

A PRELIMINARY RECONSTRUCTION OF THE YASSIADA SIXTEENTH-  
CENTURY OTTOMAN WRECK

A Thesis

by

MATTHEW LABBE

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

May 2010

Major Subject: Anthropology

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Approved by:

Chair of Committee,	Cemalettin Pulak
Committee Members,	Filipe Vieira de Castro
	Gregory Cobb
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## ABSTRACT

A Preliminary Reconstruction of the Yassiada Sixteenth-Century Ottoman Wreck.

(May 2010)

Matthew Labbe, B.A., Franklin Pierce College

Chair of Advisory Committee: Dr. Cemalettin Pulak

While excavating a late fourth-century Roman merchantman off the coast of Yassiada, Turkey in 1967, archaeologists discovered another, more recent wreck lying across the stern of the Roman wreck. The artifact assemblage, dendrochronology, and carbon-14 dating indicated that the wreck was of Ottoman origin and dated to the late sixteenth-century. In 1982 and 1983, archaeologists under the auspices of the Institute of Nautical Archaeology at Texas A&M University returned to the site to fully excavate the vessel and raise its timbers for detailed study and conservation at the Bodrum Museum of Underwater Archaeology in Turkey. The purpose of this thesis is to analyze the remains of the hull by building upon previous preliminary reconstruction efforts to determine the ship's intended form and function.

To accomplish this task, 1:10 scale drawings of the timbers were used to construct a half breadth model of the ship. By matching the nail holes on the recovered planking to the preserved remains of the ship's framing, it was possible to assess the hull's contours through transfer to a lines drawing. The resulting drawings show a moderately sized vessel with a wide flat bottom.

In order to place the reconstruction into perspective, archaeological remains of similar shipwrecks and period iconography were consulted in order to suggest the ship's type and function. Four shipwrecks were found that have similar construction features to those on the Ottoman wreck. Three of the wrecks had the same unusual knuckle joints used in securing futtocks to frames that the Ottoman wreck has, shedding light on design and construction philosophy of ships in the eastern Mediterranean. The preliminary analysis of period iconography in conjunction with the remains of similar shipwrecks indicated that the vessel was a cargo carrier that may have ties to the Ottoman navy. Four types of ships from the same general period, the *felluca*, *polacre*, and *shebek* were found to have similar design features to the Ottoman wreck, but the closest iconographic parallel was the *saique*, which was a two-masted cargo carrier found in the Black Sea and the west coast of Turkey between the sixteenth and eighteenth centuries.

## ACKNOWLEDGEMENTS

Completing a thesis is a large undertaking that is not accomplished by the student alone. I'd like to take this opportunity to acknowledge a number of people who have helped and supported me as I tried to accomplish my goals.

To Doctor Cemal Pulak, I thank you for always lending a helpful (or critical) comment whenever I needed it, even though I tested your patience on multiple occasions. I can not think of another person who could have forced me to be as critical of my own work as you did. Your ability to motivate me came as a bit of a surprise, but I don't think I could have succeeded without it, and I am positive it raised the quality of the final product. I am thankful that I have had the opportunity to get to know you as a person as well. It's been a long road, and I thank you for walking it with me.

Additional thanks also goes out to my other committee members, Dr. Filipe Castro and Dr. Gregory Cobb, for their time and input on this project.

I'd also like to thank Taras Pevny for taking time out of his own busy schedule to help me get started on this project. It's daunting to have a large box of photos, timber drawings, and artifact catalogs, and not know what to do with them. Thank you for helping me sort through it and giving me a place to start.

To my good friends Chris and Becca (Sager) Crews, Drew Roberts, Heather Brown, and Ben Ford – The guardians of my sanity – I need to thank all of you for your candor, your humor, and your friendship. To do all of this without your help...well I might have finished sooner, but I am quite sure I would have ended up a lot crazier

without you. I know I'm not always the easiest person to get along with, but I wouldn't have made it through this without your support. I certainly did not expect to find life long friends so far from home, but I will remain eternally grateful for your camaraderie. And maybe I'll visit once in awhile for ren-faire...

I'd like to thank Ryan Lee for assisting me when I wasn't computer savvy enough to do what I needed to. Sorry for dropping by unannounced those many (many) times.

My thanks also go out to the ladies in the Institute of Nautical Archaeology office for their help when I bugged them to help me fill out paperwork or to get keys for the archive. Hopefully, you'll get a little more peace and quiet when I'm gone.

To my family, thank you for seeing me through my tenure as a grad student. You were always there to lend an ear, even if you didn't always know what I was ranting about. I am also grateful for the occasional "research grants" that kept me able to eat food other than Ramen Noodles. In all seriousness though, I recently read that graduation acknowledges the sacrifices of the collective for the benefit of the student. I can not thank my parents enough for their willingness to sacrifice *anything* to ensure that I received a quality education.

Finally, to the many others that should be acknowledged – there are so many of you that I could easily have made this section the length of one of my chapters. Thank you all for your love and support.

## NOMENCLATURE

Apron – A curved, reinforcing timber that attaches to the inside of the stem, and occasionally the forward end of the keel, that provides strength to the assembly.

Floor – A skeletal timber that attaches to the keel and defines the shape of a ship.

Frame – A composite of floors and futtocks that defines the shape of a ship.

Futtock – A timber that is usually fastened to a floor. Futtocks define the shape of a vessel above the waterline.

Garboard – The strake directly adjacent to the keel; the first run of planking.

Inner sternpost - A curved, reinforcing timber that attaches to the inside of the sternpost, and occasionally the aft end of the keel.

Keel – The central longitudinal timber of a ship to which frames and endposts are mounted; the spine of a ship's hull.

Keelson – A longitudinal member mounted above the floor timbers to provide strength to the assembly of keel and frames.

Limber hole – A recess in a floor that allows water to move freely under the frames.

Midship – The center of a ship or the broadest area of the hull.

Strake – A longitudinal run made up of multiple planks.

Stringer- Longitudinal strengthening timber fixed to the interior of the frames.

Transom – A member that fastens to the sternpost to form the stern of a vessel.

Treenail – A wooden peg used for fastening timbers.

Wale – A thick strake that helps stiffen the hull.

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## CHAPTER I

### INTRODUCTION

Yassiada, meaning “flat island,” is an uninhabited Turkish island in the south eastern portion of the Aegean Sea.<sup>1</sup> The island is located approximately five kilometers off the Turkish coast near Bodrum. The area surrounding the island is home to a number of shipwrecks due to a dangerous reef that stretches 200 meters west from the island. This reef is not typically visible as it sits two to three meters below the surface (fig. 1.1).

In addition to the late fourth-century Roman wreck and sixteenth-century Ottoman wreck under study in this thesis, a seventh-century Byzantine wreck found 10-15 meters east of the fourth-century wreck has already been excavated and published.<sup>2</sup> There is also evidence of a second-century Rhodian shipwreck near the reef, as well as a number of other poorly preserved, scattered wrecks in the area that have been heavily damaged by wave action on the reef.<sup>3</sup> In 1993, a Lebanese vessel hit the reef and sunk near the Ottoman wreck site, proving that the island still an active threat to the safety of naval vessels in the area (fig. 1.2).<sup>4</sup>

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This thesis follows the style of *The American Journal of Archaeology*.

<sup>1</sup> Also referred to as Lodo, the island of Yassiada should not be confused with another Turkish island of the same name in the Sea of Marmara near Istanbul.

<sup>2</sup> Bass and van Doorninck 1982, 4.

<sup>3</sup> Pulak 1984b, 483.

<sup>4</sup> Pulak 2005, 138.

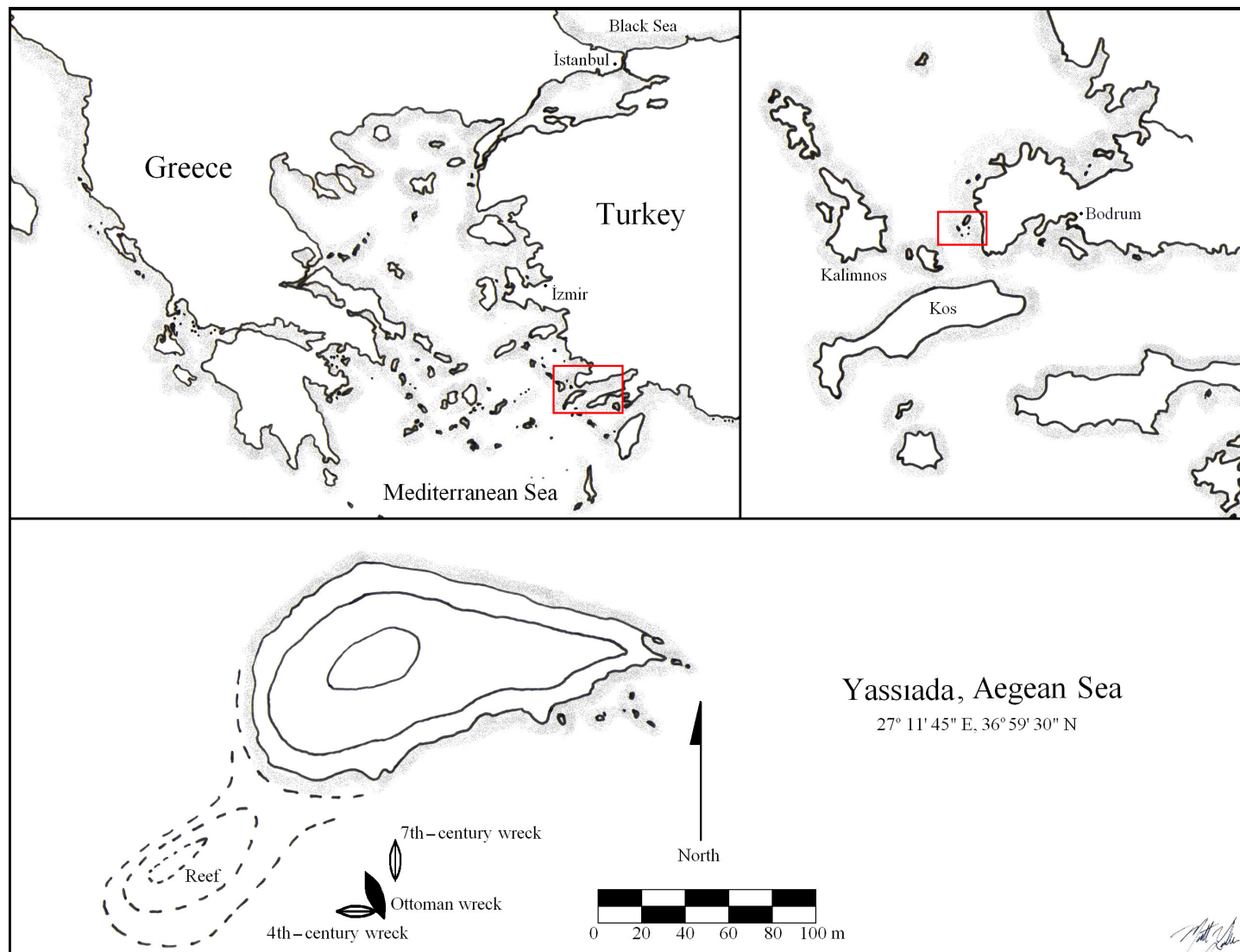


Fig. 1.1. A map of Yassiada and the surrounding region. After Pulak 1983b, 529.



Fig. 1.2. A Lebanese freighter sinking off the coast of Yassiada in 1993. Photo courtesy of the Ottoman wreck project (INA).

## EXCAVATIONS

### *1960s Excavations*

The fourth-century wreck at Yassiada was discovered by Peter Throckmorton in 1958 while he was conducting a survey for shipwrecks around the island.<sup>5</sup> He brought the wreck to the attention of George Bass in years that followed. During the summer of 1967, archaeologists from the University Museum of the University of Pennsylvania under the direction of George Bass began excavating the fourth century wreck. The merchantman had come to rest on the seabed some time in the late fourth or early fifth

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<sup>5</sup> Bass and van Doorninck 1982, 3.

century. The site was identified because of the merchantman's cargo of over 1000 amphorae, which were not buried beneath the silt.<sup>6</sup>

Near the end of June, divers began discovering pieces of wood and the occasional artifact that seemed to have no obvious relationship to the fourth-century wreck and its cargo. A number of very well preserved timbers were found that ran perpendicular to the wreck. Further, much of this wood lay directly on top of fourth-century cargo, particularly crushed amphorae, indicating that it could not possibly be construction materials from the fourth-century vessel. By 24 June 1967, divers had cleared six to eight meters worth of the this "new" wood, enough to be able to say with certainty that it was, in fact, a second shipwreck<sup>7</sup> (fig. 1.3).

At this time, nautical archaeology was a relatively new discipline, and most archaeologists were more knowledgeable about the artifacts found on these wrecks rather than historic ship construction techniques. As a result, no one was able to conclusively interpret what these new timbers were, or their age based on visible construction techniques. One of the bowls discovered appeared to have a common Byzantine glazing, and so the wreck was tentatively dated to the thirteenth-century.<sup>8</sup> It wasn't until a Phillip II four-reale coin minted in Seville between 1566 and 1589<sup>9</sup> (fig.

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<sup>6</sup> Bass and van Doorninck 1971, 34.

<sup>7</sup> Pulak 2005, 138.

<sup>8</sup> Pulak 1984a, 10

<sup>9</sup> Pulak 1984b, 471.



Fig. 1.3. Photo of the fourth-century wreck site. The Ottoman wreck is visible in the lower right hand corner. Photo courtesy of the Ottoman wreck project (INA).

1.4) was found during the 1969 season that the wreck was more accurately dated to the sixteenth century.<sup>10</sup>

Since the discovery of a second wreck was completely unexpected and the crew was limited by a lack of time and resources, the new wreck was photographed and mapped, but was not otherwise excavated. A majority of the mapping was conducted by Yüksel Eğdemir and Marie Ryan.<sup>11</sup>



Fig. 1.4. Back side of the Phillip II four-reale coin recovered from the Ottoman wreck in 1969. Photo courtesy of the Ottoman wreck project (INA).

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<sup>10</sup> Before the coin was conserved and all details on it were visible, it had been tentatively identified by Philip Grierson as a Philip III four-reale that was minted between 1598-1621.

<sup>11</sup> Pulak 1982, 2.



Associated artifacts were recovered and given Roman wreck catalog numbers. These numbers differ from those assigned to artifacts when the wreck was more thoroughly excavated in 1982 and 1983.<sup>12</sup> Artifacts were few, however, and only 45 were raised during the 1967 season, most of which were concretions of ships fastenings. A small number of ballast stones were also found, but few of these were raised and cataloged, though they are noted in the field notebooks. By August, enough of the ship had been uncovered and studied to identify principle timbers like the keel, which showed severe decay toward the bow due to it's placement atop the fourth-century cargo. At the end of the summer, both wrecks were covered with sand and excavation ceased on 25 August 1967.

A second season of excavations began in 1969 and the wrecks were once again uncovered. A number of stereoscopic photos of the Ottoman wreck were taken during this season, but the primary focus of the excavation was the raising of the timber from the fourth-century wreck. After the timbers were mapped and photographed on the seabed, they were placed in wire baskets and walked upslope to the island where they could be loaded for transport to the Bodrum Museum of Underwater Archaeology.<sup>13</sup> The Ottoman wreck was photographed during this season, but was not excavated further.

A third season was attempted in 1974, but the outbreak of hostilities on Cyprus between Turkey and Greece forced the immediate evacuation of the site after a matter of

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<sup>12</sup> During the initial 1960s excavations, artifacts were given a preface of RW for Roman wreck. In the 1980s, artifacts were prefaced with OW for Ottoman wreck.

<sup>13</sup> Bass and van Doorninck 1971, 28.

days.<sup>14</sup> With the near completion of the fourth-century excavation and little interest in the study of a post medieval ship, the Ottoman wreck lay undisturbed for almost 10 years.

### *1982 Excavation*

There was no real interest in any further excavation of the Ottoman wreck after 1974. The excavation of a late sixteenth-century shipwreck was not among the primary interests of the newly formed Institute of Nautical Archaeology, which focused its attention and resources on shipwrecks of other periods. It was not until George Bass was asked by the Council of Europe to conduct a field school in Bodrum, Turkey, just a few miles distant from Yassiada, that the excavation of the Ottoman wreck was reconsidered.

The goal of the Council of Europe field school was to advance knowledge of nautical archaeology and on site conservation techniques among European institutes of higher learning. Thirty students from 11 countries around Europe were invited to participate in a series of dives at Yassiada and a series of lectures on nautical archaeology, ship construction technology, and conservation at the Bodrum Museum over the course of a two week period starting in late July, 1982.<sup>15</sup>

The dive season commenced on 12 July 1982 with the anchoring of the excavation support ship *Virazon* above the wreck site. The primary objectives for preparing the site for excavation were to assess the condition of the wreck, move the remaining fourth-century amphorae out of the way of the excavation, and find an

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<sup>14</sup> Pulak 2005, 139

<sup>15</sup> Pulak 1983a, 6-7.

appropriate area to set up the air lifts for excavation. If the exact location of a wooden fragment was known, it was spiked to the seabed with bicycle spokes to prevent the piece from floating away when the wreck was totally exposed. After this task was completed, divers set about to establish the site grid. The grid was made up of squares of extruded steel that were two meters sided and covered the entire wreck. The grid access was laid parallel to the keel. Grids were labeled with letters on the north/south axis, and numbers on the east/west axis.

Divers then began clearing sand away from the wreck and tagging timbers. Each timber was given a number depending upon its type. For example, frames were labeled AA at the bow, and then progressed to Z, Y, X, W, and so on as they moved aft. The letters O, K, and I were skipped due to their similarities to other letters and numbers. At frame F, a change in the framing pattern was detected, indicating that this was the midship, or central, frame. After this point, frames were numbered sequentially starting with number one. Moving aft, the framing became increasingly degraded, and difficult to identify or match to existing sections.

During the course of the excavation, timbers from the wreck were raised after they were mapped (fig. 1.5). The timbers and artifacts to be raised were placed in wooden boxes that were raised with a lift balloon and then walked to the shallows of the island for storage. At the end of the excavation season, they were then loaded on *Virazon* for transport to the Bodrum museum.

As time grew short in the season, it became apparent that there would not be sufficient time or manpower to finish mapping and raising timbers during the current

**YASSI ADA, 1983**  
The 16th CENTURY WRECK

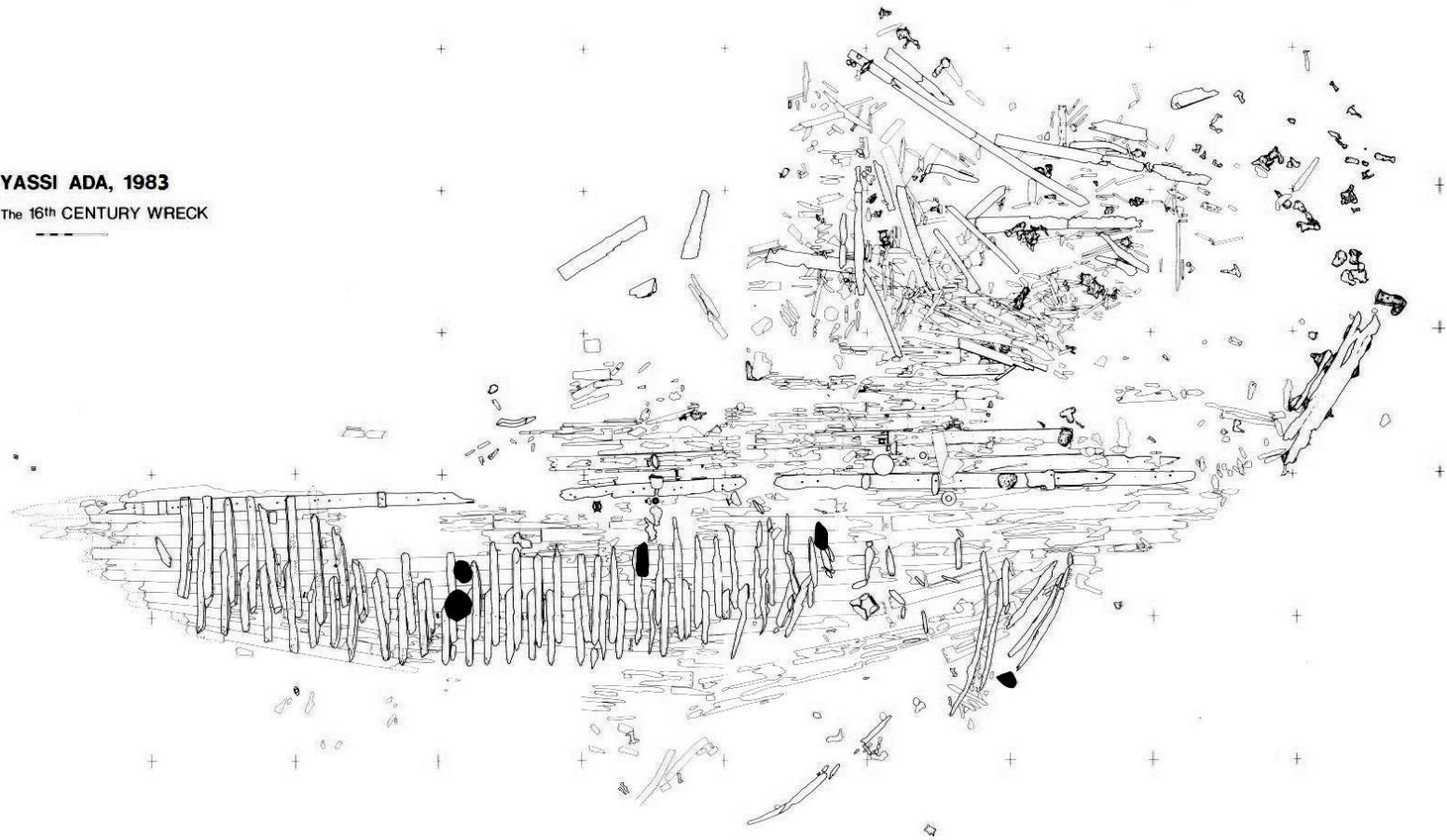


Fig. 1.5. The wreck plan after the 1983 season. Drawing by Cemal Pulak.

field season, as a majority of the crew was enrolled at Texas A&M University and they would have to return to the U.S. for classes. From a technical perspective, there were two primary reasons that the archaeologists decided to end the field season rather than try to hurry and finish the project: First, the wreck was far more fragmentary than archaeologists had initially anticipated. Coincidentally, the area of the wreck discovered in the 1960s was the most well preserved area of the hull, and additional time and personnel would be needed to account for the many small fragmentary pieces of timber they were uncovering. Second, the discovery of additional, previously unknown timbers discovered on the port side of the wreck near the aft end late in the summer indicated a possibility of more extensive remains that were previously unknown. As a result, archaeologists decided to break camp for the season and return the following year.<sup>16</sup>

### *1983 Excavation*

Since a majority of the timbers on the port side of the wreck had been mapped and raised, the primary focus of the second season of excavations was on the unknown timbers on the starboard side of the wreck. As divers began to clear away the sand in this area, they discovered that there were, in fact, substantial remains in this area, but that they were scattered and disarticulated timbers that made up a large debris field. Only some of the bottom strakes in this area were preserved in situ; the rest of the timbers were out of place and many were unidentifiable. The timbers beyond the flat, preserved starboard planking were stacked on top of each other, particularly in grids O2 and O3.

