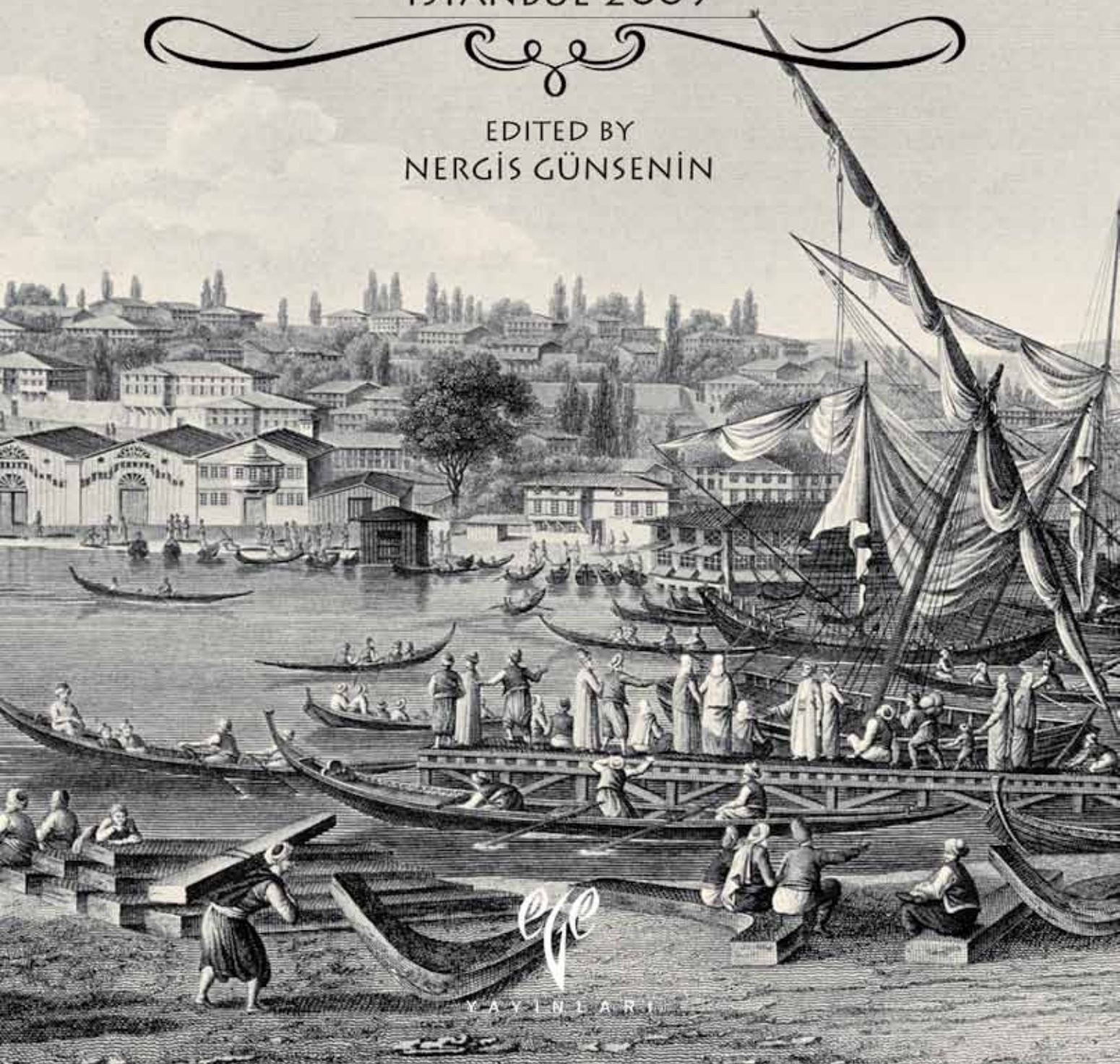
BETWEEN CONTINENTS

Proceedings of the Twelfth Symposium on Boat and Ship Archaeology

Istanbul 2009

Edited by
Nergis Günsenin



YAYINLARI

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ISBSA 12

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5. Kızılburun Column Wreck Preliminary Hull Analysis: Maximum Results from Minimum Remains

