast Asian watercraft is in general. This includes past and present examples. There is much validity in recording contemporary boats and boatbuilding, if only to preserve knowledge of what is now a quickly-changing practice. It is also important to study more closely other Southeast Asian boatbuilding traditions, such as those that contain a so-called hybrid of Chinese and Southeast Asian construction influences. Knowledge acquired from such research can very well inform lashed-lug construction, and vice versa.

To close, it is worth reiterating the importance of using a particularist methodology when first pursuing research into watercraft. The perspective that views ships and boats as the most complex technological achievement that was produced for most of humankind's past might now be considered almost cliché. This study of a single, regional boatbuilding tradition from 1,000 years ago and the data that resulted from it has hopefully added valid reasons to why this perspective has justifiably endured.

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