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<sup>16</sup> Pulak 2005, 139.

The stacking was likely a result of the wooden structures of the ship degrading, and then falling to the seabed where they were covered and preserved. This suggests that a majority of these timbers were from the upper works of the ship, which explains why many cannot be identified or joined to any existing structures. Most of the timbers appear to be planking fragments, but there are also some unusual timbers that may have been the ship's wales, deck beams, or possibly unrefined timber that was being shipped as cargo.

By the end of 1983, all of the wood on the starboard side of the ship had been raised. The planking aft of midship on the port side of the wreck had been mapped, but not raised. Since there was so little left to document or raise, and excavation was slated to begin at Kaş on the Bronze Age Uluburun wreck, it was decided that INA would not return to Yassıada the following summer.

#### WOOD SPECIES IDENTIFICATION AND DENDROCHRONOLOGY

Immediately following the discovery of the Ottoman wreck in 1967, and after all of the subsequent excavations, various samples were taken for radiocarbon dating, wood species identification, and in the case of the lead samples, sourcing. Archaeologists hoped that the ship could be accurately dated, but also that samples could be analyzed for wood types and manufacturing techniques that would suggest a cultural affiliation for the wreck.

*Radiocarbon Dates*

An initial sample from the 1967 excavation season was submitted to Barbara Lawn at the Applied Science Center for Archaeology at the University of Pennsylvania for radiocarbon analysis. Two radiocarbon dates were returned for the sample:  $1614 \pm 44$  C.E. and  $1603 \pm 45$  C.E. The first date was obtained using a half-life of 5568 years, whereas the second date was obtained using the modern accepted half-life of 5730 years for carbon isotopes, making the second date more reliable.

A subsequent sample was sent for radiocarbon dating at the University of Miami when the ship was excavated in 1982. The new sample returned a date of  $1692 \pm 90$  C.E. also using the 5568 year half-life. Calibrated, the correct date for this sample is  $1685 \pm 90$  C.E., although the standard deviation for this sample is greater than that of the sample taken in 1967. From the radiocarbon samples a construction date no earlier than 1558 can be inferred. The discovery of the silver Phillip II four-reale coin, however, provides a terminus post quem for the wreck which pushes the date of the sinking forward to at least 1566.

Peter Kuniholm of Cornell University used a sample from the ship's keel for dendrochronology and determined that the tree felled for the keel could not have been cut down prior to 1572, just after the Battle of Lepanto (7 October 1571). He also noted that an indeterminate number of tree rings were missing from the sample due to the shaping of the timber, so the date of construction of the ship could have been sometime later than this date. In conducting the analysis, he also noted that the best fit for the

sample was in northern regions like the Black Sea, perhaps indicating where the timber for the vessel was originally obtained.<sup>17</sup>

#### *Wood Species and Pitch Analysis*

Samples of pitch from artifacts OW169 and OW 199 were analyzed by Curt Beck at Vassar College and Dr. John S. Mills, scientific adviser for the National Gallery in London. The pitch was determined to be pine-based resins that were not tapped, but burnt out of the wood at high temperatures. The samples contained large amounts of pimaric acid proving that the compound was not derived from aleppo pine, which is found west of the Aegean Sea, suggesting that the pitch from this vessel could have come from somewhere along the eastern Mediterranean. Most likely, however, they came from a more northern species of pine that is found in the Black Sea region, a theory supported by Peter Kuniholm's dendrochronological analysis.<sup>18</sup>

Sixteen wood samples were sent to Donna Christensen at the Forest Products Laboratory in Madison Wisconsin for wood species analysis. Almost all of the planking was found to be an oak species, but a few fragments, likely in areas of repair, returned different results. Plank PS3/9, for example, was found to be fashioned from a species of beech. The keel, frames, and apron are all in the oak family. Likewise, Nili Liphschitz of the Botanical Laboratories at the Institute of Archaeology at Tel Aviv University determined that the sternpost of the wreck was fashioned from *Quercus cerris*, also known as Turkey Oak.

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<sup>17</sup> Kuniholm 2000, 113.

<sup>18</sup> Kuniholm 2000, 113.



### *Lead Samples*

A sample of lead was taken from OW169 and analyzed in the hopes of determining where it was manufactured. The testing was conducted by Dr. Robert H. Brill at the Corning Museum of Glass. He concluded that the lead's origin was ambiguous, and could have been manufactured anywhere in the Levant, perhaps as far south as Alexandria, indicating this was a type of lead used throughout the eastern Mediterranean and not particularly helpful for identifying cultural affiliation for the wreck.

### *Summary of Analysis Results*

The Ottoman wreck was fashioned primarily of oak some time in the late sixteenth century, and we can say with certainty that it sank some time after the 1570s, possibly as late as the early seventeenth century. Analysis of the wood indicated that most of the timber felled for the construction of the ship came from the region around the Black Sea. The lack of bark and sapwood on the principal timbers of the ship, particularly the keel, indicates that wood for the construction of the ship was plentiful and of high quality. The source for most of the ship's timber appears to have come within the Ottoman Empire, but samples of lead taken from the wreck were of a generic type that could not be sourced to a specific location.

## SUMMARY

While the discovery of the Ottoman wreck was a unique and unexpected bonus to the archaeologists excavating the fourth century Roman wreck, its late sixteenth/early seventeenth century date places it during a period Ottoman naval supremacy was at its apex, allowing an unparalleled look at the design philosophy and functioning of the Ottoman navy during this time. To date, no other Ottoman wreck has been completely excavated and none of them date to the same period as this wreck. As a result, the analysis of the Ottoman wreck provides insight into construction and labor practices during the golden age of Ottoman innovation that cannot be found in archival documents alone.

The purpose of this thesis is to provide a plausible, preliminary reconstruction of the Yassiada Ottoman wreck before intensive analysis begins as part of a final publication. Specifically, the goal of this project was to attempt to identify the ship's type and function as a means to place it in the lineage of Mediterranean ship design. As a result, the focus of this thesis is on the ship's hull construction, whereas information regarding rigging and personal artifacts is limited.

In order to begin this project, the Ottoman wreck's field director during the 1980s, Dr. Cemal Pulak, allowed the author full access to the original field notes, 1:1 acetate drawings, photographs, site plans, wood and artifact drawings, and other primary resources from both the 1960s excavations and the 1980s excavations<sup>19</sup>. These materials were absolutely critical since access to the timbers themselves in the Bodrum Museum

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<sup>19</sup> All artifacts and timbers from the Ottoman wreck are currently stored in the Bodrum Museum of Underwater Archaeology in Bodrum, Turkey. The author did not have access to any of these materials.

of Underwater Archaeology was not feasible for this preliminary study. Using these materials, it was possible to construct a model of the wreck in order to assess its hull shape and construction sequences.

## CHAPTER II

### OTTOMAN NAVAL HISTORY

As a means to understand the Ottoman wreck in a historic context, this chapter examines the state of the Ottoman navy in the 16<sup>th</sup> century, specifically addressing its political and hierarchical organization as well as its day-to-day operation and the significance of the Ottoman Empire as a naval power in the eastern Mediterranean. An understanding of Ottoman military organization during the period that the ship was built, sailed, and eventually wrecked may give some indication of its purpose in the grand tapestry of post-medieval European history.

#### NAVAL POWER IN THE EMPIRE

While a rugged, well developed naval force was extremely important in the capture of Constantinople (modern Istanbul) by the Ottomans from the Byzantines in 1453, early on the Ottoman Empire was far more renowned for their use of land rather than sea power. This is partially due to their conquest of vast stretches of inland areas, specifically the Balkans, but also because most of the ships in the Ottoman fleet had been destroyed at Gallipoli in 1416.<sup>20</sup> Recognizing the strength and value of the Byzantine fleet, the shipyards of Constantinople were quickly commandeered by Mehmed II (1432-1481).<sup>21</sup> Most of the shipwrights from these yards fled to western Europe and the Barbary Coast in northern Africa, but some remained and were recruited

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<sup>20</sup> Rose 2002, 111.

<sup>21</sup> Rose 2002, 7.

in the newly organized city of Constantinople.<sup>22</sup> While the navy was strengthened in the years following the capture of the Byzantine capital,<sup>23</sup> the focus on the Ottoman Empire as naval superpower was not truly considered or attempted until the reign of Süleyman I.

Süleyman *Kanuni* (the lawgiver), also known as Süleyman the Magnificent, came to power in 1520 and led his army on 13 major campaigns, spending over ten years on the battlefield.<sup>24</sup> Desiring to expand the empire west to France and the Spanish Habsburgs, and interrupt the blockade of the Portuguese in the Arabian Sea and the Gulf of Aden (who were damaging international trade in the Middle East), Süleyman poured a considerable amount of capital into improving the fleet. As a means to this end, he had a major, state-of-the-art shipyard built at Kasımpaşa on the Golden Horn and expanded existing shipyards at Gallipoli in the Dardanelles and Kadirga in Constantinople. The navy was also instructed to seek out experienced sailors from around the Mediterranean and Black Sea coasts. The money won from the conquest of Egypt in 1517 was allocated for the construction of new ships and the training of sailors.<sup>25</sup> By the mid 1520s, the fleet included 60 galleys, 53 galleasses, 17 large galleys, 7 barks, 6 galiottes, 13 gun ships, 10 caiques, 3 *agribar*, 4 *mudanya*, and thirty transport vessels; a large fleet in contrast to the mere 46 galleys built by Süleyman's predecessor, Selim I.<sup>26</sup>

In 1522, Süleyman had opportunity to test his new, quickly growing fleet by besieging the island of Rhodes. The Knights of Saint John had been attacking ships bringing grain and gold to the heart of the Ottoman Empire, taking money from the

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<sup>22</sup> Papadopoulos 1972, 60.

<sup>23</sup> Shaw 1978, 87.

<sup>24</sup> Shaw 1978, 87.

<sup>25</sup> Shaw 1978, 86.

<sup>26</sup> Gülerüz 2004, 88.

sultan. While this was bad enough, Rhodes had an important strategic location that Süleyman believed should be his. In the summer of 1522, he sent his fleet to attack the well fortified fort at Rhodes. Even with 60,000 defenders, the fort fell by December of that year.

The conquered were allowed to leave with their weapons, and those that chose to remain were given a tax exemption for five years and freedom of religion.<sup>27</sup> While Süleyman could have ordered the conquered executed, his compromises kept the peace and established him as a shrewd businessman, recognizing that the long term benefits of trade and taxes outweighed the extermination of foreigners. Further, the victory of his fleet made the other European powers recognize the Ottoman Empire as a force to be reckoned with.

### *Süleyman's Generals*

By the 1530s, Süleyman had again focused his attention to land battles and let the navy become lax. Alarmed that Andrea Doria, a competent Genoese general working for the Habsburgs, had entered the eastern Mediterranean, Süleyman decided that his navy needed to be re-fortified. In order to do so, he sought an audience with the famous Barbary corsair, Hayruddin Barbarossa (Redbeard), the Bey of Algiers. With typical flair, Barbarossa sailed into Constantinople with 40 ceremonially decorated ships, bearing gifts of gold, jewels, fabrics, exotic animals, and Christian slave women for the sultan's harem. Over the course of a single winter, Barbarossa managed to make a

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<sup>27</sup> Shaw 1978, 88.

complete turnaround in the fleet.<sup>28</sup> Süleyman appointed Barbarossa to the position of *Kapudan Paşa* (Grand Admiral) and made him the governor of Algiers, giving him a seat in the Imperial Court<sup>29</sup> (The person in this position was always appointed by the Sultan, which could have been problematic as those appointed were not always trained navy men<sup>30</sup>). The money from this position was to be used by Barbarossa to maintain his fleet and train his crews. The timing of Barbarossa's appointment was fortuitous, because by 1534, there was fierce competition among the European powers for control of the central Mediterranean. Barbarossa quickly captured Sicily, but Andrea Doria, then working for the Holy Roman Emperor, Charles V, captured Tunis in 1535, destroying the Ottoman hopes to expand westward.<sup>31</sup>

Knowing that he was unable to take the area himself, Süleyman entered into a delicate alliance with the Kingdom of France against the Habsburgs. Together, they planned to attack Italy in 1536. While Barbarossa expanded the fleet, Süleyman led an army of 300,000 men through Albania toward Italy. Charles V, however, was under a great deal of pressure from the Pope to break all ties with the Ottomans so that the Christian powers could unite against the Muslims. He understandably ended the agreement, infuriating Barbarossa, who began to capture islands in the Aegean in 1537. This was actually a brilliant move on his part, because with the subsequent capture of

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<sup>28</sup> Kinross 1977, 218-19.

<sup>29</sup> Shaw 1978, 97.

<sup>30</sup> Brummett 1994, 96.

<sup>31</sup> Shaw 1978, 97.

Candia in Crete the following year, the Venetian stronghold on the Mediterranean was severely weakened.<sup>32</sup>

A Spanish historian once commented that Barbarossa was “the creator of the Turkish navy, its admiral and its soul.”<sup>33</sup> His major contribution to the empire’s supremacy in the Mediterranean was that he opened up the west by giving the Ottoman’s access to North Africa. This position in the western Mediterranean would be strengthened with the capture of Tripoli, Jerba, and Tunis in the years following his death.<sup>34</sup> For the time being, however, the Turkish navy was dealt a serious blow in 1546 when Barbarossa died. Political problems in the empire led to the appointment of two army generals, with little or no experience on the sea, as admirals of the fleet; Mehmet Sokullu (1546-1550) and Koca Sinan Paşa (1550-1554). Fortunately, this position was merely political, and actual control of the fleet went to Barbarossa’s star pupil, Turgut Reis.<sup>35</sup>

Meanwhile, Süleyman’s attention was also focused on the Indian Ocean where there was constant conflict with the Portuguese. Ottoman success in this area was generally limited, as their galleys simply could not compete with the long range weapons of the Portuguese carracks.<sup>36</sup> Further, galleys were simply of little use on the open ocean, as they were very susceptible to the elements.<sup>37</sup> To counter the Portuguese presence,

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<sup>32</sup> Shaw 1978, 98-9.

<sup>33</sup> Kinross 1977, 223.

<sup>34</sup> Imber 2002, 288.

<sup>35</sup> Shaw 1978, 105.

<sup>36</sup> Black 1999, 129.

<sup>37</sup> Cipolla 1965, 103.



Süleyman appointed Piri Reis as Grand Admiral of the Indian Ocean fleet and the Admiral of the Fleet of Egypt in 1547.<sup>38</sup>

Piri Reis was born in the town of Gelibolu in the Dardanelles sometime around 1465 (the exact date is unknown, but generally ranges from 1465-1470). The historian Ibn Kemal once commented that “The children of Geliboulu grow up in water like alligators. Their cradles are the boats. They are rocked to sleep with the lullaby of the sea and of the ships day and night.”<sup>39</sup> Piri Reis was no exception. At the time, it was common for small fleets of ships to be owned by private investors for the purpose of trading or privateering. At the age of 12, Piri Reis went to sea with his uncle, Kemal Reis, who owned such a fleet. With his uncle he had opportunity to learn the ways of the sea while exploring the coast of North Africa, and had opportunity to travel as far as the Atlantic Ocean.<sup>40</sup> Within months of his appointment as Grand Admiral, Piri Reis was able to take the Portuguese port of Aden and, in 1552, drove them from the city of Muskat in the Persian Gulf.<sup>41</sup>

While strong, the Portuguese were not invincible. For example, Mir Ali Bey, with a single ship, once ran the Portuguese fleet off the coast of Swahili, capturing 20 ships in the process.<sup>42</sup> Still, the logistics of fighting a war in the Indian Ocean were difficult and unpractical. When preparing to deal with the Portuguese, it was decided that the Empire needed a stronger foothold in the Red Sea. In 1530, a base was built in the Suez which required 60 ships carrying supplies to land at Alexandria, where the material

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<sup>38</sup> Shaw 1978, 107.

<sup>39</sup> Afetinan 1975, 9.

<sup>40</sup> Afetinan 1975, 5.

<sup>41</sup> Shaw 1978, 107.

<sup>42</sup> Boxer 1969, 57.

would then be carried by camel the rest of the way. In 1532, this complex built 80 ships for use in the Red Sea, but these ships were, in essence, a double edged sword. While the ships were needed to secure the Red Sea, the money used to build them was money that could not be directly used to fight the Portuguese.<sup>43</sup>

Some may question why, in the face of an adversary with radically different technology, the Ottomans would choose to continue using the galley as the lynchpin in their navy. Up until this time, the galley, a type of oared warship, was extremely effective as a tool for fighting wars in the Mediterranean. The main factors, other than practical considerations such wind and sea currents as well as harbor depths, were economy and labor. The galley hulls were relatively inexpensive to produce, and the organizational structure on board was such that older seamen could quickly train younger ones.<sup>44</sup> It allowed for fewer experienced soldiers, and thus resulted in cheaper labor. The idea of using multiple men per oar was so cost effective, that it would eventually become the standard for galley warfare.<sup>45</sup>

For all the technology and experience of the Ottomans in the Mediterranean, the nature of warfare in the open ocean made their fighting style ineffective and their government was too far away to rectify this problem. Piri Reis, while a skilled mariner, was unable to usurp Portuguese power in the Indian Ocean, and was, instead, required to maintain the status quo.

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<sup>43</sup> Çizakça 1981, 774.

<sup>44</sup> Imber 2002, 289.

<sup>45</sup> Guilmartin 1974, 100-1.

## DAY-TO-DAY OPERATIONS

The Ottoman victories in the Mediterranean compared with their defeats in the Indian Ocean makes one question how their naval power was organized and why was its success in some areas stunning, and in others extremely limited.

As mentioned previously, it took a considerable amount of time for the Ottomans to get their navy up to par with that of the other European powers. One way they did this was by simply observing the technology of other European powers and adapting it to their own needs. Their organizational structure and style of command evolved out of Venetian and Genoese models, going so far as to even use Italian terminology for naval attributes. For example, their use of the term *kaptan-ı* (later *kapudan*<sup>46</sup>) for a commander comes from the Italian word for the same position, *capitano*.<sup>47</sup>

Before the Ottomans are judged to be uninventive, however, we must consider why copying an established model is useful. The greatest reason is that it helps to maintain the balance of power. Enemies fighting with comparable technology are more likely to have a balanced war, in which a victory may be gained through the economics of having more ships rather than more skilled mariners, which may be expensive to hire or difficult to find (and especially replace). For example, only very large cities with substantial economic support can afford to be engaged in large scale wars. What we know of the balance of power in the area is explained by analysis of a naval power's support facilities.<sup>48</sup>

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<sup>46</sup> Kahane and Tietze 1958, 142.

<sup>47</sup> Shaw 1978, 131.

<sup>48</sup> Guilmartin 1974, 99.

The Ottomans had a number of shipyards placed strategically around their empire, though many were small, with simple wooden sheds and wooden slipways.<sup>49</sup> Almost all, however, had ship shed's for constructing and protecting vessels during the winter, areas for metal working and production of rigging, and facilities for repairs.<sup>50</sup> The shipyards were controlled by two offices: The Naval Ministry, which handled administrative duties; and the Naval Headquarters, which handled the practical aspects of shipbuilding. The provinces of the empire were instructed to build their own squadrons which could join the imperial fleet at a moment's notice.<sup>51</sup> The day to day duties of running the shipyard were left to the Commissioner of the Shipyard. The navy was centered at the imperial dockyard (*Tersane-i amire*) in Constantinople, and the hierarchy of officials and departments mentioned previously were required to manage several dockyards at once.<sup>52</sup>

The ships themselves were commanded by a captain, or *reis*, called a *kaptan* when leading a flotilla. The ships were manned by marines (*azap*), and crewed by men from around the empire, including Greeks, Albanians, and others. These men, called *levant*, from the Italian word, *levantino*, meaning sailor, were occasionally salaried, but often worked in lieu of taxes for their families. Oarsmen (*kürekçiler*) were occasionally hired, but were generally slave labor, captives, or local prisoners.<sup>53</sup>

Ship construction was managed by four different groups of workers: Carpenters (*neccaran*), mast workers (*barudreşan*), caulkers (*kalafatçıyan*), and augers

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<sup>49</sup> Dağgülü 2009, 13.

<sup>50</sup> Dağgülü 2009, 15.

<sup>51</sup> Gülerüz 2004, 84.