John D. Littlefield

Introduction

In 1993, a survey team from the Institute of Nautical Archaeology (INA) at Texas A&M University discovered five shipwrecks off the southwest Turkish coast (Pulak & Rogers 1994: 17-21). The sites lie off the Karaburun peninsula, south of Izmir, at what is now called Kızılburun or 'Crimson Cape' in English. Of the five shipwrecks, one was of particular interest due to the nature of the cargo; marble architectural components of the Doric order. This wreck is commonly referred to as the Kızılburun Column Wreck and was chosen for study as it holds potential to answer questions about the lading and construction of ships with stone cargoes prior to the Imperial Roman period.

The wreck is a Late Hellenistic ship, of the 1st century BC, with a main cargo consisting of eight large Doric order column drums and capital, with various other marble pieces. The combined weight of the cargo is at least 50 tons. Excavation began, under the direction of Donny Hamilton and Deborah Carlson, in 2005 and has been ongoing, with 2009 being the final excavation season (Carlson 2010: 145)[1]. The goals for this last season were to finish the material excavations, recover some of the marble elements for further study, and recover any remaining hull timbers.

Recording and analysis of the hull remains were begun in 2008 and is ongoing. At least one more season of recording is required before all remains are cataloged, thus, this is a preliminary report.

Overall, the wooden hull remains are sparse, friable, fragmented and discontinuous. The dearth of remains forced modifications to typical hull recording methods. J. Richard Steffy penned an article entitled *Maximum Results from Minimum Remains* (Steffy 1978), from which the sub-title of this presentation was borrowed. In his article Steffy emphasized the need to closely study even the most scant ship remains where large questions loom over construction techniques or general ships features. This is certainly the case with any ship that carried a stone cargo in antiquity. With the Steffy philosophy in mind and using the information gleaned from the ship's fasteners, artefact positioning and 3D modeling, in addition to the extant wood remains, a better, yet still incomplete understanding of the Kızılburun Column Wreck's hull is nascent. There is of course no way to know if the Kızılburun Column Wreck's hull is typical for a stone carrier of the time as examples are few. However, if it is, this preliminary report holds potential to shed light on stone carrying ships of the Late Hellenistic period, if not the Roman *navis lapidaria*.

The Wreck Site (Fig. 5.1)

Each column drum is between 1.5 and 1.9 m in diameter and weight is estimated to be between 5 and 7 tons each. This is significant for the hull studies as the intense weight and pressure exerted by the drums were key factors in the preservation of the sparse wooden hull remains.

After the wrecking event, the ship came to rest on the seafloor at a depth of 45-48 m on a moderate slope. The position of three lead anchor stocks and one complete, yet disarticulated, iron anchor suggests the orientation of the ship, with the bow at the northern, upslope end of the site. There appears to be little movement of the cargo components from their originally laden positions (Fig. 5.1) and smaller artefacts were grouped in a rather tight pattern within close proximity of the marble cargo. The extent of artefacts reached 19.75 m. This information was used to determine the minimum length of the ship at 20 m.

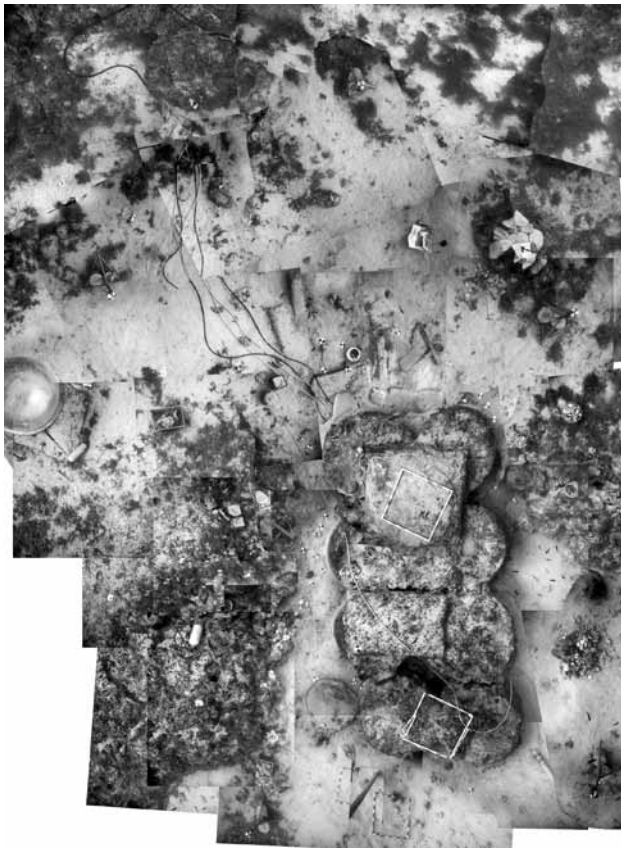

Fig. 5.1. Kızılburun site mosaic 2005.

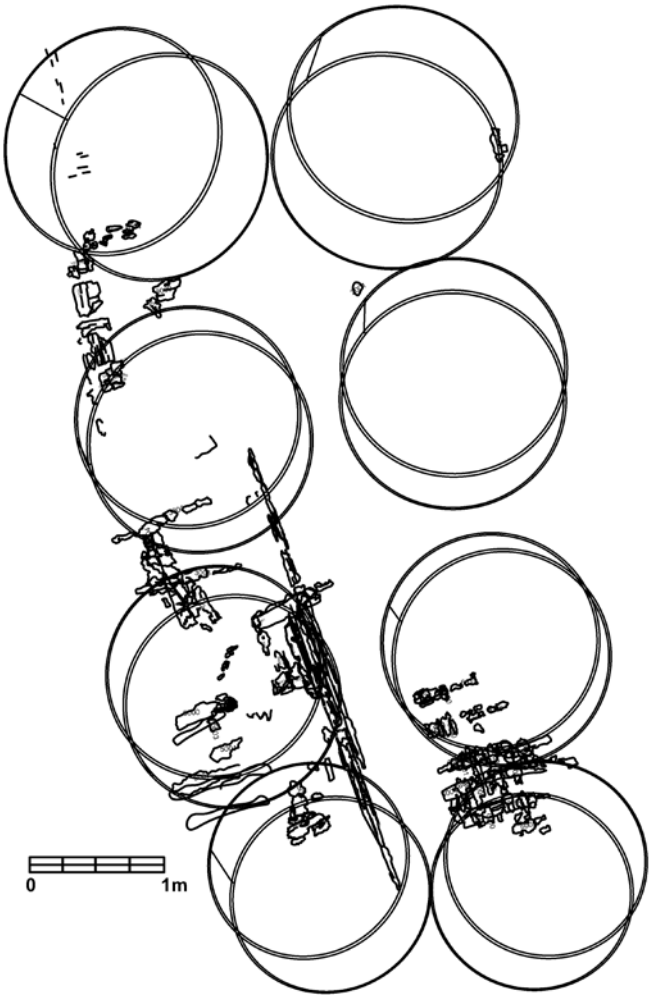

Fig. 5.2. Wooden remains with drums in place (Courtesy S. Matthews).

In 2006 and 2007, the marble components were relocated to the eastern area of the site to allow exploration beneath for hull remains. Several small sections of wood were discovered (Fig. 5.2). Some of these remains were recovered in 2007, while others were left in place until excavations resumed in 2009. These included a nearly 3 m section of longitudinal timber that was identified *in situ* as the keel of the ship by the presence of a rabbet and a short section of garboard strake. This keel section was the focus of analysis after the 2009 field season and has confirmed constructional features previously recorded, yet there are still many questions to be answered due to the scant nature of the extant wooden remains.