<sup>52</sup> Shaw 1978, 131.

<sup>53</sup> Shaw 1978, 132.

(*burgucüyan*).<sup>54</sup> Between 1529 and 1530, the empire had in its employ 78 caulkers, 22 carpenters, and 28 mast makers. The number of augers was not recorded. These men worked 355 days a year on average with no weekends or holidays, though this grueling schedule was probably an aberration brought about by the threat of conflict with the Habsburgs during those years.<sup>55</sup>

The best example of how materials for ships were acquired is the rebuilding of the fleet after the Battle of Lepanto. During the winter of 1571, the shipyards were alive with workers. Even the sultan's private gardens on the Bosphorus had been converted into a makeshift shipyard. A French ambassador visiting one of the construction sites in May of 1572 reported that the Turks had built over 150 galleys in less than five months,<sup>56</sup> an operation that constituted an immense investment to find the proper materials and supplies.

The sails were of French origin, and the Dutch traded oars, spars, and cordage. The acquisition of these types of material could become very expensive though. For example, in 1607 the arsenal in Istanbul purchased 162,000 nails for 198,608 *akches*. An additional 188,014 *akches* were spent to transport the nails, plus 29,451 *akches* for the wages of various clerks involved in the exchange and the master blacksmith who fashioned them.<sup>57</sup> When the admiral of the fleet, Ochiali, mentioned that he was having trouble finding 500 anchors, the Grand Vizier told him, "The wealth and power of this empire can supply you, if needed, with anchors of silver, cordage of silk, and sails of

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<sup>54</sup> Çizakça 1981, 776.

<sup>55</sup> Çizakça 1981, 776-7.

<sup>56</sup> Beeching 1983, 228.

<sup>57</sup> Imber 2002, 296.

satin; whatever you need for your ships, you have only to come and ask.”<sup>58</sup> There was a clear desire to rebuild the fleet at any cost to maintain the supremacy that the empire had gained through hardship in the previous 50 years.

Normally, however, ships were constructed using materials from inside the empire. Timber came from the İzmit Sanjak forests, and other provinces of the empire, all of which were required to allocate a certain amount of timber to the navy,<sup>59</sup> much in the same way the British tagged colonial forests in America almost two centuries later.<sup>60</sup> Every year, 395 tons of hemp was shipped from Samsun to be made into as cordage, with smaller amounts coming from other towns. Most of the sails required for the fleet were weaved in Constantinople, but some came from other parts of the empire as far away as Egypt. Nails and other iron hardware were sent to shipyards pre-made and came, primarily, from Bulgaria during the 16<sup>th</sup> and 17<sup>th</sup> centuries.<sup>61</sup> Cannon balls of stone and iron were produced around the country.<sup>62</sup>

The oakum, tallow, and oil used to waterproof the hulls of ships came from Albania, Bulgaria, Samsun, and the Aegean coasts, though Albania was the most common source in the 17<sup>th</sup> century with over 115 tons of material imported per year. These substances were relatively inexpensive, with a majority of the price tied up in transportation costs. In terms of volume, however, it was a large and important resource.

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<sup>58</sup> Beeching 1983, 228.

<sup>59</sup> Gülerüyüz 2004, 85.

<sup>60</sup> Chard 1980, 143.

<sup>61</sup> Imber 2002, 296.

<sup>62</sup> Gülerüyüz 2004, 85.

To place this in perspective, the average galley required 350 kilograms of oil for its hull that needed to be re-applied three times a year.<sup>63</sup>

It is impossible to overestimate the logistics required to coordinate such a massive shipbuilding effort. For example, there was an official position in the provisioning bureau, *mevkufat kalemi*, which managed the production of biscuits. This person kept an account of supplies and coordinated the production of thousands of biscuits required to feed the sailors in a major campaign.<sup>64</sup> One could argue that this was a type of mass production on a scale not seen again until the Industrial Revolution.

The summer campaign season ran from late March to early November, and ships were protected at sheds at shipyards over the winter.<sup>65</sup> This was a problem for any empire that was set on maintaining or expanding its extensive borders. With such a short sailing season, ships that traveled to distant lands had less time to accomplish their objectives. This could be a critical problem, for many Ottoman campaigns involved season-long sieges. For example, after the battle of Prevesa in 1538, Barbarossa's fleet was driven into the Albanian coast due to inclement weather. While the loss of life was slim, the loss of ships was not. Had the sailing season been longer, or the Ottomans used ships other than galleys, it is likely that far fewer, if any, ships would have been lost. There is also the example of the fleet that captured Tunis in 1574. The fleet left Constantinople on May 15 and spent five weeks at sea just to reach its destination. By the time the battle was over and the fleet returned home, it was mid-November. This

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<sup>63</sup> Imber 2002, 296-7.

<sup>64</sup> Guilmartin 1974, 100.

<sup>65</sup> Dağgülü 2009, 13.

represented the extreme limits of the empire's reach during this period.<sup>66</sup> Ultimately, the length of the sailing season was determined by the storage limits of the individual ships and the size of their respective crews.<sup>67</sup>

## THE BATTLE OF LEPANTO

By 1571, the Ottoman Empire dominated the eastern Mediterranean with its navy, and the Christian powers of western and central Europe were becoming frustrated at consistently losing ground to the Turks, especially the recently captured island of Cyprus. Fearing further encroachments, the kingdom of Spain, Genoa, Venice, the Knights of Saint John in Malta, and Pope Pius V formed the dramatically named Holy League. The three powers agreed to contribute financially to the construction and maintenance of a large fleet for three years. Contributing money at a ratio of 3:2:1 respectively between the Spanish, the Venetians, and the Pope, the newly formed alliance was able to muster a force of 206 galleys, 100 sailing ships, 50,000 infantry, and 4,500 cavalry.<sup>68</sup> Because they made the most significant financial contribution, the Spanish were granted the honor of choosing the fleet commander, 24 year old Don Juan, the half-brother of King Phillip II. The Ottoman fleet, comprised of almost 230 galleys and 70 galiottes was commanded by Muezzenzade Ali Pasha.<sup>69</sup>

The construction of both fleets along with other logistical planning represented preparations made on a scale not seen since classical times. The Ottomans, for example,

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<sup>66</sup> Guilmartin 1974, 104-05.

<sup>67</sup> Brummett 1994, 95.

<sup>68</sup> Guilmartin 2002, 137-8.

<sup>69</sup> Guilmartin 2002, 138-9.



developed a new type of ship specifically for the battle. The two large ships, known as *kokas*, were a type of double decked galley measuring 70 cubits (26.6 m) by 30 cubits (13.72 m). The masts were composite and measured 4 cubits (1.83 m) in circumference, and were capable of holding 40 armored archers and riflemen in its top.<sup>70</sup> The ship, though it had a stern like a galleon (in order for boats to be suspended from the transom), was oared via 24 banks of rowers, each oar powered by nine men. Each boat carried 2000 soldiers and sailors, and the ships were commanded by Kemal Reis and Burak Reis. Construction was overseen by Iani, who had learned the art of shipbuilding in Venice,<sup>71</sup> again suggesting that the Turks were interested in foreign technology.

In a rush to complete the fleet, the Turkish galleys were sometimes built of unseasoned wood, and were extremely standardized in form. Many of the captains and mariners were Greek or Venetian traitors, as they could earn more in four months for the Ottomans that they could in a year elsewhere. The downside of their high pay check was, of course, that there was no wine issued in the Turkish service.<sup>72</sup>

The Christian fleet left Messina on September 16, 1571 and made their way to Lepanto, where Ali Pasha was already sheltered at the island. The renowned French historian Fernand Braudel suggested that there were 500-600 galleys operating in the Mediterranean, suggesting that 70-90 percent of all galleys in existence at the time were somehow engaged in the battle.<sup>73</sup> If this is true, its significance can not be understated:

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<sup>70</sup> A cubit in this instance is calculated to be 45.72 centimeters. Mitchell 1831, 19.

<sup>71</sup> Mitchell 1831, 20.

<sup>72</sup> Kinross 1977, 192.

<sup>73</sup> Guilmartin 2002, 140-1.

the battle was intended to decide once and for all who would gain dominion over the Mediterranean Sea.

The fleets sighted each other on October 7, and a fierce and relentless battle ensued. Don Juan, aboard the *Reale* attempted to board Ali Pasha's ship three times before they finally succeeded, and the Muslim commander was quickly dispatched with a musket. As news of Ali Pasha's death spread to the rest of the fleet, the Ottoman offensive became increasingly disorganized.<sup>74</sup> The *kokas*, while powerful, were destroyed. Burak Reis, in an attempt to break the line of the Holy League, began throwing burning pitch at one of the enemy vessels. Unable to separate his own ship from the melee, however, caused it too to catch fire. Both ships were burned and their commanders killed. The survivors who were unwilling to give up were able to commandeer an enemy galleon and imprison its crew.<sup>75</sup>

When the battle finally ended, the Muslim fleet had lost 200 galleys. 30,000 soldiers and sailors were killed, 3,000 were taken prisoner, and 15,000 rowing slaves were freed. The Christian losses were light in comparison, consisting of only 10 lost galleys, 7,500 killed, and 20,000 wounded.<sup>76</sup> Even with such staggering losses, the Grand Vizier did not seem especially concerned by the setback, commenting "The infidels only singed my beard; it will grow again."<sup>77</sup>

The standing Ottoman fleet was significantly weakened in respect to sheer physical force, but more damaging was the loss of 4,000 technical experts and

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<sup>74</sup> Guilmartin 2002, 147.

<sup>75</sup> Mitchell 1831, 21.

<sup>76</sup> Guilmartin 2002, 148-9.

<sup>77</sup> Cipolla 1965, 100.

experienced mariners. As a result of the Ottoman naval disadvantage, Christian ships began sailing and trading in the eastern Mediterranean without fear of being accosted.<sup>78</sup>

The battle of Lepanto is significant for many reasons. First, previous battles between galleys had shown that battles between single ships and small squadrons of ships resulted in decisive win/loss scenarios (the enemy would be completely destroyed), whereas battles between fleets generally resulted in an indecisive stalemate.<sup>79</sup> Lepanto broke that mold, although the reason is somewhat mysterious. While numerically smaller than that of the Holy League, the Ottoman fleet was not to be scoffed at, and there was no clear mismanagement by fleet commanders. The battle showed the providence of warfare, and how a well matched fight can quickly become one-sided. Second, and more importantly, this battle decided the fate of Europe. Had the Holy League been defeated so completely, they would have been unable to protect themselves from Muslim expansionism, and Western Europe may have fallen under Muslim control.<sup>80</sup>

As mentioned earlier, after the battle, the Ottomans were eager to quickly rebuild their fleet, presumably to protect their country folk from Christian privateers and to protect the empire as a whole. In Venice, however, ship production went down significantly after the battle. The employment of Venetian carpenters, for example, fell from 1022 in 1559 to a mere 250 in 1581.<sup>81</sup>

Although the Turkish fleet was restored, the government began to have severe economic problems in the following years. In 1574, the Ottoman currency was devalued,

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<sup>78</sup> Guilmartin 2002, 149, 150.

<sup>79</sup> Guilmartin 2002, 119.

<sup>80</sup> Guilmartin 2002, 151.

<sup>81</sup> Bondioli et al. 1995,178-9

and many Janissaries complained that it was worthless.<sup>82</sup> Over time, skill and competition from other nations increased. As a result, the Ottomans engaged in a number of drawn-out wars, leaving the empire with a deficit every year after 1592.<sup>83</sup>

## SUMMARY

It is a shame that our knowledge of such a pivotal time in European history is limited by our lack of quantitative data. While historical records and accounts are extremely important to our understanding of Ottoman society, one can not deny that intensive archaeological study of naval relics, particularly shipwrecks, would contribute significant information that is not readily apparent in these historical records.

While very little first hand information regarding the design and building practices of the Ottoman Empire's navy has survived to this day, it is likely that a complete analysis of an Ottoman shipwreck would indicate a great deal of innovation and craftsmanship, shedding light on design philosophy. While this type of information may seem trivial to some, it is important to remember that archaeology is a holistic science, and that the importance of this information is dependent on how it can be related to the culture as a whole.

Thinking in such terms, the study of Ottoman seafaring during the pinnacle of its naval supremacy is extremely important. There is little doubt that the Ottomans had an important role in the formation of modern Europe as we know it and as the battle of Lepanto showed, all of Western Europe could have easily become a Muslim state.

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<sup>82</sup> Beeching 1983, 229.

<sup>83</sup> Black 1999, 136.

Further, the Ottoman Empire remained a significant player on the European stage until the early twentieth-century. One cannot deny the impact that it had on the history of Europe and, as such, its historical and cultural legacy should be preserved.

## CHAPTER III

### THE WRECK

#### THE EXCAVATION

##### *Site Layout*

The Ottoman wreck lies off Yassiada on a slight slope at a depth between 39 and 42 meters, with the bow at the deepest end. The bow of the ship faces south, and crosses the stern of the fourth century Roman wreck site, which was excavated by George Bass between 1967 and 1974. It appears that when the Ottoman wreck came to rest on the seabed, it crushed a number of the fourth-century ship's amphorae. It is likely that the stem of the ship was not preserved because the exposure to sea water and ship-worms left it with no protection from the elements, whereas sections of the ship that were quickly buried preserved much better. The starboard side of the bow was not preserved at all save for the garboard strake along the frames that were still attached to the keel aft of the apron. Approximately 25% of the ship's surface area was preserved.

East of the wreck, between the bow and the fourth century wreck were a number of artifacts associated with the Ottoman wreck. These include all manner of fasteners, ceramics, a silver coin, and some chain that was likely part of the ship's rigging. There are some timbers in this area that have not been identified, but their sections indicate that they may have been part of a beak or bowsprit, part of the stem, or possibly mast or spar fragments.

A few meters north-east of the wreck were the remains of a seventh-century Byzantine wreck that was also excavated by George Bass, and was published in 1982. This Byzantine wreck sat so close to it, in fact, that a ceramic roof tile and a ceramic pitcher associated with this wreck were found under the planking of the Ottoman wreck.<sup>84</sup>

The port side of the Ottoman ship was preserved best, although large sections of the starboard side planking at the aft end of the ship up to the turn of the bilge were also preserved. The frames in this area, however, did not fair as well and none remain in their original locations. To the west of this preserved starboard planking is a large debris field made up, primarily, of what may be the ships upper works, but they are so dislodged and battered that they were of little help in the reconstruction. This area was not fully excavated until 1983.

At the aft end of the starboard side of the ship were the remains of at least six upper futtocks. although their original locations were not know, they are preserved well enough that they were used in the reconstruction and represent direct evidence of the ships high sheer line at the stern.

#### *Hull Recording and Timber Removal*

The position of all of the ship's timbers was trilaterated from the corners of the two-meter wide grid squares and plotted on plastic drafting film while divers were still underwater (fig. 3.1). These maps of the individual grid square were then combined to

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<sup>84</sup> Pulak, Cemal. Personal communication November 3, 2009.

form a single master site plan drawn by field director Cemal Pulak. These measurements were supplemented with the application of stereophotogrammetry, which allows the general arrangement of the wreck to be captured by photographs with minimal parallax.



Fig. 3.1. Divers map the hull of the Ottoman wreck in 1982. Photo by Don Frey, courtesy of the Ottoman shipwreck project (INA).

Divers could only spend only 20 minutes on the seabed before beginning decompression and returning to the surface due to the depth of the wreck. As a result, it was necessary to expedite the mapping process to utilize bottom time more efficiently. This was accomplished by simplifying the underwater maps. For example, since the timbers were going to be raised and documented in detail after completion of the



excavation, the general shape of the timber was recorded with little detail regarding tool marks, pitch, or some fasteners. This was especially true of nail holes under the frames that were obscured by concretions. The recording of the planking, which typically ran across multiple grid squares, was delineated with string along the seams of the planks. Many of the edges of these planks were eroded or cracked, making it difficult to determine and photograph the strake runs; so the string acted as a makeshift boundary for the edge of the planking. This resulted in smooth, fair runs of planks on the site plan, and in the interest of maximizing bottom time, erosion and attrition was not recorded with needless detail. After the excavations ended and all faces of the raised timbers were drawn at 1:10 scale with full details<sup>85</sup>, a revised site plan was drawn showing all of these details.

Once the site was mapped, timber removal began. The timbers were placed into custom made wooden boxes that had been sunk to the seabed. After they were loaded, they were raised by loading the boxes on a large metal framed lifting tray, which was attached to an airbag. The air bag was inflated, and the timbers walked to the surface and loaded onto *Virazon* (fig. 3.2).

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<sup>85</sup> Pulak 1984b, 476.

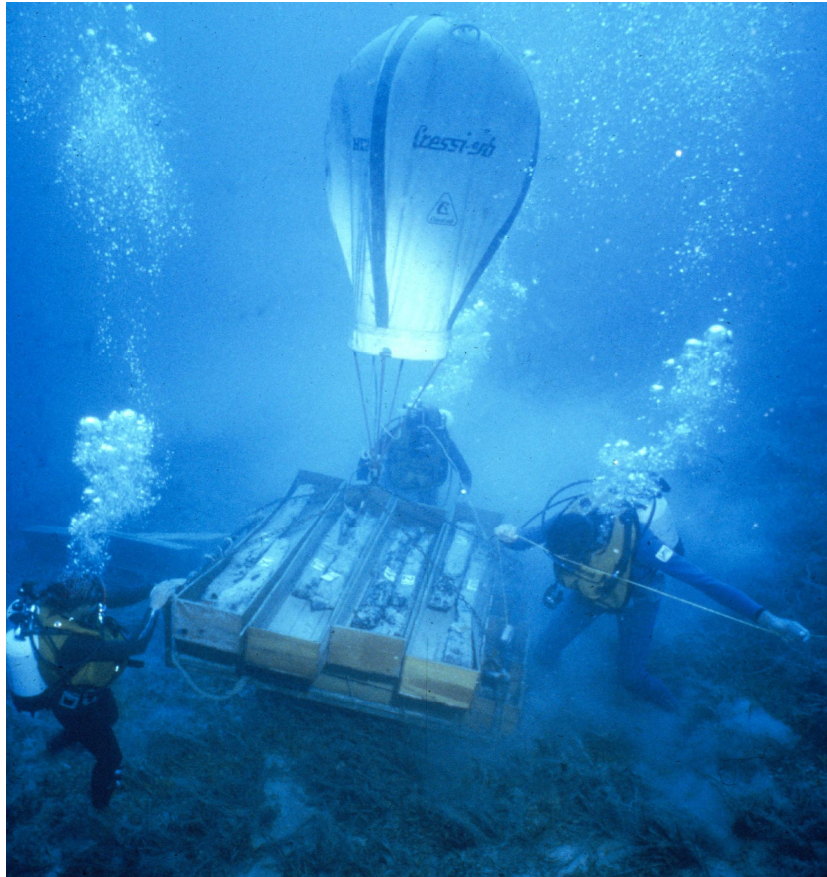


Fig. 3.2. Timbers being raised from the seabed. Photo by Don Frey, courtesy of the Ottoman wreck project (INA).

By the end of the 1982 season, parts of the keel, all of the frames, and approximately 30% of the surviving port side planking was raised and loaded onto the excavation support craft *Virazon* so they could be sent to the Bodrum Museum of Underwater Archaeology. Here, the timbers were put into freshwater storage where they continue to await conservation. The artifacts were cleaned in the conservation lab, and

when appropriate, cast with epoxy. The casts of artifacts from the 1960s were cast in polysulfide rubber.<sup>86</sup>

## SCANTLINGS

Presented here are descriptions of the principle timbers that made up the Ottoman ship. Some were well preserved, while others are surmised based on evidence preserved on other timbers and period construction techniques. These descriptions are presented so that the readers may familiarize themselves with the components of a substantial conglomerate artifact as well as the inconspicuous evidence that is preserved in these timbers. The sections are presented starting with timbers at the bottom of the wreck, and then moves upwards toward the areas of the ship where there are few if any archaeological remains were preserved.

### *The Keel*

The keel was discovered in four broken sections, spaced a short distance apart, and numbered keel1 through keel 5 starting at the bow to facilitate raising these neatly in five separate keel pieces. At the extreme ends of the keel, specifically forward of the apron and aft of the stern deadwood, are the preserved remains of a rabbet for the installation of the garboard strake. No rabbet exists at midship. Overall, the preserved remains of the keel are in moderate condition, with heavy damage concentrated at the

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<sup>86</sup> Bass and van Doorninck 1971, 28.

extremities and sections Keel 2 and Keel 3 near midship. Elsewhere, however, original surfaces are present with preserved tool marks, pitch, and fasteners.

The keel is straight, and is relatively consistent in section along its length (20 cm molded by 20 cm sided), save for the extreme aft end of Keel 5, which begins to curve up slightly to meet the sternpost. The area of the keel at the end of the curve is very flat, possibly indicating that the sternpost broke off or rotted away at or near a scarf that would have joined this section of the keel to the sternpost. There are no preserved scarves anywhere on the keel, but it is likely that one or more existed in areas where the keel was not preserved because these are weak points where decomposition could be accelerated, particularly if the process of wrecking the ship or laying on the reef for some time damaged the keel significantly. It is also possible that the keel could have been damaged by the collapse of the ship's masts as they began to decompose, but there is no direct evidence that this occurred, since the entire keelson and maststep complex were not preserved.

The forward most section of the keel (Keel 1) is relatively well preserved with original surface visible on all four faces. Both ends are broken, but otherwise the timber is solid and in good enough condition to obtain accurate sections at multiple intervals. The damage to the forward end of Keel 1 was likely caused when the ship hit the reef off Yassiada. Direct evidence for this theory was preserved on the ships apron and will be discussed at length in the following sections of the scantling list.

Keel sections 2 and 3 are poorly preserved to the extent that some of the framing nails have entirely worn away. These sections of the keel have suffered heavy damage

and have been flattened so that they are approximately half as thick as the other sections of the keel. As a result, it is difficult to obtain an accurate keel section in these areas. Unfortunately, this is the area amidships which would be, arguably, one of the most important portions of the wreck to have preserved. Fortunately, the keel was not rabbeted in this location, making a section of the keel at midship less necessary. The poor level of preservation in this general area is likely a result of silt being unable to reach and cover the timbers before decomposition commenced. Originally, Keel 3 was believed to have shifted down slope very slightly, but experiments with frame spacing based upon existing nails in the keel, frame impressions, and concretions, showed that this was not the case and this section of keel is in its original location, except for a slight shift by twisting.

The largest of the section of the keel, the extreme aft end (Keel 4/5), was sawn into two pieces near the start of the aft rabbet for ease of removal, transport, storage, and to get a good look at the keel's section at this important location. After the two sections of the keel were raised, a slice of the keel was taken from the area where the keel was cut to be used for dendrochronological analysis. The cut to separate the two pieces was made 3.10 m from the forward end of Keel 4. While the surface of the keel in this area was slightly eroded and waterlogged, the interior remained solid.

Looking at the site plan (Plate 1), the planking on the starboard side of Keel 5 is a short distance away from the keel, whereas the port side planking is crushed up against it. This indicates that this section of keel has moved over time, rotating in a slight clockwise direction. This did not pose a major impediment to the reconstruction, as it

was easy to line up the framing nails on the keel to nails on the starboard planking. An image of the keel and sections along its length can be found in figure 3.3.

### *The Stem*

The stem of the wreck was not preserved. A bent and concreted forelock bolt containing large splinters of wood at the forward extremity of the keel/apron, however, indicate this was the area where the ship originally struck the reef at Yassiada, and represents direct evidence as to how the ship sank.<sup>87</sup> Some of the forward portions of the planking had rotted away between the time the wreck was found and uncovered, and the final excavations in 1982 and 1983. As a result, the 1967 wreck plan and associated photographs are the only indication of the apron's original curvature. Because the photo-mosaic was taken above the wreck, the apron shows no curvature, but the hood ends (the edges of the plank where it terminates on the endposts) of the first three strakes, which now lay flat on the sea bed, show significant curvature.

Unfortunately, the original photo-mosaic and plan suffer from some degree of parallax, making it difficult to add these planks to the modern plan. Since the parallax is minimal in the longitudinal perspective, the missing planks were first added to the plan based on their relationship to the preserved frames. Next, their widths were scaled to match the known run of strakes. The projection of these missing planks was drawn on plastic drafting film and superimposed on a drawing of the existing keel and a preliminary projection of the stem's curvature was drawn up to the fourth strake. Tests

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<sup>87</sup> Pulak, personal communication, October 2009.

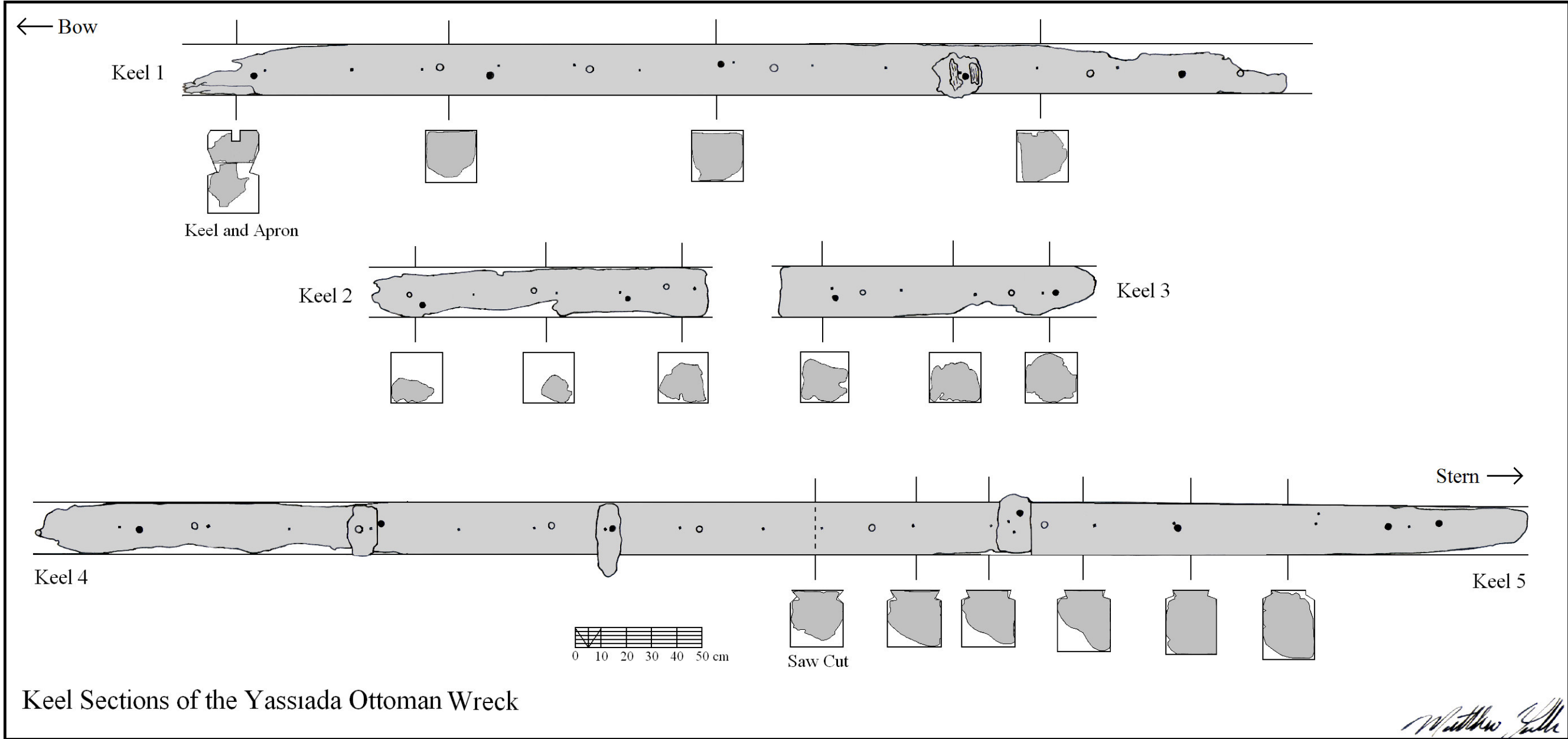


Fig. 3.3. Sections of the Keel. Preserved areas of the keel are highlighted in grey. Port side is to the left on all sections. Drawings by Cemal Pulak, graphics by Matthew Labbe.

with a model of the ship's forward section, however, showed that this preliminary curve was too hard. Fortunately, sufficient information was compiled from the early photographs of the wreck to rectify this problem, which is discussed further in Chapter IV.

### *The Apron*

A one-meter-long section of the apron, a timber used to reinforce the keel at the stem and allow for easier placement of frames in the congested area at the extreme forward end of the bow, was found attached to the forward end of Keel 1 and extends 67 cm beyond its broken end. The preserved fragment of the apron is 92 cm long, with molded dimensions of 19 cm on its inner face and 15 cm on its outer face, giving the timber a distinct trapezoidal section. The section of this piece matches the angles of the rabbets on the keel, allowing for more secure attachment of the garboard strake in this area.<sup>88</sup> Distortion due to wearing away of the wood, however, makes it difficult to obtain an accurate section at its forward end. Its sided dimension is 13 cm where the aft end of the apron is fully preserved and it abuts frame AA.

The forward end of the apron deteriorated significantly between the first excavation in 1967 and the excavation in 1982. This is supported by photographs of the wreck taken in the 1960s which show the apron to be longer at the forward end than what was eventually excavated and raised in the 1980s. Indirect evidence for the forward curving end at the keel or stem does, however, exist in the form of drawings taken from

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<sup>88</sup> In some instances, the garboard was nailed directly to the side of the apron.



the 1967 photo mosaic, which shows the curving of the garboard strake and lower planks at the hood ends. The preserved forward end of the keel is flat, ending before the section where it would begin to curve up to meet the stem.

On the inner face of the apron is a preserved notch 9 cm deep and 13 cm wide that was used to step the frames in this area (fig. 3.4). They would reduce in depth as they moved toward the bow, and eventually the frames would have sat on top of the apron with no notches. In August of 1967, divers recorded the depths of the notches preserved on the apron up to frame station DD. The measurements given were 9 cm at frame station BB; 6 cm at frame station CC; and 2.5 centimeters at frame station DD. All measurements were taken from original surfaces on the inner face of the apron. The reduction in the depths of the notches as they near the bow indicates the frames were stepped gradually to accommodate for the curving of the stem and to prevent the installation of Y-shaped frames, also known as crotch timbers.

It also appears that forward of these notches, either the apron disappears since it was no longer needed to accommodate the frames after frame station DD, or they simply sat on top of the apron without the notches. The latter is more likely since 1967 photographs indicate the apron was preserved as far forward as frame station FF. It is impossible to know if the forward most frames were canted to fit in such a small area, or if these were installed as half floors, although the notching on the apron suggests that no half floors were used. Further, the notch in the apron runs perpendicular to the timber, indicating that canted frames were not used.

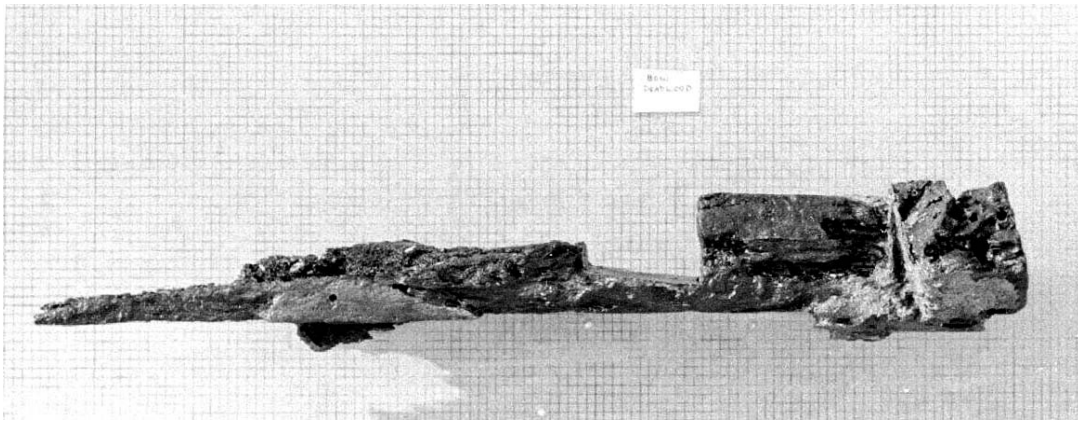


Fig. 3.4. Side view of the apron. Note the large notch for the stepping of frames. Photo by Cemal Pulak, courtesy of the Ottoman wreck project (INA).

A variety of fasteners were used in the construction of this area. The apron was secured to the keel with nails, although only one is preserved. Located between frame stations AA and BB, the nail is countersunk so that it adheres to the keel sturdily. This nail is similar in length and section to the nails used to secure the floors to the keel. Forelock bolts and treenails were also used to hold the apron firmly between the keel and the keelson.

The forward most forelock bolt on the apron is bent aft (fig. 3.5). In its concretion are preserved wood fragments that came from the keel. On the port side of the apron in approximately the same location is a nail hole that shows no evidence of concretion or oxidization, suggesting that the nail was ripped out during the sinking. These two pieces of evidence indicate that this is the area where the ship struck the reef; the keel would have broken from the impact and some of the planking ripped away from

the frames, allowing seawater to flood the ship.<sup>89</sup> The forelock bolt in this area bent aft since the ship was moving forward at the time it struck the reef.

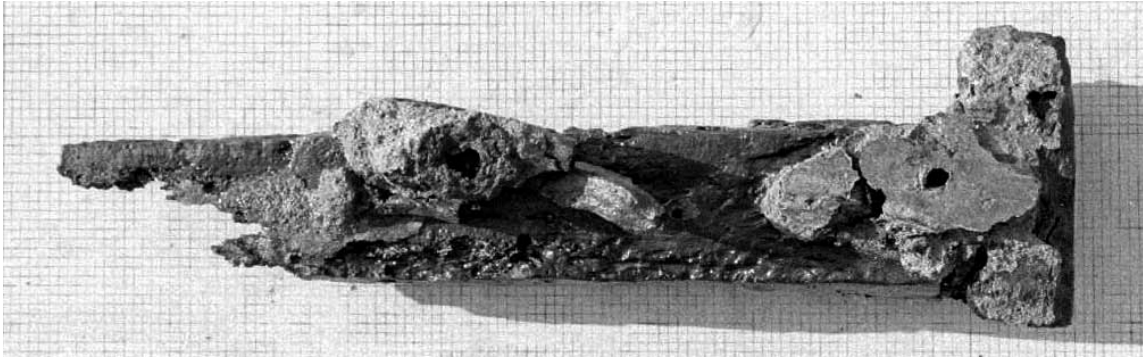


Fig. 3.5. Bottom view of the apron. The bent forelock bolt (center) is the area where the ship struck the reef. Photo by Cemal Pulak, courtesy of the Ottoman wreck project (INA).

It is possible that the apron continued to mirror the stem up to the deck level, and may have been used to anchor a beak or bowsprit on the ship. Forelock bolts and treenails passing through the apron as well as photographs from the wreck's discovery in 1967 indicate that the ship's keelson would have extended at least to the area around frame station FF and likely farther. On the *Kadırga*<sup>90</sup> in the Istanbul Naval Museum (Beşiktaş Deniz Müzesi), the keelson continues all the way to deck level.<sup>91</sup> Since there are a number of construction similarities between the Ottoman wreck and *Kadırga*, it is likely that the Ottoman wreck's keelson was constructed in a similar manner. It is

<sup>89</sup> Cemal Pulak, field notes and drawings, personal communication, October 2008.

<sup>90</sup> While *Kadırga* is capitalized and italicized in this thesis (a standard convention for ship names), it should be noted that the word is not actually the name for the ship, but rather an inaccurate description of its type that has found its way into common Turkish usage.

<sup>91</sup> This information is based on the unpublished construction plans of the ongoing *Kadırga* project. I thank Cemal Pulak for sharing this information with me.

possible, however, that the apron on *Kadirga* was a replacement timber added during the 19<sup>th</sup> century renovation, and the original apron may have been constructed differently.<sup>92</sup>

### *The Sternpost*

A two-meter-long section of the sternpost (fig. 3.6) was found a short distance away from the aft end of Keel 5, lying on its starboard face. A concreted gudgeon was found near the upper end, but not attached to the preserved sternpost. The sternpost tapers 6 cm along its outer face from its lower end to its upper end, and is curved along its length, indicating that this ship had a rounded stern, a style of shipbuilding popular in the Mediterranean, and used by the Ottomans on some types vessels until the first half of the twentieth century.<sup>93</sup> This is also supported by the discovery of the ship's lower pintle which is also curved in such a way that it must have been attached to a ship with a round stern.

In addition to the four forelock bolts that held the sternpost and inner sternpost together, a single nail hole was found on the outer face of the sternpost between the two uppermost forelock bolts. It is unlikely that any timber could have been fastened here, as there is only one nail hole, and anything mounted here would have interfered with the movement of the rudder. In addition, there is no evidence of concretion in this area indicating that the nail was not in place when the ship sank. It is possible that this nail was used during construction, probably for the attachment of a wooden support while the sternpost was free standing (i.e. before frames and planks were installed).

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<sup>92</sup> Arcak 2003, 242.

<sup>93</sup> Denham 1986, 281.

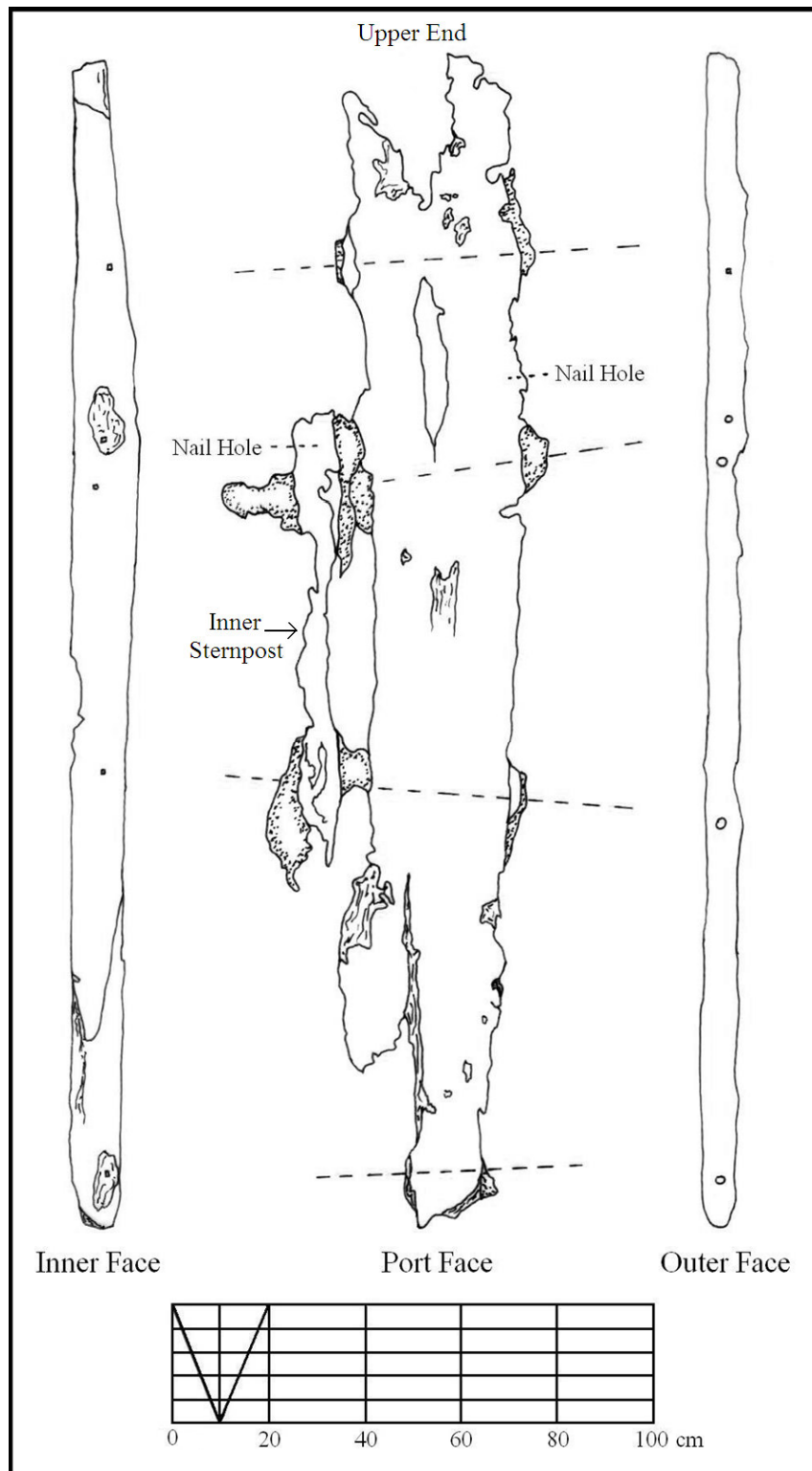


Fig. 3.6. View of the sternpost. Dashed lines represent the run of fasteners through the timber. Drawing by Cemal Pulak, inked by Matthew Labbe.

### *The Inner Sternpost*

A 1.26-meter-section of the inner sternpost, which serves a function similar to the apron, was preserved at the aft end of Keel 5. The lower section of the inner sternpost is similar to the apron in molded and sided dimensions but is not trapezoidal in section. Its rectangular section is molded 20 cm and sided 11.5 cm. It is known to have extended at least to the point of the upper gudgeon, as it is preserved on both the keel and the large sternpost fragment.

Like the apron, it too was fastened to the keel, and likely the keelson, with both forelock bolts and treenails, although the treenails terminate before the aft end of Keel 5. Unlike the apron, however, it is not notched to accommodate the ship's aftermost frames, and is not wider on its inner face than its outer face. This may indicate that the ship's stern was not as full as its bow.

A 95-centimeter-long fragment of the inner sternpost was concreted to the preserved sternpost section by bolts that hold them together. Its dimensions are consistent with the fragment preserved on the keel, but overall, the timber is not as well preserved. It is fastened to the sternpost with three forelock bolts, and no treenails. Since the treenails were used to temporarily hold the base of the hull including the keel, frames, and keelson in place, they were not needed this far up on the post. The treenail pattern deviates at the aft end of Keel 5, and there is no indication that they would have extended past the scarf that would have held the keel and sternpost together.