Indirect Data Acquisition

The substantial weight of the marble drums aided in wood preservation, but also crushed, compacted and distorted much of the remains. Often, valid timber measurements are only available in two dimensions. Most of the planking timber fragments have been compacted to the point that thickness measurements are completely invalid. This factor, coupled with the sparse extant wood remains from the site, forced the examination of other materials and construction elements to be more closely scrutinized.

In this respect, analyses of the ship's fasteners have proven to be very informative. Rows of fasteners were discovered *in situ*, stretching across the east west axis of the site. With the confirmation of the keel running in a northsouth direction, and as these nails had no other wood remains beneath, they likely represent planking to framing nails. In all, there were seven rows of nails in one area and two other areas had similar patterns of fasteners. From these patterned nails frame spacing was determined at an average distance of 25 cm (centre-to-centre). This dimension was later supported in the examination of the planking where framing elements left impressions on the planking timber fragments.

Over 1000 nail fragments have been cataloged, yet only approximately 300 distinct nails have been identified. These are non-ferrous nails (analyses pending)

Wreck Site	App. Date	Length (m)	Keel (SxM)	Frames (SxM)	Frames (c-to-c)	M & T (w x l x th)	M & T (c-to-c)	Peg (diam.)	Planking (Th.)
Ma'agan Mikhael	5th c. BC	13.4	11 x 16	13 x 11	75	(3.4-4.8) x 8.8 x 7.9	13	1	4
Kyrenia	4th c. BC	14	12 x 20	9 x 9	25	4.5 x 15 x 0.6	12	1	3.7
Chrétienne C	2nd c. BC	15-16	12 x 18	8 x n/a	38	(3-5.5) x (8-16) x 0.7	12	1	2.9-3.6
Laurons 2	2nd c. BC	15	12 x 20	9 x 20	20-22	6 x 13 x 0.4	12	0.9	2.5
Apollonia 1	2nd - 1st c. BC	15				6 x 16 x 1.0		1.1	3
Ashkelon Roman	2nd - 1st c. BC	15-25							4-5.
Cavalière	2nd - 1st c. BC	13	11 x 16	10 x 20	30	6 x 12 x 0.6	11	0.9	3
Miladou	2nd - 1st c. BC	15	9 x 11	7.4 x 12	25	6.5 x 14 x 0.6	8.8-13	0.6-0.8	2.4-4.3
Antikythera	1st c. BC	c 30				(6.5-9.5) x 15 x 0.9	6.5-13.8	0.9-1.5	9
Tre Senghe	1st c. BC	20-24							4
Kızılburun	1st c. BC	>20	15 x 18.5	8 x 14	25	6 x 12 x 0.6	12	1	4-4.5
Caesarea	1st c.	40		16.3 x 22	25	(9-12) x 10 x 1	12	1.8	9.4
Diano Marina	1st c.	22-25				8.0w	12	0.8-1.2	6
Ladispoli	1st c.	18-20	14.5 x 12	10 x 20	12-15	5.5 x 15 x 1.5			4-4.5
St. Gervais 3	1st c.	17				7 x 13 x 0.7	13.2	1.2	3.5-4.5
Torre Sgarrata	2nd c.	24				12 x 16.7 x 1.1	15-20	1.4	7.2
Bourse-Marseille	2nd - 3rd c.	23				6 x 12.5 x 1.0	20	1.5	6
Yassıada	4th c.	20.5	12.2 x 22	14 x 12.5	27	4.5 x 8.5 x 0.7	28	1.1	4.2

Table 5.1. Comparanda.