One of the more unusual artifacts found on the wreck was a fragment of the upper end of a forelock bolt, OW81 (fig. 3.7), found in grid L2 above the preserved

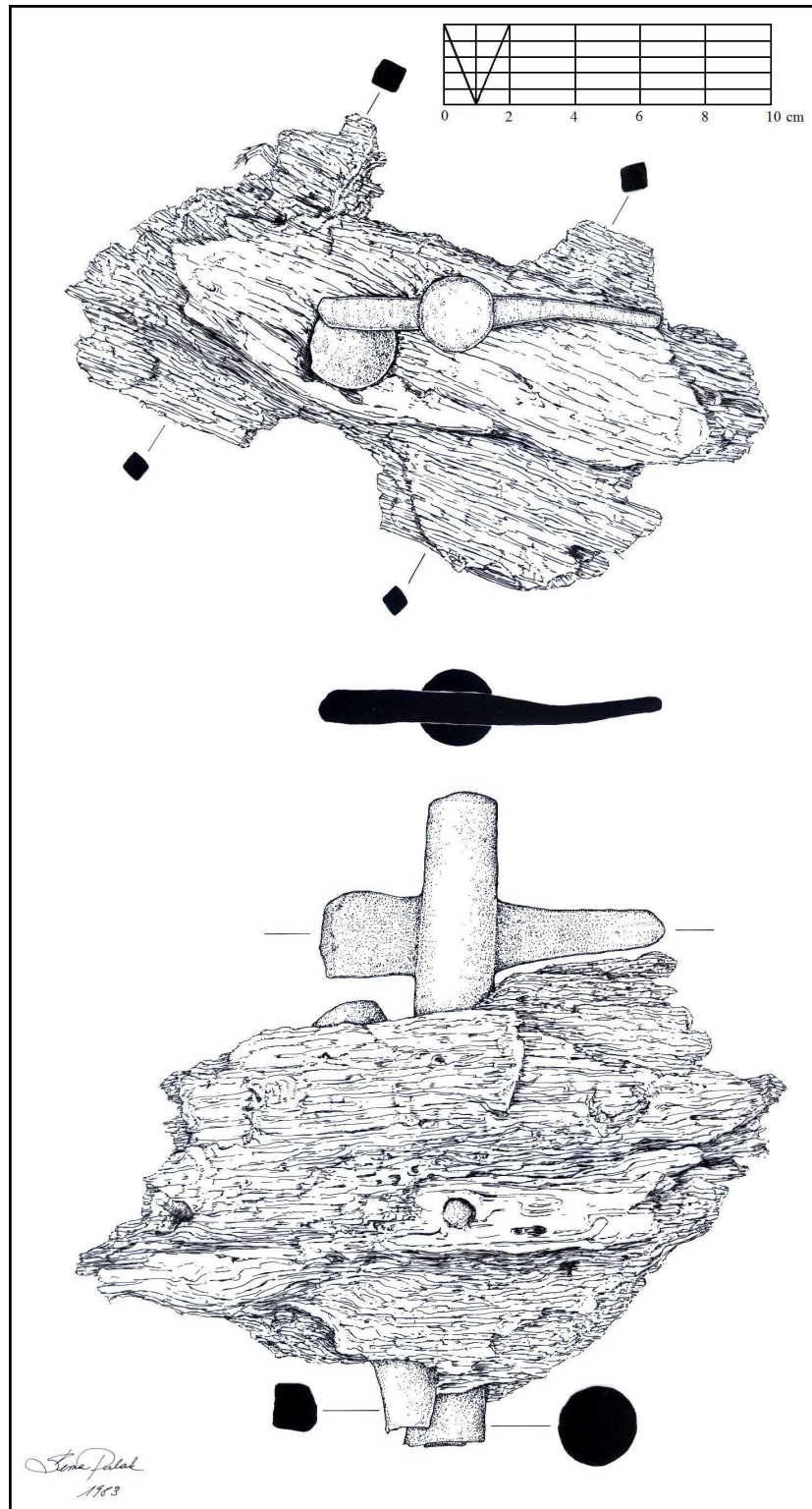


Fig. 3.7. OW81. The artifact includes a fragment of a forelock bolt and a nail embedded in a fragment of the inner sternpost. Drawing by Sema Pulak.

fragment of the sternpost. It is unusual because in addition to the key for the forelock bolt, it has a nail head that runs vertically through the timber, as well as nails that run through the side. The presence of a forelock bolt in this area indicates that the preserved wood attached to the bolt is a fragment of the inner sternpost, and represents some of the best evidence that the inner sternpost continued up to deck level. This is supported by the nail that runs vertically through the timber, since this type of nailing was also utilized to fasten the lower end of the inner sternpost that was attached to the aft end of Keel 5. The nails that pass through the sides of the timber may represent two possible scenarios. The first is that they are planking nails attached at this point because it was the location of a hood end. The second, but less likely, possibility is that these nails were placed here as a means to attach transom timbers. Because the sternpost is not especially well preserved, and the stem is non-existent, the apron and inner sternpost help give an indication as to the original length of the ship. We know that the frames on this ship were pre-erected because the fasteners for the hook scarves could not have been installed after the floors were erected, since they are longer than the space between the frames. The midship frame also gives an indication that the entire shape of the hull was pre-designed. This means that frame AA and frame 21, which would have butted against the stern knee, were probably the last pre-designed frames. As a result, the presence of these two components indicates that no significant section of the wreck at the ends has decomposed, and the ship could not originally have been much longer than the remains that were preserved.



*The Keelson*

The ship's keelson was not preserved, although considerable evidence for one exists. The most obvious evidence of the keelson's presence is the forelock bolts and treenails in the keel. The forelock bolts are almost always canted to some degree, indicating that the space under the hull while the ship was under construction was not of sufficient height to allow the forelock bolts, which, because of their pronounced heads had to be installed from under the ship, to be installed vertically, whereas the treenails tend to be straight, indicating that they were installed from inside the hull. Why both bolts and treenails were used is unknown, but it is possible that the treenails were added first, before the ship was planked, as a temporary way to sandwich the keel, floors, and keelson together. Once everything was installed and aligned properly, the forelock bolts would then have been installed as a way to permanently hold all of the bottom timbers together.<sup>94</sup>

Another piece of evidence is the lightly nailed frames. A single spike 25 cm long would not be sufficient to hold the frames securely to the keel, and so a keelson would be required to secure them together. Unfortunately, we will probably never know the keelson's exact sided dimension, or some of the other features that would have been attached to it because none of the recovered forelock bolts are completely preserved, although fragmentary sections of the keelson preserved with the forelock bolts indicate that the minimum molded dimension for the keelson was 19.5 cm, almost the same size as the keel itself. If even one forelock bolt had been preserved along its entire length, it

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<sup>94</sup> Cemal Pulak, personal communication, January, 2010.

would have been possible to subtract the molded dimensions of the keel and floor timbers near it to find the original molded dimension of the keelson. It is impossible to say how far forward and aft the keelson would have extended, but the arrangement of these features on similar ships such as *Kadırga* or the later Kitten shipwreck may provide an indication.

### *The Frames*

Twenty nine frames in their original positions were found on the wreck in nearly complete condition, along with a dozen or so fragments of other frames that have little or no context. As mentioned before, at least five more frames sat forward of frame AA, as the apron is notched to accommodate them. Likewise, nails in the inner sternpost indicate at least as many frames on the knee itself. A small fragment of frame BB, where it steps into the apron, was preserved but was found dislodged from its original location. It was probably protected from decomposition by the notch on the apron and was dislodged after the 1974 campaign, when the wreck had to be abandoned on short notice. It is comprised of the base of a floor where it attaches to the keel and has four planking nails on its outer face. A rather large number of frames and futtocks are also found in the debris field in the aft starboard quarter of the wreck site, although their original locations are unknown. The frames are relatively square in section, save for some beveling to accommodate the curving planking at the extremities, and average between 11 cm and 13 cm in both molded and sided dimensions.

Seven upper futtocks were found on the port side of the ship near the aft end. These are very long timbers that have only a slight curve, which may mean that they represent an area near deck level on the ship. Unfortunately, their accompanying floor timbers were not preserved, so their placement on the study model was not definitive, but hypothetical.

All of the frames are attached to the keel with a single spike, and were probably held in place more by the keelson rather than just these spikes. Each frame was attached to its futtock with a sawn out knuckle joint, also known as a hook scarf, and three clenched nails (fig. 3.8).

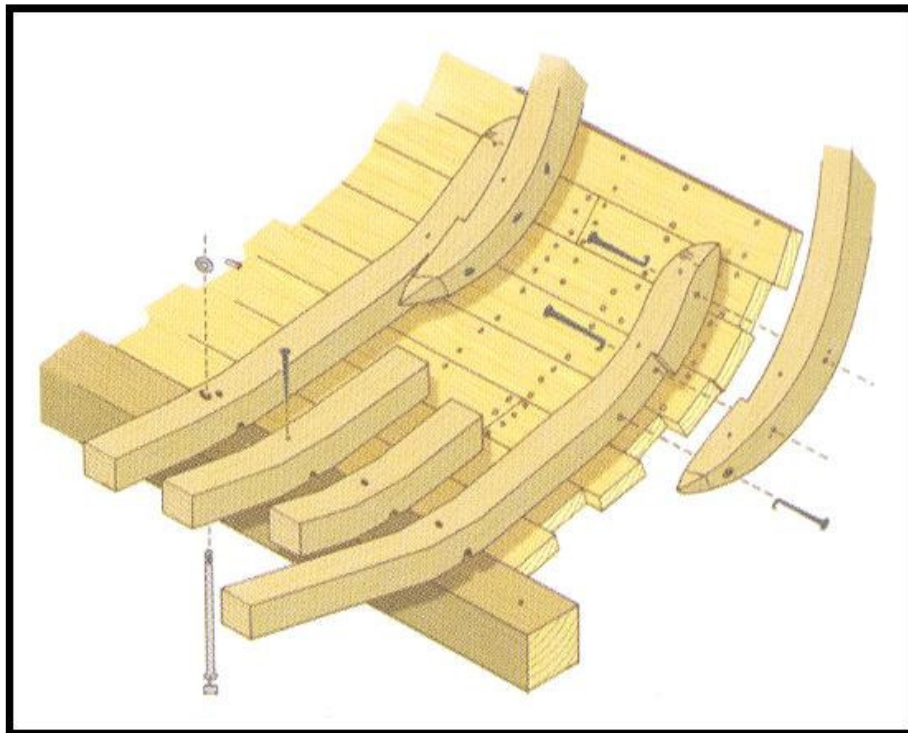


Fig. 3.8. Isometric diagram of frame assembly of the Ottoman wreck. Drawing by Jay Rosloff (from Pulak 2005, 141).

The knuckle joints were adzed out of both the floors and the futtocks to a depth of 1-2 cm. The length of their overlap does not appear to be of a standard measurement from frame to frame, although it is difficult to obtain absolute measurements for many of them as many of the ends of the floors and futtocks are damaged. From the well-preserved frames, it appears that the overlap of the floors and futtocks, where they attach to each other with a hook scarf ranges from 68 to 95 centimeters, with those near the bow being slightly longer than those amidships. Floor AA did not have a hook scarf preserved, but the nail pattern on the planking indicates that it was originally fastened in the same manner as the other frames. As it stands, it appears that all of the framing on the Ottoman wreck had these hook scarves.

Forward of midship, two of the nails that secure the knuckle joints were installed from the aft side of the timber and one from the forward face. In the stern, the pattern is reversed with two nails being driven from the forward face and one from the aft face. The alternating of the fasteners in this area is consistent with the location of the futtock relative to the floor (e.g., the reversal of attachment points at midships) and was probably used as means to securely hold the timbers together without putting undue stress on the futtocks or knuckle joints.

In the bow, the futtocks sit forward of the floor timbers, and aft of the floor timbers in the stern. The reversal is very clear at midship, but the two central frames are not attached to each other; they are merely spaced closer than the other frames. It is possible that there was a floating futtock that would have sat between frames F and 1 to reinforce the area, since the distance between the futtocks here is greater than elsewhere

on the ship. There is a fragment of a floor or futtock in this location, but it is too small and degraded to match with other timbers in the area, and there is no planking preserved here that could be used to match the nail holes on the outer face of the fragment (fig. 3.9).

No frame completely crosses over the keel, making it difficult to obtain a proper hull section, but the first seven preserved frames at the bow at least rested on the keel when the ship was excavated. Frame AA was particularly well preserved, and is the only frame for which its original orientation on the keel is known definitively. Compounding the difficulty of obtaining an accurate hull section is the fact that in addition to frames no longer sitting on the keel, the portions of the floor that would have rested on the keel are worn on all sides, further obscuring their original curvature at this point. The need to align the frames in order to assess the shape of the hull was the primary reason for building a study half model for the reconstruction.

All of the frames had a single limber hole averaging 3 cm square, which allows for the free movement of water in the bilge of the ship that would have occasionally been pumped out. Their location staggers from frame to frame to prevent the limber holes from being blocked by the spikes securing the floors to the keel, as well as the forelock bolts and treenails that would have held the keelson in place. The pattern of staggering limber holes changes, however, at Frame U. Unencumbered by the tight space at the bow, at Frame U, the limber hole is located above strake 2. Presumably, another limber hole would have been located above the same strake on the starboard side. Aft of this point, each floor probably had two limber holes instead of the single holes observed in the bow.

Because the frames are spaced so closely together, and the nails holding the futtocks to the frames are so long, we know that the frames had to have been assembled before they were installed on the ship. This means that the shipwright had a clear indication as to the shape of his hull before building it, and probably had a specific

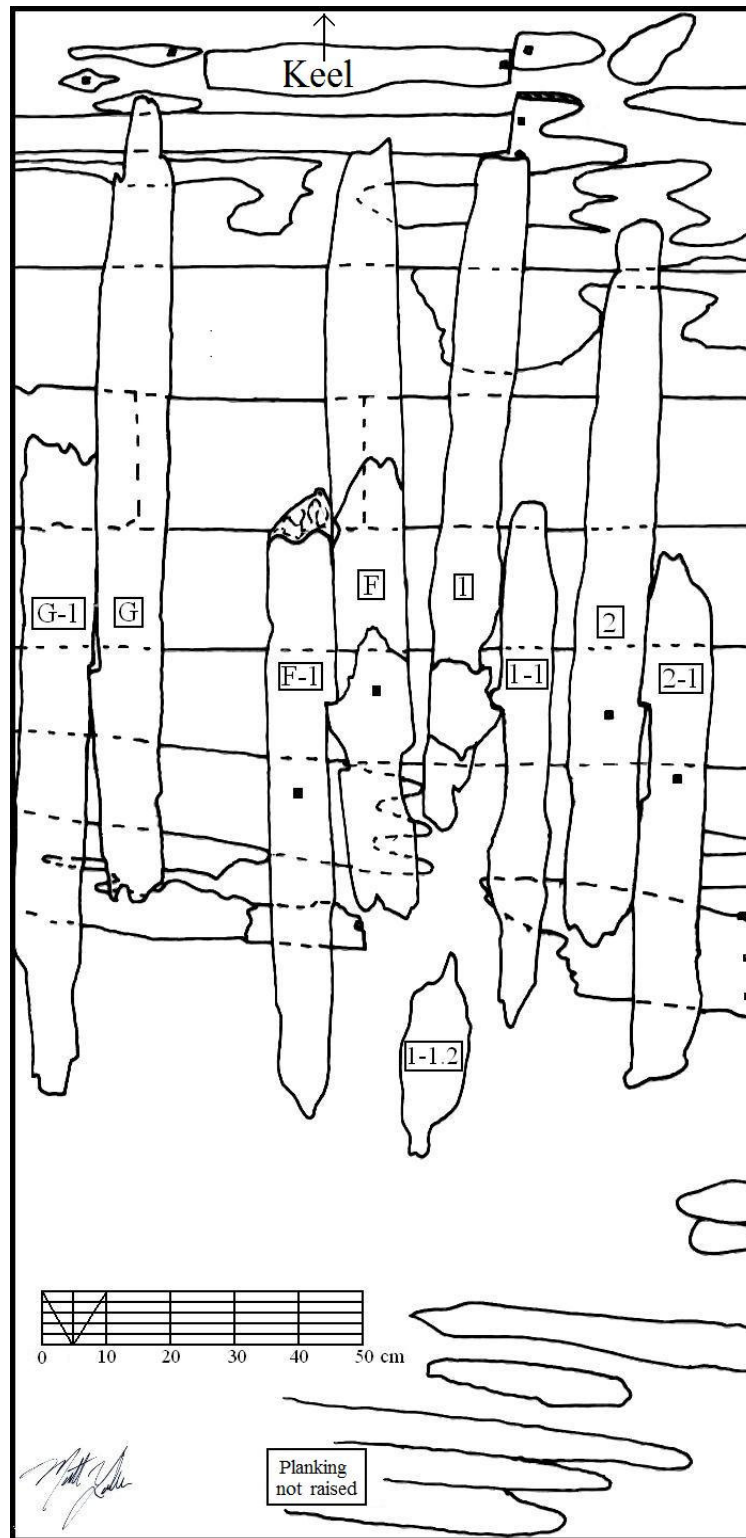


Fig. 3.9. A close up of the area around midships. Fragment 1-1.2 may attach to one of the midship floors or could be a futtock that sat between them. Image from the revised site plan drawn by Matthew Labbe.

design in mind, if not geometrical progression for determining the rising and narrowing of the frames. The Ottoman wreck's reconstructed framing pattern can be found in Plate 4.

### *Stringers and Wales*

None of the ship's stringers were found preserved in situ, but nail holes in the frames and futtocks over the hook scarves indicate their original location. It is likely that the stringers sat on top of the junction of the hook scarves on the frames to add longitudinal strength at these points. The 1967 photo-mosaic shows a large section of a stringer still in place at the forward end of the wreck between frames V and R. This gives an indication as to the original width of the stringer, which can be estimated from the photo as being 20-25 cm, but the thickness is unknown. It may, however, be possible to obtain this thickness from preserved stringer sections in the debris field.

Unfortunately, it is very difficult to differentiate between these pieces and wale fragments. Based on the preserved upper futtocks at the stern of the vessel, however, there is direct evidence of at least five stringers in the form of nail holes on the inner face of the futtocks.

The wreck was not preserved up to the wales, but as with the stringers, sections may be found in the debris field. One thing we do know, however, is that these wales do not appear to be half logs, but rather wide, thick, sections of flat wood. A mushroom head bolt was found on the wreck and shows three levels of wood, with the grain



changing direction at each level. This indicates that the bolt passed through a wale, then a frame, and finally a stringer.

### *Planking*

When the wreck was first discovered in 1967, the planking on the port side appeared to be in very good condition. It had fallen flat against the seabed and had been completely buried in sand. When the ship was excavated in the 1980s, however, it was discovered that the planking was far more fragmentary than was originally thought. In order to better comprehend the strake runs for mapping purposes in 1982, the excavators placed string along the run of the strakes and mapped these lines, which did not always reflect the precise slight curvature of the planking seams, especially at the bow and stern of the ship. It was not possible to create a precise wreck plan until these fragments were raised and drawn at 1:10 scale in the following few years. Due to the nature of the wreck, the port side planking is far more complete than the starboard side, although a large run of fragmentary strakes does exist on the starboard side at the after half of the ship, and was well recorded.

The planking, which averages 20 cm wide by 5-6 cm thick, was nailed to the frames with two square shanked nails per frame, but typically three at butt joints. Butt joints were typically used to secure sequential runs of planking, although port strake 14/2, likely a repair, shows evidence of a diagonal scarf. A number of drop strakes and stealers, areas where multiple planks come together and then continue as a single plank, are evident at the forward end of the ship. None appear preserved at the aft end. The

planks also have a tendency to narrow at the extremities of the ship in order to control their run. Deposits of pitch are commonly found between the frames and the planking. Tool marks indicate that the planks were roughly sawn to shape and then finished with adzes.

When working on the study model of the ship, it became evident that there were a number of nail holes on the outer faces of some of the frames that had no corresponding holes on the abutting planking. These extra nail holes represent two likely scenarios. The first is that they represent repairs – areas where the planking was removed while the ship was still in use and replaced with new sections. We know this to be the case because some of these extra nail holes are visible for the same plank on adjacent frames. Also, some of these repairs are visible in the planking itself as runs of planking that deviate from the norm. For example, port strake 14/2 has a cut-out for the placement of a repair plank (fig. 3.10). In addition, analysis of wood from the planks indicated that most of them were fashioned from oak, most likely Turkey oak, but some in the areas of expected repairs were found to be made of beech.

The second explanation for extra nail holes is that they were attachment points for a support structure when the ship was being built or battens used to control the run of the planking as it was being installed. In these cases, there should be only one or two extra nail holes per frame, and fewer or none on adjacent frames. The run of these extra nail holes is visible in plates 2 and 3.



Fig. 3.10. An overhead view of the planking showing repairs to strake PS 14/2. Note the L-shaped cut in the plank near label Y-1 near the center of the photo. Photo courtesy of the Ottoman wreck project (INA).

The aft planking on the port side was never raised or recorded completely, as the excavation ended in order to begin excavating the Uluburun shipwreck in 1984.

Fortunately, the starboard planking in this area was recorded well enough to aid in the reconstruction, and these planks are noted as not raised on the site plan.

### *Debris Field*

There is a large debris field on the starboard side of the ship near the stern. A number of substantial timbers are contained therein, which may be wales, stringers, deck beams, or some other unknown structural members. The lack of fasteners and their

unfinished, triangular ends could also indicate that these are raw timbers that were being carried as cargo, rather than integrated into the ship's construction. A few frames or futtocks are also found in the pile of debris, some of which still appear to be in their original location, but lacking their complimentary planking fragments. Unfortunately, it is nearly impossible to put much of this debris into context as part of the reconstruction since it is so jumbled and many of the fragments are non-diagnostic.

Directly adjacent to the keel is a number of planking runs, still in their original location. As one looks farther away from the keel, the debris looks more jumbled. This is probably because much of this debris is from the upper parts of the ship that fell to the sea floor as the structural integrity of the wreck was compromised by wood boring organisms. There is a relatively large concentration of artifacts made up primarily of mushroom head bolts, spikes, and forelock-bolt fragments above the sternpost, perhaps indicating that the ship had a transom.

One of the most interesting wooden objects found in the debris field are about two dozen large, whittled sticks about a half meter long with pointed ends. Probably not part of the ship's construction, they may have been used as weapons of some sort (perhaps thrown from the mast like a spear<sup>95</sup>), although it is remotely possible that they are stanchions for a small railing along the presumed aft quarter deck. One historic account that could be linked to these artifacts claims that in the Black Sea, if a sail

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<sup>95</sup> Cemal Pulak. Personal communication, October 2009

became so full as to strain the yard arm, sharp, javelin-like sticks would be thrown at the sail puncturing it and letting the wind out.<sup>96</sup>

## RELEVANT ARTIFACTS

A vast majority of the artifacts recovered from the Ottoman wreck were utilitarian, that is, of types used in the construction or functioning of the ship. Very few personal artifacts were found, although plates and bowls discovered are sufficient for a crew compliment of a dozen sailors.<sup>97</sup> The lack of artifacts and ballast suggest that the ship was carrying some kind of cargo when it hit the reef, and that the ship was hung up there long enough to be salvaged of every useful or valuable artifact before it became waterlogged and sank.<sup>98</sup>

The following are descriptions of some of the artifacts discovered on the Ottoman wreck that were used in its construction or for shipboard use. Artifacts of a personal nature or utilitarian artifacts that were not used in the construction and functioning of the ship are not considered here.

### *Mushroom Bolts*

Named for their unusual mushroom-shaped head, mushroom bolts were used to fasten the ship's wales. Eleven mushroom bolts were found on the wreck primarily in the area above the preserved remains of the sternpost, and attached to the port side futtocks

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<sup>96</sup> Eton 1805, 4-5.

<sup>97</sup> Pulak 2005, 140.

<sup>98</sup> Pulak 2005, 139.

at the aft end of the vessel. There is no evidence that they were used anywhere but the wales. With a shaft diameter ranging between 2-3.5 cm, mushroom bolts are similar in diameter to the other bolts used elsewhere in the construction of the ship. Their defining feature is a large, protruding head averaging 5.2 cm at the base and the head extends an average of 4.8 cm from the shaft. The head of the mushroom bolts probably had an exaggerated shape so that they would protect the hull of the ship from damage by a pier or wharf while docked.

This theory is supported by one particular mushroom bolt, OW113 (fig. 3.11), which is a preserved section of one of the ship's wales with the head of the mushroom bolt, as well as a standard nail. The presence of common planking nails indicates that they were sufficient to hold the wale in place, so the mushroom bolts must have had some secondary function, most likely that they were installed as a means to protect the hull from damage. Further, a single complete mushroom bolt (OW88) was found with fragments of a wale, frame, and a stringer (fig. 3.12). This gives us a thickness of at least 9-11 cm for the ship's wales. The fact that the mushroom bolts were anchored to the frames and stringers indicates a desire to make the wale rigid and able to absorb the force of contact between a bouncing ship and a dock.

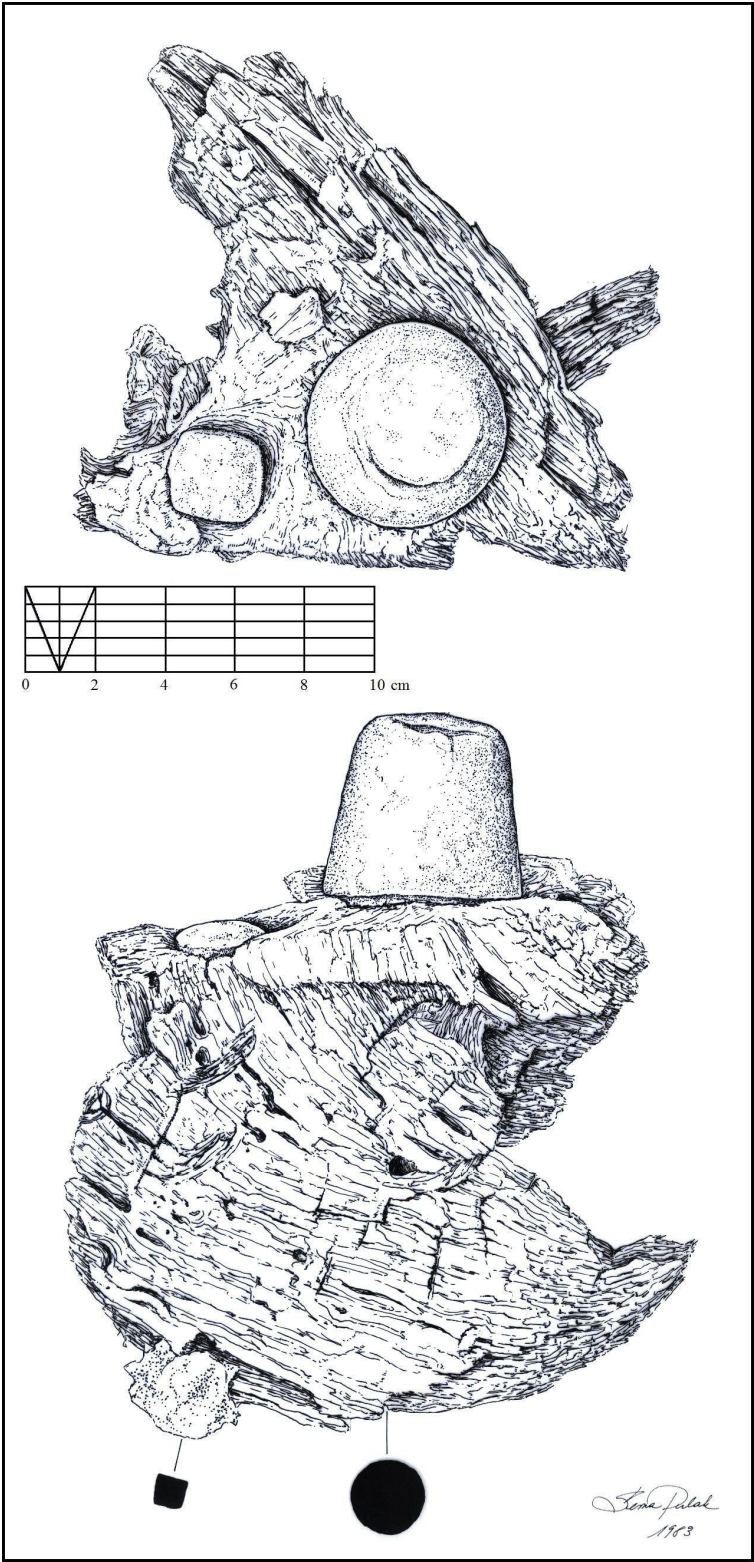


Fig. 3.11. OW113. Mushroom bolt with additional nail. Drawing by Sema Pulak.

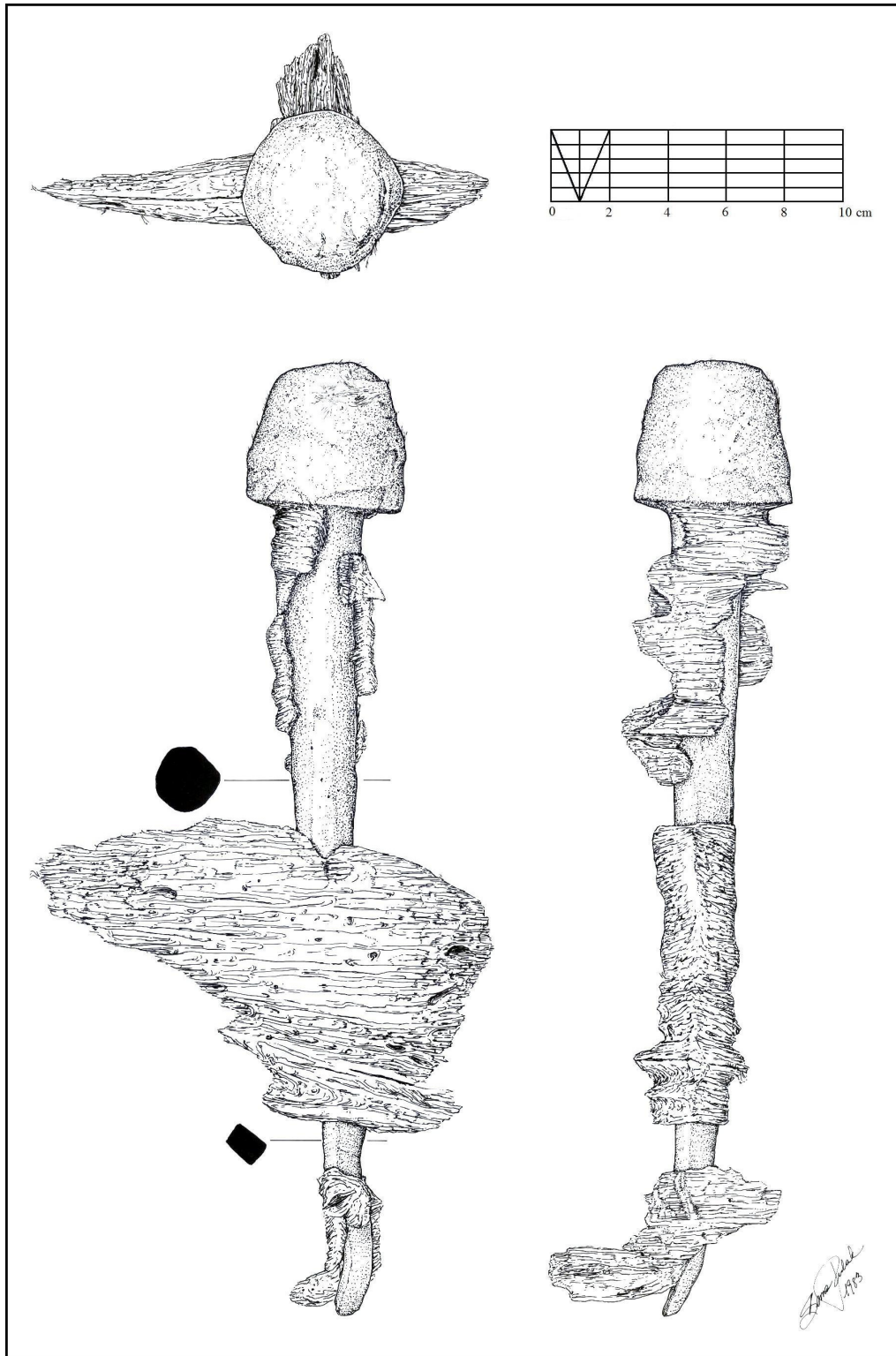


Fig. 3.12. OW88. This was the only complete mushroom bolt found on the wreck. The change in direction of the wood grain on the artifact indicates which timbers the bolt was attached to. Drawing by Sema Pulak.



### *Treenails*

Treenails, a type of large wooden peg used to fasten timbers together, were found only on the keel of the Ottoman wreck. Ranging in diameter from 2.5-3 cm, the treenails appear to have been used as preliminary fasteners to hold the keel, frames, and keelson together while the ship was under construction. They occur every 60-70 cm along the keel, but their spacing becomes closer around midships (50-60 cm) where a mast step was likely installed. The maximum spacing for treenails was 80 cm between the aft end of Keel 3 and the forward end of Keel 4.

They were driven through the keel in a way that almost all of them are perfectly vertical. The forelock bolts in the same areas, however, are rarely vertical. While the holes for both the treenails and forelock bolts were probably drilled from the inside of the ship outward, the forelock bolts, because of their large head, had to be installed from outside the ship. The holes for these bolts may not be vertical because the ship was not suspended high enough off the ground during its construction for the forelock bolts to be installed vertically. Why the fasteners were driven in this way is unclear, but it is possible that because the treenail had no head, they did not need to be driven from the bottom like the forelock bolts. Instead, the carpenter made use of increased visibility and work space inside the ship to make their installation easier.

### *Forelock Bolts*

These bolts were used in conjunction with wooden treenails to help fasten the keel, frames, and keelson together securely. The bolts have a hole through its bottom end

for the insertion of a wedge to “lock” the bolt in place. A washer was placed just below the wedge so that the wedge would be prevented from working into the timber and becoming loose over time.

Forelock bolts were found in the keel and sternpost. The heads of the bolts were countersunk into the keel so that they would not be damaged by protruding, but were not capped with a false keel or other material to prevent their degradation. The only evidence that they were used forward of the apron is the presence of RW40, the end of a forelock bolt with its wedge in place, that was found on top of the apron at its forward most end. While a number of fragments of both ends of particular forelock bolts were discovered, none survived completely intact, making it difficult to estimate the molded dimensions of the keelson.

### *Nails*

The most common type of artifact found on the Ottoman wreck was square, wrought iron nails (Fig. 3.13). This makes sense, because common nails were used to attach all of the planking as well as the framing of the ship. There is little to no difference between the nails used on the framing and those used for planking the vessel, suggesting they were manufactured in the same place.



Fig. 3.13. A selection of planking nails from the Ottoman wreck. Photo by Cemal Pulak, courtesy of the Ottoman wreck project (INA).

### *Ballast*

Only 29 ballast stones were found on the wreck during the 1980s campaigns. Others were discovered in the 1960s but were not measured or raised. The lack of ballast is surprising, as all ships need some sort of bottom weight to stabilize them in the water by lowering their center of gravity. The lack of ballast may be a result of two events: Either the ship was salvaged of its cargo before it sank, which is also supported by the lack of personal artifacts, or the cargo was perishable, something like grain or cotton, and simply did not survive. This would not be terribly surprising as the principal commodity of ship traveling in the southern Aegean Sea was grain.<sup>99</sup> The latter scenario is less likely because the damage to the forward end of the keel suggests that the ship was hung up on the reef long enough to be unloaded before it sank.

<sup>99</sup> Brummett 1994, 13, 124.

## SUMMARY

When excavations resumed in 1982, archaeologists discovered that in opposition to their original expectations, only 25% of the ship was preserved. Due to the fragmentary nature of the ship's planking particularly, a number of changes were made to excavation protocols in order to use time and resources more efficiently. These changes included simplification of the underwater mapping and use of stereophotogrammetry to record the site. Further, a second season of excavations was planned when archaeologists realized the project could not be completed in a single season.

At the conclusion of the two excavation seasons, divers had a clear view of the orientation of the wreck and its extant remains. The ship lay at a depth of approximately 40 m, oriented in a southerly direction. The keel was broken and damaged, and few of the frames discovered were preserved over the keel. The stem of the ship, being suspended on ancient amphorae, was not preserved, but a two-meter section of the ship's sternpost remained. The starboard side of the ship had a large debris field consisting of timbers of unknown provenience. The layout of these timbers, however, did give some indication as to the sequence of events involved in the formation of the site.

Very few artifacts of a personal nature were found on the site, but the presence of utilitarian objects such as nails, bolts, and treenails allow us to infer the location and size of timbers that did not preserve, such as the keelson, stem, and wales.

With a clear understanding of the parts that comprise the site, we can now examine in detail how and in what order these parts were assembled in order to discover what type of ship the Ottoman wreck was and what it may have been used for.

## CHAPTER IV

### RECONSTRUCTION

#### METHODOLOGY

##### *The Revised Wreck Plan*

The first step in the reconstruction of the ship was the completion of a revised wreck plan. As the wreck was excavated in the 1980s archaeologists developed a general site plan. When it was discovered that the planking aft of frame T was far more fragmentary than was initially suspected, archaeologists had to find a way to simplify the site plan so that they could use their bottom time more efficiently. The compromise was that strings were laid over all plank seams (especially where the planking was fragmentary) to facilitate the mapping of the planking. This resulted in very clean runs of planking lines on the site plan. After the fragmentary planking was raised, it was put into wet storage and then every piece was cleaned, cataloged, and eventually drawn in the years following the excavations at 1:10 scale with all faces and details visible (fig 4.1). Using these 1:10 drawings, the 1980s site plan was revised to more realistically show what the timbers looked like on the seabed.

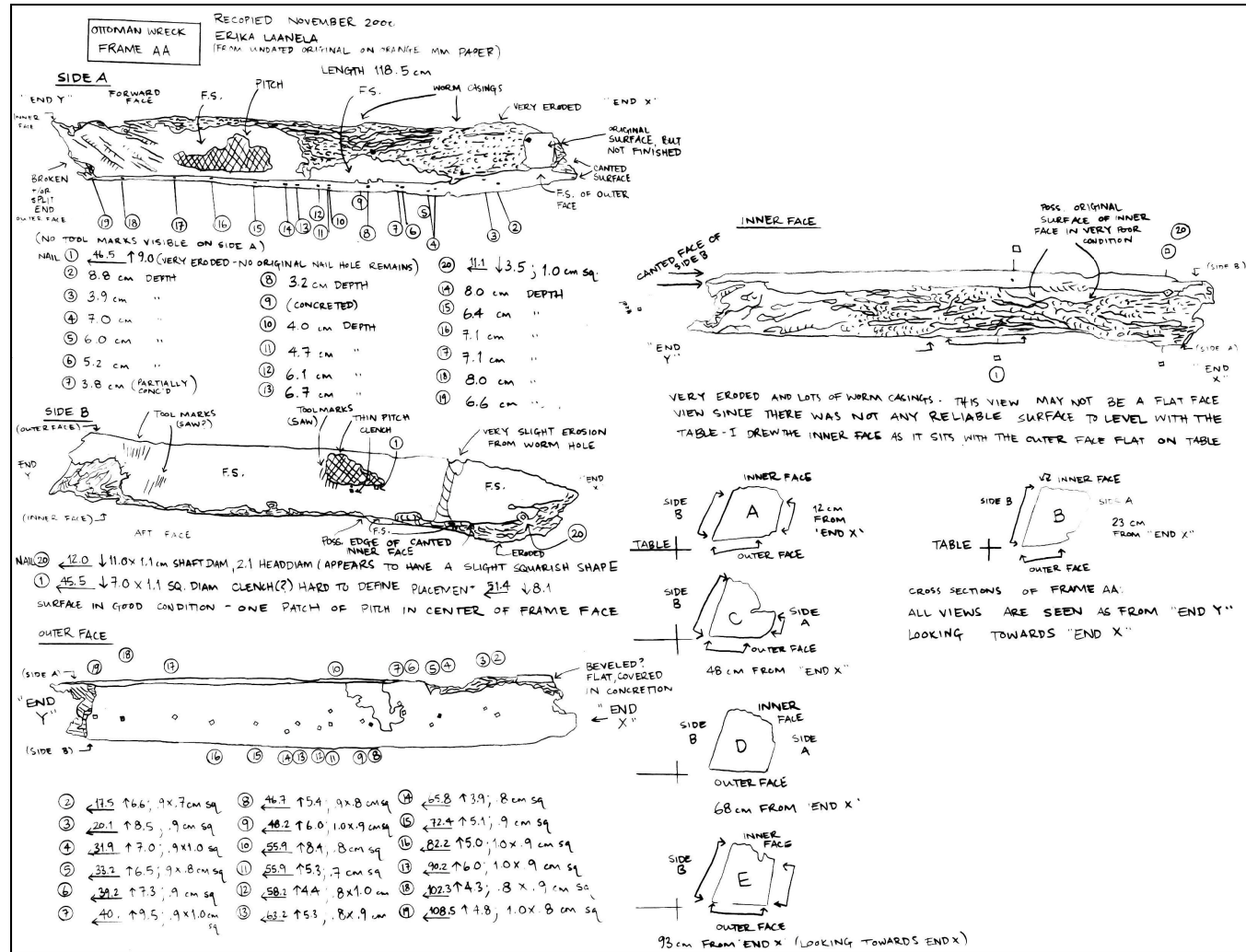


Fig. 4.1. A 1:10 scale drawing of frame AA. The drawings, which show all fasteners, tool marks, and other details, were invaluable to the reconstruction. Drawing by Cemal Pulak, recopied by Erika Laanela.

The revised site plan was a vital component of the reconstruction. With the added detail, the positions of nail holes relative to each other and those on other previously attached timbers were visible. The added detail of frame impressions and pitch made it possible to accurately place timbers in their proper location; an absolute necessity, particularly in reconstructing the original frame spacing, since a majority of the frames on the wreck had detached from the keel as the ship disintegrated.

The revised wreck plan was not a simple undertaking, however. During the time the timbers and planking were in storage, some of the labels on the timbers had become illegible or fallen off. When this happened, the timber was still drawn, but assigned an unknown member number based on the date of the drawing (e.g. planking fragment 1/25.9.1985). While a number of timbers lost their original number, a majority of these were too small to be of significance, or the original number was found by comparing the numbers on drawn timbers to their original storage tray location or previously known features. For example, a planking fragment from strake six on the port side (PS6) had lost its label and was re-labeled as UM 1/24.8.1985.

Even though this fragment had been assigned a UM number, it was possible to place it on the revised wreck plan based on the original site plan of the wreck. If a timber was lost or had a UM-number that could not be resolved, the original 1982-3 version of that timber was transferred to the revised site plan. For example, while frame 6 was drawn in the mid-1980s, its drawing was misplaced during the intervening years. The original 1982 drawing of this timber was drawn on the revised site plan because even though it is missing details such as the nails on the outer face that abut the planking, its



general state of preservation and original location are known and this information can still be used in the reconstruction. When the final reconstruction of the wreck is eventually undertaken, all of these inconsistencies will have to be resolved, but fortunately, they have had little impact on this preliminary phase of the project.

Another area of difficulty was showing artifacts on the site plan. When the 1982 and 1983 site plans were made, none of the concretions (save for those with Roman wreck numbers) had been cast, so the shape of the concretion was shown on the site plan but not the shape of the artifact inside. For the revised wreck plan, it was necessary to show what was inside the concretions since all but two have now been cast and their proper orientation on the seabed often gives clues to follow during reconstruction. Most of the casting drawings were available, although a few small artifacts, nails particularly, do not appear to have been drawn after they were cast. In other cases, the provenience of artifacts was recorded by excavators but the objects themselves were never worked into the master site plans after the excavation ended. If a concretion was never added to the original site plan (like some of those discovered late summer 1983), they were added to the plan if sufficient notation on their original location and orientation could be found in the original field notes. If not, they were not added to the plan. Fortunately, however, a majority of the artifacts related to the Ottoman wreck that were excavated in the 1960s were already on the plan.

### *Frame Spacing*

As work on the revised wreck plan neared completion, more time and energy was put into planning and starting the reconstruction of the ship. One major difficulty in starting the reconstruction was that very few of the floor timbers were preserved up to the level of the keel. Of the 29 preserved floor timbers, only five remained in their original location, all of which were located near the bow. Even though the remaining frames were located in relatively undisturbed positions on the seabed, the fact that the sections of the floors that would have sat on top of the keel were missing meant that any change in the deadrise of the floors relative to the keel made in order to fit them to the planking during the reconstruction could result in gross, compound errors, including errors in the proposed final lines drawing for the ship.