with typical square section shanks. Very early in the analysis of the fasteners a pattern of nail breakage between 3.9 and 5.1 cm length below the nail head was recognized. This suggests a common stress point. It was hypothesized that these presumed planking to framing nails sheared at a length that should be representative of the thickness of the planking and the actual measurement should lie somewhere between these two figures. The idea of a common stress point and a breakage pattern was later supported by a site report from the Israeli coast that showed similar nail breakage patterns (Galili 2009: 7). Even later in the cataloging process a small planking section with a broken nail fragment, a small section of original inner face surface, and some original outer face surface confirmed the hypothesized planking thickness at 4 cm. The 2009 examination of the keel offered further support, as the rabbet width is 4-4.5 cm.

Planking thicknesses of 3 to 5 cm appear to be somewhat common for ships of less than 20 m length, but appears thin by comparison to larger ships (Table 5.1). For a thorough discussion of planking thickness versus ship size as well as ancient writer's attitudes towards merchant ship planking thickness see Fitzgerald (1995).

Also of note with regards to the fasteners was the presence of at least three nails that were found *in situ* below the keel with heads down. This may suggest the use of a false keel or shoe, but other evidence is, at this time, lacking.

Direct Data Acquisition

Information on the framing elements is far from complete. Evidence suggests the use of typical alternating floors and half-frames although this has not been shown definitively. Many of the frames broke from the planking and toppled onto their molded sides either at the time of the wrecking incident or as a consequence of wood deterioration and the weight of the marble cargo at a later time; thus supporting the sheared nail theory previously mentioned.

Frame sided dimensions have been taken from impressions left in the planking and from surviving fragments, while the molded dimensions are somewhat vague as these were sculpted to increase

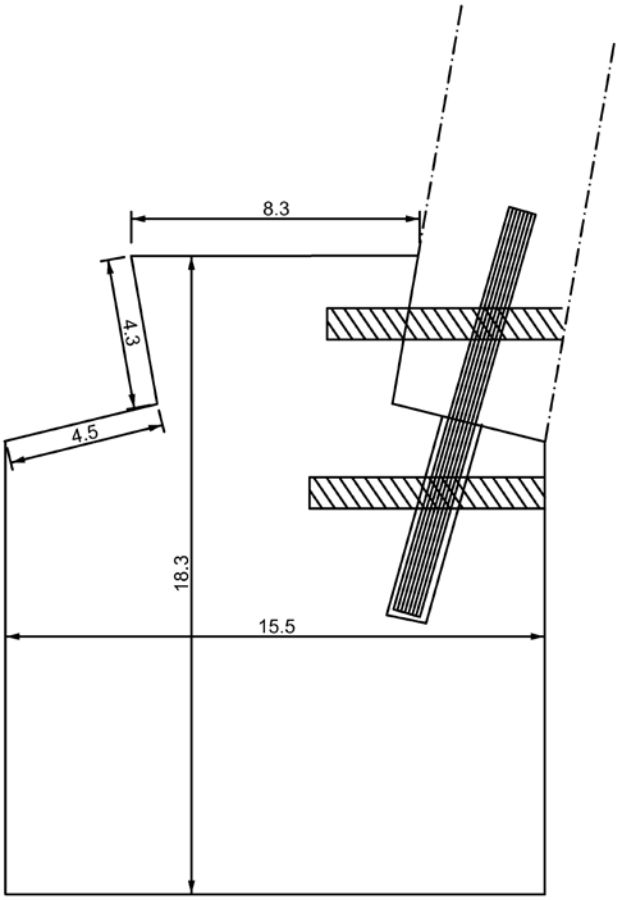

Fig. 5.3. Keel profile (Courtesy S. Matthews & J. Littlefield).

in size as they approached the keel. For the moment it can be reported that the average *surviving* sided dimension is 7.6 cm and the average molded dimension is 13.4 cm. There is also an outlier of 21.4 cm that was obtained from a fragment directly over the keel where floors would be of greatest dimension. Frame spacing has been established at 25 cm. This is relatively close, but common spacing. The frames appear to be of diminutive size, although further examination of the remaining components may reveal more definitive dimensions and alter this perception.