The first step in resolving this issue was to develop a plausible framing pattern based on the fasteners preserved in the keel, in order to be sure the preserved floors were in the correct location in relation to the adjacent timbers. Each floor timber was fastened to the keel with a single spike. The timbers near the bow indicated that these nails were typically centered on the floor. It was also possible to measure the approximate room-and-space (the width of a floor and the distance between two adjacent floors, respectively) on the preserved floors near the bow. Typically, floors were 11-13cm sided with a space of 17-18 cm. At midship, between frames F and 1, however, the spacing was only 8 cm. It also appears that the frame spacing became slightly wider toward the stern. The maximum space between any two frames was 26 cm, which occurs just aft of the start of the inner sternpost. It is possible that this wider spacing was intended to

accommodate a pump well for cleaning the bilge, but no direct evidence of this pump exists.

Work began at the bow where the first seven frames aft of the apron were attached to or at least extended to the keel. After finding the average spacing of these frames, the pattern was projected aft. The spacing was modified if the projection did not match with the nail holes preserved on the keel.

In some cases, concretions caused by the bleeding of the keel fasteners under the floor timbers left impressions of the original limits of a particular floor's sided dimensions. This, essentially, acted as an invisible frame that could be used as a check for the proposed framing pattern. In some instances, trenails or bolts that were used to secure the floors between the keel and the keelson passed through the floors themselves. Originally, this suggested that the proposed framing pattern was incorrect, but evidence on frame X showed a bolt passing directly through it. Apparently, while the trenails were being installed, they were done so in such a way that, on occasion, the carpenter was unable to see precisely the direction that a trenail boring passed through the timbers, and he occasionally "nicked" the floors. The reconstructed frame spacing can be found in figure 4.2.

#### *Reconstruction of the Endposts*

Once the revised framing pattern was completed, the reconstructing the endposts began, as these would be necessary on the model to attach the ends of plank runs.

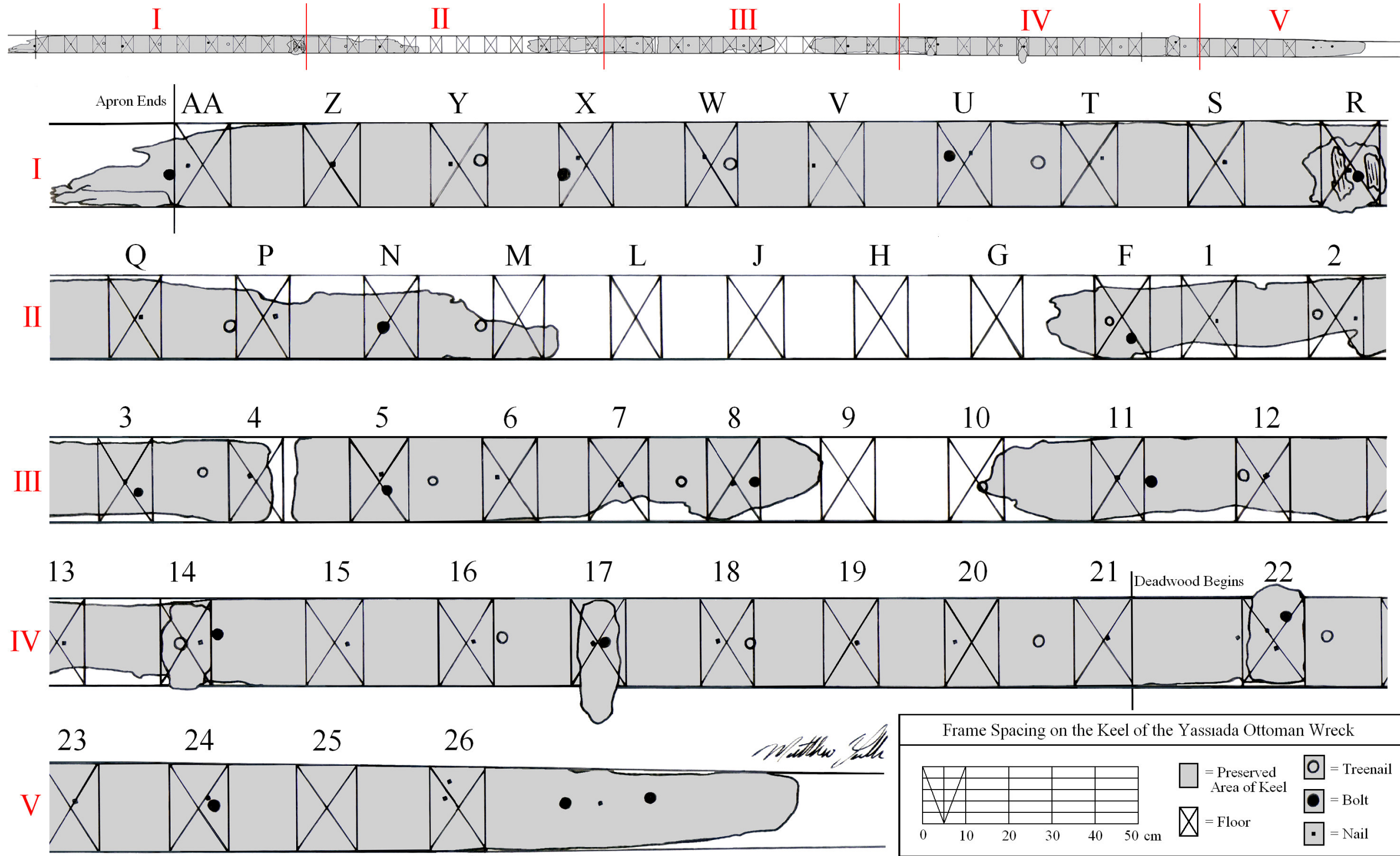


Fig. 4.2. Frame Spacing.

Many variations were proposed, even after the model was under construction as new information became available, but these preliminary reconstructions were sufficient for the early stages of the project and were modified as needed.

The sternpost was completed first, as it was still partially preserved, whereas the stem was virtually nonexistent. The outer face (bottom) of the aft end of Keel 5 begins to curve upwards. This curve, along with the flat “table” on its inner (top) face, represents the junction between the keel and the sternpost. This inner face was probably part of a scarf that joined the two timbers, which broke away or degraded because it was a weak point on the assembly. It is also possible that there was simply a flat scarf here and the planks were simply butted together and were held in place by the forelock bolts and keelson.

On many Mediterranean ships, the entire stern curved gradually upward before straightening out near the transom or top deck of the ship in contrast to many other northern and western European vessels where the sternpost was straight and joined at a set angle to the keel. The curved sternpost also results in a curved rudder attached at two points, as opposed to a straight rudder which typically attaches at three or more points. By projecting this curve and aligning it with other preserved features such as the sternpost and the pintle (which curves to match the run of the sternpost), it was possible to create a reconstruction of the ship’s stern, which satisfied the existing data. Although the curved stern is the most common type of stern in the history of naval architecture,<sup>100</sup> they are far more difficult to reconstruct.

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<sup>100</sup> Mott 1990, 104.

The first step was to examine the preserved hood ends on the planking. They are curved and beveled so that they abut the endpost (usually by being inserted into a rabbet) and create a water tight seal. The curve of their inner and outer faces at the aft end should, thus, match the curve of the keel at the rabbet. The two aft hood ends for strake PS1 on both sides of the Ottoman wreck were preserved, with a third on the starboard side, probably for strake two, which was displaced.

In order to align these hood ends properly and to extend the curve of the top face of the keel, and, by default, the outer face also since we can assume the sternpost was of uniform molded dimensions in this area, it was necessary to draw a side view of the keel. In this case the port side was chosen so that it would not have to be mirrored when the model was built. The hood end was placed on the drawing and shifted until its bottom edge matched the curve of the rabbet on the keel, extending the curve of the rabbet by a few centimeters. The nails that run through the planks to secure them to the floor timbers acted as a check by insuring that the hood ends were fit in such a way that they would correspond to the reconstructed framing pattern. The single displaced hood end was also added as strake two, which extended the line slightly further. This did not produce dramatic results, but it at least allowed for the outer curve of the sternpost to be extended slightly.

The next step was to find the distance that the preserved section of the sternpost would have sat above the keel. When the keel is viewed from the top aspect, it is seen to narrow slightly as it runs aft. The preserved fragment of the sternpost does the same. By continuing to narrow the keel beyond its after end, it was possible to position the

sternpost in such a way that its narrowing was consistent with that of the keel (fig. 4.3). This resulted in 1.28 m as the distance from the preserved end of Keel 5 to the base of the preserved section of the sternpost.

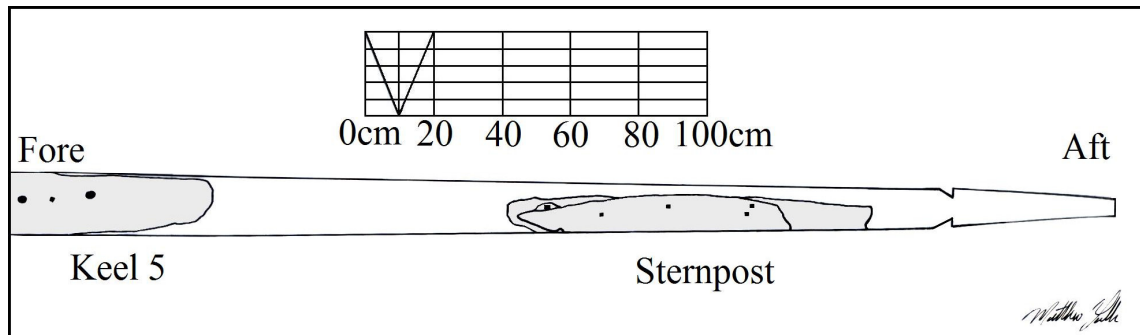


Fig. 4.3. An overhead view of the keel showing the original location of the sternpost fragment. The sternpost has been foreshortened to accommodate the curve of the post. Drawing by Matthew Labbe.

Unfortunately, this location alone was not sufficient to place the sternpost accurately. With only a single point locked in, the sternpost fragment could be rotated to produce a variety of curves that are consistent with its outer face as well as the outer face of Keel 5. Another point between these two was needed in order to assure that the run of the sternpost was plausible while remaining consistent with the preserved remains. This point was found by analyzing the shape of the 1.9 m long pintle that was found southeast of the wreck. Parts of the pintle were bent and heavily concreted (fig. 4.4). Due to the very poor preservation of the pintle, Cemal Pulak spent a significant amount of time cleaning, casting, and reconstructing the artifact before it could be accurately measured and drawn (fig. 4.5).





Fig. 4.4. The heavily concreted pintle awaiting conservation in 1983. Photo by Cemal Pulak, courtesy of the Ottoman wreck project (INA).

The long arm of the pintle was mounted to the sternpost below the waterline in such a way that it would have maintained a consistent distance away from the curving sternpost so that it would not interfere with the rotation of the rudder. This meant that the curve of this arm had to be nearly identical to that of the sternpost. By placing the pintle on the sheer view drawing of the sternpost and shifting it, it was possible to see the limited number of places that the pintle could fit with the proposed reconstruction. With this information, as well as that from the keel itself, and from the sternpost fragment, it was possible to obtain a fairly accurate reconstructed curvature for the stern.



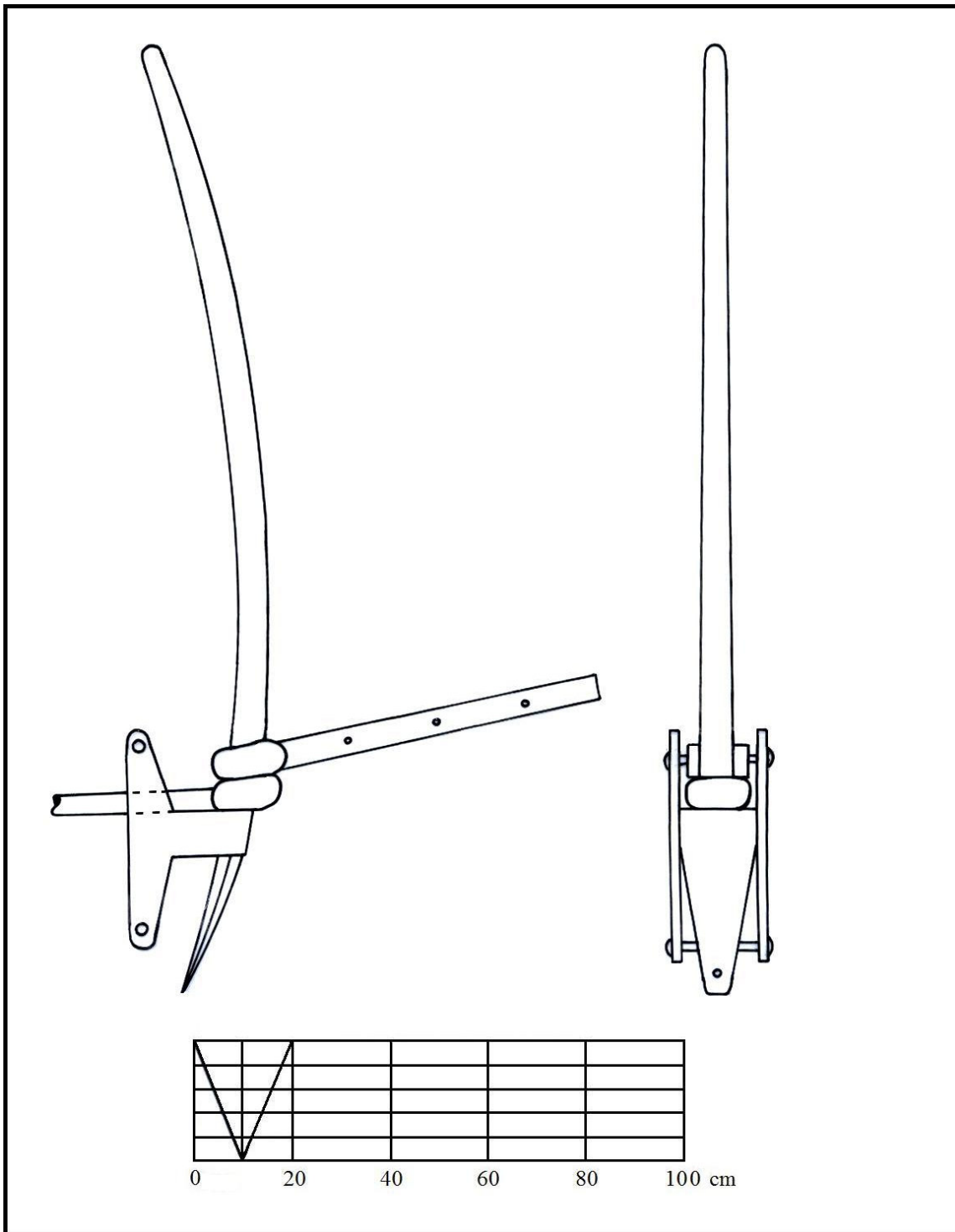


Fig. 4.5. Port and aft views of the reconstructed pintle. Drawn by Cemal Pulak, inked by Matthew Labbe.

The next step was to reconstruct the stem in the same way. This area proved to be more difficult to reconstruct as the only information preserved was a fragment of the apron, which sits on top of the keel, and the photographs and notes from the initial 1967 excavation. Since then, much of the stem had rotted away before the wreck was fully excavated in the 1980s.

The preserved remains of the keel at the bow offered little or no information because it was heavily damaged during the sinking, and its preservation was hampered because it came to rest on top of the amphorae of the fourth-century wreck. By resting on these amphorae, the keel was prevented from being buried as was the rest of the ship, allowing the normal course of deterioration in salt water to take place.

The preserved fragment of the apron offered little information about the curvature of the stem, but did give some insight into the construction features in this area. The top of the apron was cut in such a way that it had a number of “steps” that allow for the rising of the frames towards the bow. If the frames near the bow were not stepped in this manner, it would have been necessary for the shipwright to produce more Y-shaped crotch timbers. Such frames would have been rather difficult to find in sufficient quantities and quality of wood with its grain (which provides strength) running in the axis of the floors. Instead, the shipwright had these bow frames constructed in the same manner as all of the other frames, and bypassed the problem by adding the apron, which also provides more strength for the stem. The presence of an apron with this kind of stepping is a clear indication that the stem would begin to curve upwards shortly forward of this point.

The final bit of information regarding the stem came from the photographs of the excavations from the 1960s. The most useful photograph shows the forward most end of the apron, with a portion of it broken off and lying on its port face (fig. 4.6). This face shows the outer curve at the beginning of the stem, as well as the remains of a frame, likely frame EE. Because the preserved section of the apron is in the photograph, it was possible to scale this fragment to assess its dimensions with the help of Ryan Lee, a nautical archaeology program student, in the Wilder 3-Dimensional Imaging Lab at Texas A&M University.



Fig. 4.6. Photo from late summer 1967 showing the broken keel. Photo courtesy of the Ottoman wreck project (INA).

The photograph was scanned and imported into Rhinoceros 3.0, a 3-D modeling program, where all of the wood fragments were traced. A known distance, in this case, the width of the step at frame BB, was imported as real world measurement, and the picture was scaled to fit this measurement. It was then printed out at 1:10 scale so that it could be traced onto a reconstructed stem drawing. It was necessary to find out, however, exactly where this fragment would sit on the keel. In this case, the preserved frame fragment on this newly scaled keel fragment gave a clue.

One of the stereoscopic images of the wreck taken in 1969 had been traced and showed traces of stepping of the apron that was not preserved when the apron was raised in 1982. It shows the steps preserved as far forward as frame FF, whereas on the recovered piece, only the step for frame BB was completely preserved. These extra steps and their known distances from each other allowed for the placement of the new fragment containing a fragment of frame EE to be added to a top view plan of the wreck. The distance from the after end of the apron to the after end of this new fragment could then be taken and added to the reconstruction. The bottom face of the fragment would have the same curvature as the top face of the keel. Since the keel is consistent in thickness over its length, this fragment allowed for the calculation of the curvature on the bottom face of the keel. Ultimately, this added fragment allowed for the keel to be accurately extended to the start of the stem curve, even though none of the wood in this area was preserved.

Beyond this point, the curvature of the stem is mostly conjectural. It was reconstructed based on the natural run of planks on the model, the lines drawings, and

iconographic sources. It is possible that some of the wood fragments to the south east of the wreck that were documented in the 1960s could be from the stem or a beak that attached to the stem, but currently, there is no way to put these finds in context.

### *The Model*

When work on the revised site plan, reconstructed frame spacing, and endposts were completed, work began on a foam-core and balsa wood half model of the port side of the ship. Since all of the ships timbers were drawn at 1:10 scale, the model was constructed at the same scale. The half model was a longitudinal representation of the port side of the ship. A full model was not constructed due to time constraints and lack of preservation on the starboard side of the ship. Some information from the starboard side was used, however, and these pieces were mirrored to fit on the port side.

A large foam-core base was laid down with a copy of the revised site plan on it. On top of this was a two-piece balsa wood keel that separated amidships to make the model easier to handle. The balsa keel was 2 cm square and extended beyond the preserved sections of the keel. This would later be amended as a better understanding of the shape of the end posts became available.

Because a large majority of the floor timbers do not cross the keel on the wreck and their exact orientation on the ship was not known, it became necessary to devise a system so that the floors could be rotated up or down, depending upon the information derived from the ship's planking. A support structure for the model was constructed to solve the problem. Two pieces of particle-board of the same length and shape of the keel were placed to the starboard side of the model keel. A series of L-shaped brackets, one for each frame (even those that were not preserved), were mounted to the particle-board pieces at distances that corresponded to the location of frames on the reconstructed framing pattern. The foam-core floor timbers could then be mounted to the brackets with one or more screws and butterfly nuts in such a way that the frame was either held in place securely by multiple bolts, or was free to move when attached with a single bolt (fig. 4.7). The other advantage of this plan was that the floor timber could also be slid back and forth across the keel by cutting a square channel in the foam-core frame equal to the diameter of the attachment screws and perpendicular to the mounting bracket. The brackets were placed in an area where no frames were preserved so that the curves of the missing frames could be reconstructed as the planking of the model progressed.