Only 62 cm of the garboard strake survives. The upper section of the timber survives in a better state of preservation than the lower portion that is so eroded and deteriorated that none of the mortise-and-tenon joinery survives and no original surface is extant.

Fortunately, some of the mortise-and-tenon joinery does survive in the rabbets of the keel. Cross-sectional data shows that the garboard rose sharply from the keel, only eight to twelve degrees from perpendicular to its inner face, giving an initial impression that the ship had a pronounced wine-glass shape. However, it is possible that the ship flattened out after the sharp rise of the garboard in a more Romanesque hull shape. Ongoing examination may offer more definitive information concerning the hull profile.

The width of the planking strakes was at least 15 cm and diagonal scarfs were used that were nailed close to the extremities much like the Nemi barges (Ucelli 1950: 152-153), albeit there is only evidence for a single nail as opposed to the double nails used on the Nemi vessels. This is a typical Graeco-Roman constructional feature (Fitzgerald 1995: 33, 136).

Only a short section of the keel survives; approximately 3 m in fragmented, but mostly continuous sections. Along most of the length of the extant keel the rabbets survive in various states of preservation and mostly on one side of the keel at any given station along the length. Along a very small section of the keel the rabbets survive on both sides simultaneously, albeit in a heavily degraded state. At various points the inner face width is near complete. It is at these points that a minimum original inner face width dimension of 8.3 cm was obtained.

Given the maximum surviving dimensions of the keel of 11.5 cm sided and 18.3 cm molded, and it must be stressed *surviving* here, the keel's size may seem surprising due to its gracile dimensions. These dimensions, coupled with approximately 20 cross-sections taken from the keel fragments, were used in 3D modeling of the timber. Closer approximations of the original dimensions of the keel are slightly greater than the surviving dimensions as projected in Fig. 5.3. It is unclear if the keel was rockered although the extant timber shows none, nor is the exact length known. However, this model permits comparison of this keel's cross-section to that of other shipwrecks.

There are only ten partial mortises that survive along the length of the keel from which mortise-and-tenon dimensions could be taken. Some of these mortises retain partial tenons of 6 cm average width and 0.6 cm thickness, matching dimensions taken from tenons of the planking. The depth of the mortises is at least 5.1 cm which is roughly corroborated in the planking where the depth was closer to 6 cm in each receiving plank.

The tenon size (6 x 12 x 0.6 cm) of the Kızılburun ship is seemingly common in comparison to other ships of antiquity (Table 5.1). The predominately oak tenons were locked in place with oak pegs of 0.95 cm average diameter. There are 27 surviving peg holes extant on the keel section, many of which retain partial pegs, from which mortise spacing measurements were taken. The longitudinal spacing of the

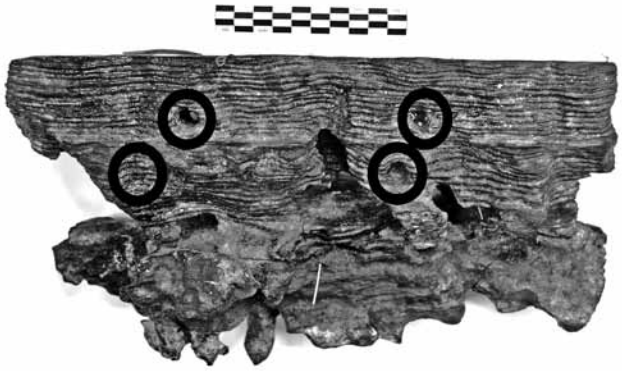

Fig. 5.4. Staggered keel pegs (Photo: J. Littlefield).

pegs averages 12.1 cm (centre-to-centre, regardless of whether they are in the upper or lower files of tenon pegs.

An unusual and possibly unique feature was observed in the tenon peg placement; they are staggered along a vertical central axis of the tenon**.** This occurs in over 90% of the discernible peg holes and always in the same orientation regardless of which side of the keel you are looking at. The upper peg is always to the right side of this central axis (Fig. 5.4). This feature may have been employed to prevent possible splitting of the tenon, but may simply be the product of a particular shipwright with no functional quality.

Hull Wood Identification

Approximately 150 wood samples have been taken, representing all major and distinguishable timbers of the ship. Thus far, 33 wood identification sample results have been returned by Nili Liphschitz at the Institute of Archaeology Botanical Laboratories, Tel Aviv University for species identification. Approximately 120 additional samples were more recently sent in order to obtain the most complete understanding of timber choices for the ship.

Most samples have been identified down to the species level. Planking fragments have been identified as both *Pinus brutia* (Turkish Pine) and *Pinus nigra* (European black pine). The keel has also identified as *Pinus nigra.* Tenons and pegs are of oak (most samples not species specific) and frames are of *Fraxinus excelsior* (European Ash).

Most of these wood types are commonly found throughout the Mediterranean region; however, the use of ash for the framing components is somewhat unusual. In antiquity (Plin. *HN* 16.24; Vitr. *De arch.* 2.9.11), as today (Edlin 1956; Meiggs 1982: 110; Rival 1991: 66-7), ash was known to be a strong but flexible timber, yet archaeological sampling to date has yet to establish the timber as significant to Graeco-Roman shipbuilding. Initial research has shown *Fraxinus sp.* identified in at least 14 other shipwrecks dating from the 2nd century BC to the 5th century AD. Of these, ash was used for framing elements of six ships, albeit none of these ships had ash used as the dominant frame timber, but used only sporadically. This suggests ash may have been more commonly used for repairs or possibly when other wood types were unavailable. Pending complete timber type identification, the Kızılburun ship appears to have employed only ash timber for framing elements.

The use of multiple species of pine by the shipbuilder(s) for the planking strakes suggests they were using any pine variation that was available. The unparalleled use of ash, however, may suggest that the wood was intentionally chosen for the purpose of framing the ship, as ash is known only to grow sporadically both in modern time as in antiquity (Davis 1978: 149). The significance of this has yet to be determined.

Discussion

How does the Kızılburun ship's construction fit with contemporaneous shipbuilding? Its constructional features appear to fit quite nicely with ships of less than 20 m length, but several features appear gracile for ships of greater length, albeit the number of fully excavated contemporaneous ships studied in detail is few.

Was the vessel a more heavily constructed vessel than normal in order to carry a concentrated weight of stone? One might expect a hearty keel size with large frames and thick planking for a stone carrier. However, the framing elements appear to be of relatively common dimensions when compared to contemporaneous vessels. Likewise, the keel also appears to be of common size. Furthermore, mortise-and-tenon sizes (6 x 12 x 0.6 cm) appear to be somewhat common as well as planking thickness.

Taken together, these features do not suggest a heavily built ship, but a ship constructed to the norm of the day. Again, it must be stressed that this is a preliminary report and as analysis continues other features of construction may be discovered that alter these findings.

One must keep in mind that at this point no evidence of decking, through-beams, or stanchions have been discovered and these elements, assuming

their existence, would likely add a greater degree of strength to the hull (Fitzgerald 1995: 144).

The study of the remains of the Kızılburun ship has already yielded some valuable comparative information about Hellenistic period stone transport, hull wood-type choice and construction methods as well as some new details about the intricacies of individual shipwright's methods. Continuing examination will likely yield even more surprises and supporting data.

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Note

1 For preliminary information on excavation seasons see INA Quarterly publications by Carlson 2006, 2007, 2009, 2010 and Carlson & Atkins 2009. INA Quarterly publications are available at http://inadiscover.com.

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