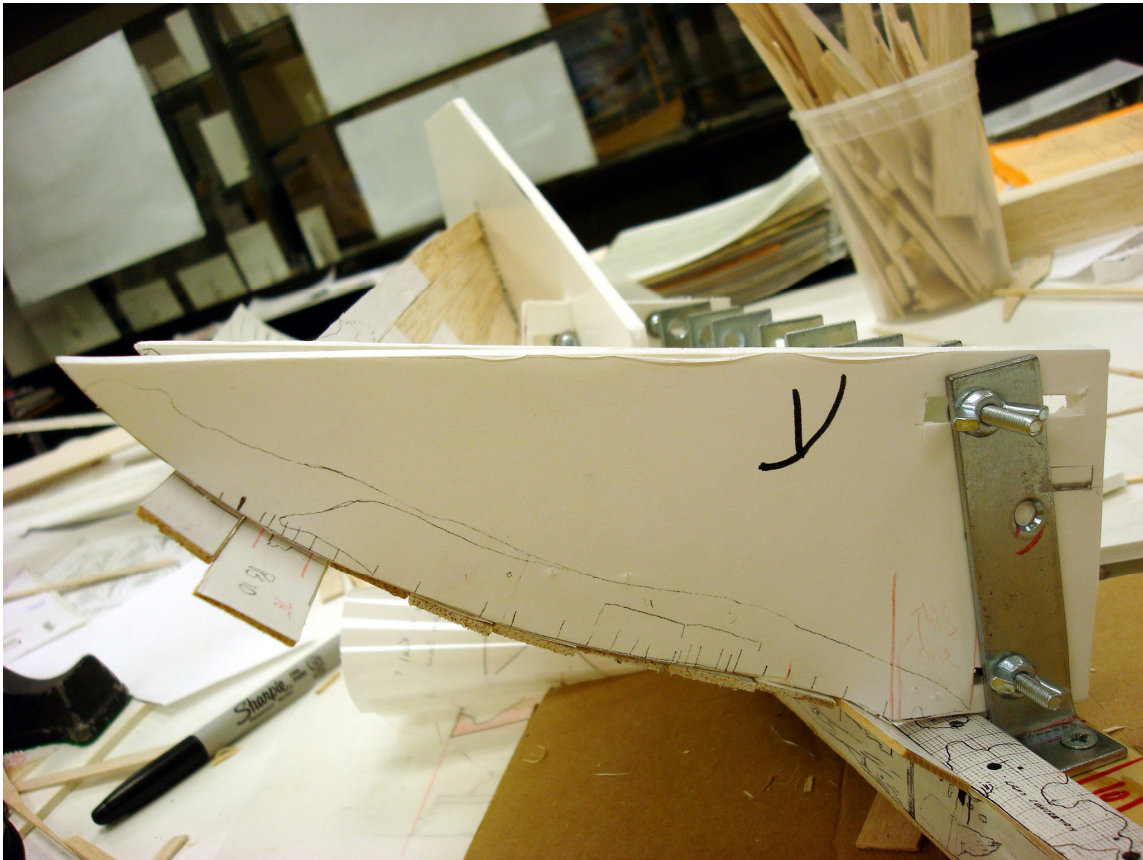


Fig. 4.7. A frame attached to the model's support structure. Photo by Matthew Labbe.

Once the support structure was constructed, copies of the 1:10 scale floor timber drawings were glued to sheets of foam-core. The planking nails visible on the frames were marked on the copied frame drawings with red lines so that they could be aligned with nail holes in the planking. The foam-core was then cut to shape along the bottom of the frame, but was left square elsewhere so that it could be mounted to the support system.

Work on the model began in the bow where some of the floor timbers were still attached to the keel. The first five foam-core frames were loosely attached to the support



structure. Photocopies of plank remains were glued to strips of balsa wood. Multiple planking fragments were added to each piece of wood to increase the plank length in order to produce smoother, more accurate hull curves. Original locations of plank butt joints were maintained. The nails on the inner faces of the planks were marked in red and matched to their corresponding nail holes on the frames (fig. 4.8). When the two matched, the planking was pinned to that area of the frame with steel pins.

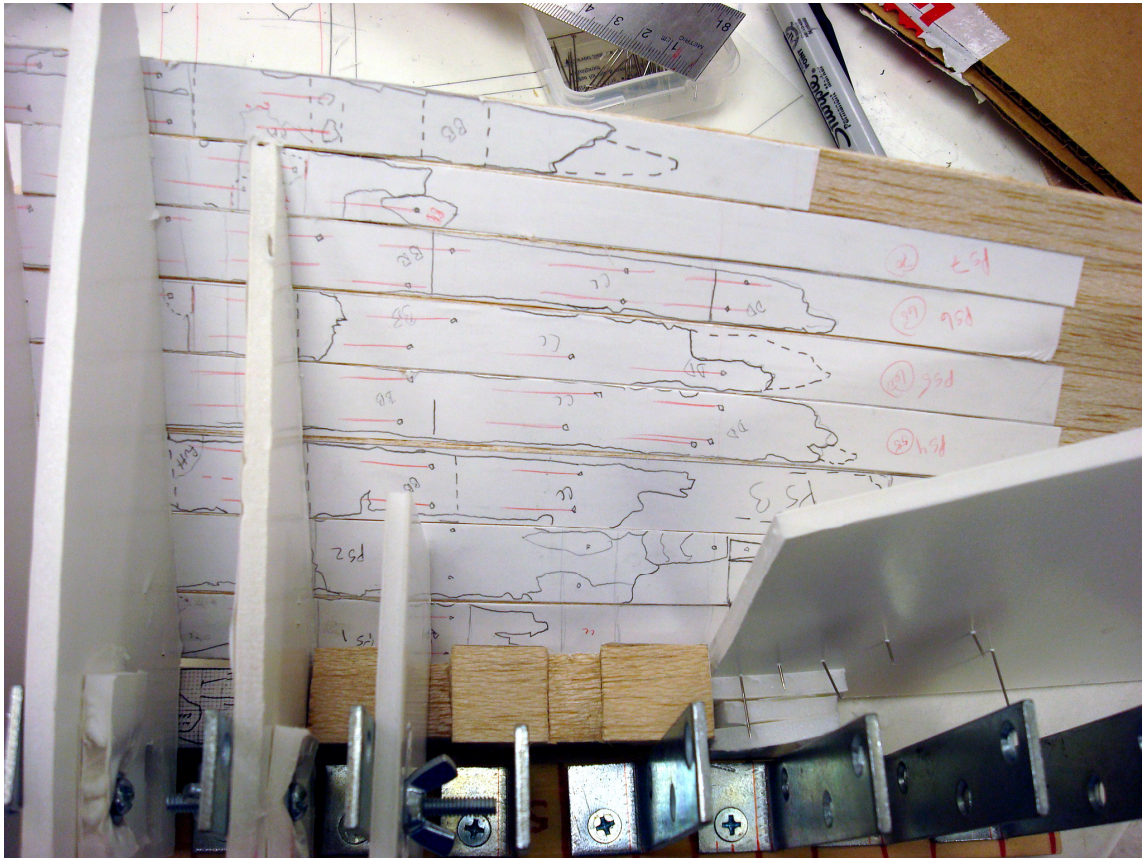


Fig. 4.8 View of the model early in the construction sequence. Note the alignments of nails on planks to which frames were attached. Photo by Matthew Labbe.



As the planking progressed, it became evident when a frame was not in its proper location. If a frame was incorrectly placed, either its curvature did not sit flush against the planking, or the nails on its outer face matched with the nails on some planks but not others. If the nails on the frames did not match the nail holes on the planking, then the frame was moved, rotated, or replaced with a corrected version.

The planking progressed slowly from the garboard upwards toward the turn of the bilge. The process was slow due to the number of nails that needed to be matched (approximately 25 per frame), and the degradation of planking in areas near the bilge where there were drop strakes, repairs, and changes in the consistency of the plank widths. In some instances, particularly those involving the confusing assemblages of repairs and stealers at the bow, the best solution to the problem was to draw the plank runs in two dimensions based on evidence from the wreck plan to figure out how they were assembled before adding them to the model.

As the model neared the limits of the preserved architectural details on the wreck, it became necessary to start filling in the gaps between elements with speculative features. For example, one critical piece of information that was missing was the location of the load water line, the highest level of water on the ship's hull when it was fully loaded. Looking at iconography of Ottoman ships, it appeared that this line was at or just below the first wale, and just below the tip of the lower pintle where it extends up between the sternpost and the rudder.

The latter location was known with some certainty, but no wales were preserved on the wreck, save for some possible non-contextual wale fragments on the starboard side of the ship.

There was, however, a line of mushroom-head bolts running perpendicular to the top ends of the futtocks preserved on the port side of the ship at the aft end. These bolts, used to hold the wales to the framing of the ship, were attached to the futtocks when they fell to the seabed during the disintegration sequence. By examining the distance between these bolts and known planking runs, it was possible to discern where the wale may have sat; in this case, somewhere around strake 18. A wale made of a thicker strip of balsa wood than the planking was installed on the model at this location, and additional strakes were added above it for three more strakes (fig. 4.9).

After the addition of the wale, it became more and more difficult to add further reconstruction details to the model based on the preserved timbers from the wreck. The model hull had been built up sufficiently to provide suitable information for the lines drawings.



Fig. 4.9. The stern of the model showing the wale in place. The wale is the uppermost complete strake. Photo by Matthew Labbe.

### *Repairs*

In the process of building the model, numerous extra nail holes were found on some of the ship's frames on the port side that did not correspond to the nailing patterns found on the planking. These nail holes and wood genus identification indicated that the areas where these extra nail holes were found most likely represented repairs to the ship. In order to determine exactly where these repairs were made, it was first necessary to generate hull sections that showed all of the planking nails aligned with their corresponding nail holes on the frames (plates 5 and 6). Once these sections were

completed, a top view planking diagram was completed in order to plot all of the nails so that the runs of repairs were clearly visible (Plate 2 and 3).

There was no evidence of repairs to the ship's port garboard strake or strake 2, but all other strakes up to strake 10 showed evidence of repairs. Strake 3, a section of which was determined to be fashioned of beech rather than oak, showed repairs between frame T and frame Y. In fact, most of the visible repairs were made to the portions of the ship forward of frame T. There is also evidence of a repair to strake 6 at frame H, F, and 1 but because some of the planking in this area was not raised, we can not know the full extent of the repair. In areas where planking was not well preserved, it became difficult to tell the precise extent of where these repairs occurred. It should be noted, therefore, that the previous information represents the minimum possible extent of repairs to the ship. It is very likely that some evidence of repairs disappeared due to degradation of the wreck on the seabed.

In addition to the extra nail holes on the frames that represent repairs, some solitary nail holes were also found that do not seem to correspond to repairs. For example, a typical repair is visible because each frame in a given sequence has two or three extra nail holes per strake. Since each strake uses a minimum of two nails per frame for attachment of the planking, we can say with some certainty that another plank had previously been installed in this location, became damaged, and then was removed and replaced.

In other cases, in the area corresponding to strake 7, for example, a single nail hole was found on frames R, L, and H. These additional holes cannot be for planking

repairs since a minimum of two nails per frame were used to secure the planking to the framing. Instead, these additional nail holes indicate that some timber was temporarily and loosely fastened to the frames in this area, probably a batten used in aligning the planking when the hull was under construction. It should also be noted that because the batten was attached to both floors and futtocks of the same frame, it provides further evidence that most of the frames were pre-assembled before being installed on the ship. In areas where a single extraneous nail hole is found on a frame with no other repairs or extra nails in the immediate vicinity, the additional nail holes may represent locations to which support timbers were attached to brace the framing while the ship was under construction.

### *Lines Drawings*

Once the model was completed, it was time to begin drawing the ship's lines (Plate 7). These large format drawings show the contours of the ship in a two dimensional perspective. It contains a sheer (side), a half-breath (top), and a body plan (fore/aft) view. The lines drawings are easily checked for accuracy since every line drawn on one view is also represented on the other two views. Further checks for the fairness of the lines are made with the inclusion of diagonals, which represent a sectional view cut diagonally across the ship.

The most critical step in setting up the lines was the transfer of information from the model to the lines drawing. The process involved measuring the curves on the hull of the model, and being able to represent these measurements in a two-dimensional image.

To do this, a support structure was built to take measurements off the model. The frames were pinned in place permanently, and the support structures of the model were removed. The model was laid on its side, and propped where needed to ensure that the keel and endposts were level. If they were not maintained level, the model would warp and distort any measurements taken off of it.

Next, section lines were drawn on the model every 10 centimeters. These lines corresponded to where vertical measurements of the hull's shape were to be taken. Because they were placed at regularly spaced intervals, they could be transferred to the lines drawing in such a way that each of these sections would represent a cross-sectional view of the hull that could be used on the body plan. These cross sections could then be joined using basic drafting techniques to present a full, accurate representation of the model.

A new support structure had to be built around the model to ensure that the measurements taken on the model were accurate. A U-shaped frame built of pine was placed over the model corresponding to the location of the first section station. Once this U-shaped frame was leveled, measurements were taken from a ruler mounted on its upper surface, using a plumb bob. Because of the curved surfaces of the vessel, the locations of these measurements on the Y-axis were not standardized from section to section. Instead, they were taken as needed to ensure a fair curve. These measurements resulted in a series of x-y coordinates that could be plotted on a grid (fig. 4.10). These plots resulted in clean, fair sections. After all of the sections were recorded in this way, the thickness of the balsa wood planking had to be subtracted from the contour of the

sections, since drafting conventions for the lines drawings require the lines to show the contours of the vessel where the planking and frames meet, and not on the exterior surface of the planking.

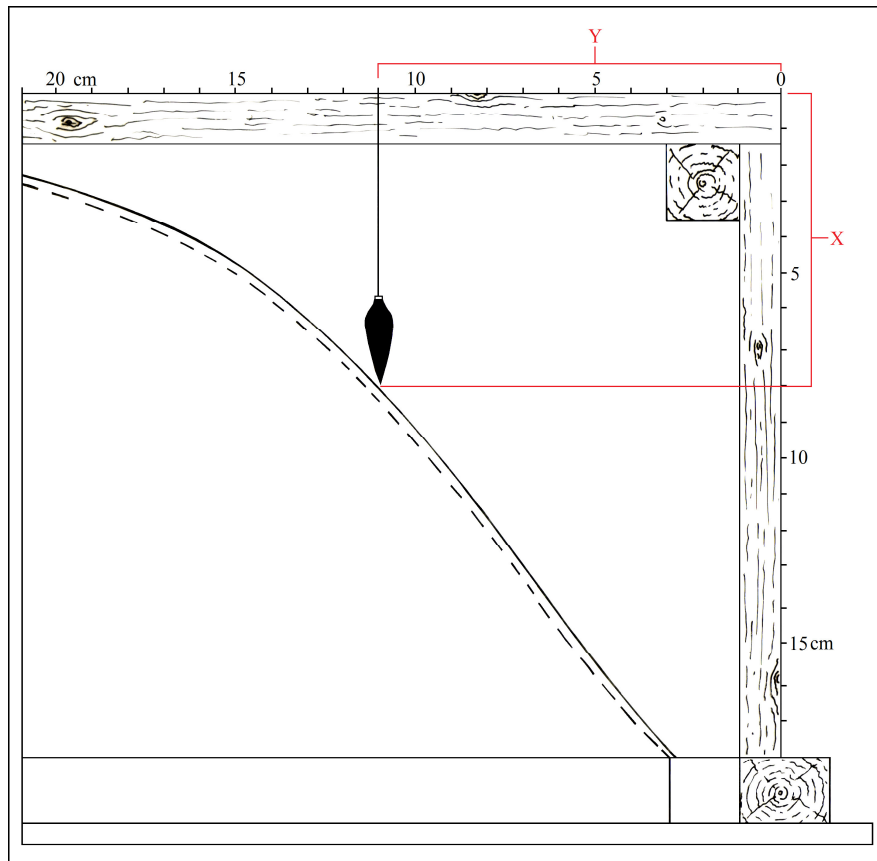


Fig. 4.10. Schematic showing the recording of hull sections from the model. The dashed line represents the framing of the hull under the planking, and the solid line, the exterior surface of the planking. Drawing by Matthew Labbe.

Once sections were taken from the model, the measurements were transferred to plastic drafting film, and the lines drawn. The resulting drawings included a plan, sheer, and half-breadth views of the vessel as taken from the study model. Endposts were

drawn based on the most accurate two-dimensional reconstructions. With the hull sections from the model in place, details such as water lines, buttock lines, and diagonals were slowly filled in.

Once the water lines were drawn, some inconsistencies in the lines began to emerge. The most significant inconsistency was the shape of the bow forward of frame AA. The problem was that the sides of the vessel were far too flat. We know this was an error because the frames forward of frame X show an increasing wine glass-shaped profile. These profiles were not represented on the model due to missing frames forward of frame AA. To remedy the problem, the lines drawings were amended until these curves presented themselves as fair lines consistent with the other views of the vessel. After all of the information from the model was incorporated to the lines drawings, work began on the upper-works of the vessel where no archaeological remains were preserved.

During the construction of the model, the runs of planking at the ends of the vessel indicated that the stern of the vessel was located much higher than the bow; the reason being that the planks at the stern showed far less narrowing than their forward counterparts. This information, as well as iconographic sources showing Ottoman vessels with high sterns, was used to project the sheer line of the vessel. In reality, this sheer line may have deviated somewhat from the one shown on the lines drawing, but its general shape is plausible, if hypothetical.

Another problem involved the attempt to determine whether or not the ship had any kind of transom, sterncastle, or a counter. Unfortunately, the wreck site had no direct evidence of a transom, although the presence of a large amount of metal hardware above



the level of the sternpost suggests that one may have existed. Because no direct evidence of a transom exists, it was not added to the lines drawing. Iconographic examples, however, suggests that the ship probably had some sort of structure at its after end, probably built by extending the wales beyond the sternpost. This theory is supported by the discovery of mushroom headed bolt for the ship's wales that were found beyond the extant remains of the sternpost.

Upon completion of the lines drawings, calculations regarding the dimensions of the vessel and its tonnage and displacement were undertaken. It should be noted that these measurements and calculations correspond only to the reconstruction and may have varied slightly from the ship's actual proportions. In order to account for the hypothetical nature of some areas of the reconstruction, such as the sheer line and upper stem, the figures presented here represent the minimum possible sizes and quantities for the vessel:

Length overall = 21.2 meters

Length of keel = 16.5 meters

Length at load waterline = 18.8 meters

Beam = 6 meters

Length to beam ratio = 3.5:1

Depth of hold from load waterline amidships = 1.2 meters

Depth of hold from sheer line amidships = 2.78 meters

Volume of hull = 61.12 metric tons

Displacement = 62.59 metric tons

## SUMMARY

When excavations on the Yassiada Ottoman wreck recommenced in 1982 and 1983, archaeologists discovered that the wreck was far more fragmentary than was initially anticipated. Only five of the vessel's floor timbers crossed the keel, and fragmentary planking from the ship's port aft quarter were left in situ, and not raised along with all the other timbers. The fragmentary nature of much of the planking throughout also required archaeologists to simplify their underwater maps.

For the purposes of the present study of the wreck, it was necessary to redraw the site plan based on the post-excavation drawings of the raised timbers to show all of the detail that could not be added before the hull remains were raised and drawn. This resulted in a plan that showed far more detail, including elements such as the position of tool marks, timber damage, pitch, and types of metal fasteners. The new site plan allowed for closer analysis of the ship's construction features and deterioration sequence.

In order to accurately assess the original shape of the ship's hull, a 1:10 scale half-breadth model was constructed. Frames were cut out from foam-core with copies of the 1:10 timber drawings glued to them. Likewise, drawings of planking fragments were transferred to strips of balsa wood. The nail holes on the planking were then aligned with the corresponding nail holes on the frames, and the planking pinned in place. Slowly, the model was constructed up to the limits of the preserved remains. The construction of the

model allowed for a number of questions regarding the design concepts used in building the ship and the sequence of construction to be answered.

The information from the three-dimensional model was then transferred to a set of lines drawings, which shows the hull in a two-dimensional drawing. These lines drawings represent plausible contours for the ship based on the archaeological remains. In the following chapter these drawings are compared to historic, iconographic, and archaeological material to suggest the type of ship represented by the Ottoman wreck, and what its function may have been.

## CHAPTER V

### ARCHAEOLOGICAL AND ICONOGRAPHIC COMPARANDA

#### COMPARABLE WRECKS

An important step in a reconstruction is identifying valid archaeological comparanda for use in reconstructing the wreck in question. This is done to help identify the ship by time period, type, and cultural affiliation. It is also done to assess the significance of the find and to link the reconstruction to the sequence of ship design over time, essentially adding it to the family tree of local ship design. Unfortunately, in the case of the Ottoman wreck, very few Ottoman ships have been excavated or studied, although those that have provided invaluable insight into the reconstruction. Other comparative shipwrecks are those that represent ships from other Mediterranean cultures that shared some construction techniques in common with those used by Ottoman shipbuilders. Presented here is information on excavated wrecks with similar construction or outfitting features to that of the Ottoman wreck.

#### *Kitten Wreck*

Excavated in the Black Sea off the coast of Cape Urdoviza, Bulgaria, the Kitten wreck is an Ottoman period wreck that likely dates to the time of Sultan Selim III (1789-1807), approximately two hundred years after the sinking of the Yassiada Ottoman ship.

As with the Ottoman wreck, the Kitten wreck was constructed using hook scarves to hold together the floors and futtocks of the frames, but this type of

construction was limited to 27 frames at the center of the vessel. At the extremities, the floor and futtocks were not joined together in this fashion. Varying between 1.5-2 centimeters deep, the hook scarves on the Kitten wreck were constructed in a manner virtually identical to that of the Ottoman wreck. They differ in attachment, however, in that the Kitten wreck's futtocks are attached to their floors with a single spike and a treenail. No treenails were used to fasten the frame timbers on the Ottoman wreck. Further, the overlap of the futtocks and floors on the Kitten wreck was recorded as being approximately 40 centimeters,<sup>101</sup> whereas this overlap ranges between 68 and 95 centimeters on the Ottoman wreck.

Kroum Batchvarov, who conducted a reconstruction of the Kitten wreck, postulates that hook scarves were used on this vessel as a means to align floors and futtocks that were projected using a whole-molding technique and he notes that there seems to be no pattern to the fastening method employed to join these timbers.<sup>102</sup> The same is probably true of the Ottoman wreck since the spikes that secure the floors and futtocks in place are longer than the space between the timbers, which would have required the frames to be assembled before they were raised on the keel. The pattern of fasteners, however, is extremely regular on the Ottoman wreck, but the amount of overlap of the futtocks is not.

There is also evidence that the Kitten wreck had a similar stern configuration to that of the Ottoman wreck. The discovery of a curved lower pintle led to the conclusion that the ship had a round stern. In this case, the sternpost butted against the keel without

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<sup>101</sup> Batchvarov 2009, 79.

<sup>102</sup> Batchvarov 2009, 80.

a scarf; the timbers likely held in place by a keelson.<sup>103</sup> No scarves were detected on the keel of the Yassiada Ottoman wreck, although a flat table on the inner face of the aft end of Keel 5 may represent the scarfing of the two posts. Further, the inferred presence of a keelson makes it entirely plausible that the sternpost of the Ottoman wreck was constructed similarly to that of the Kitten wreck.

The planking of the Kitten wreck is also very similar to the planking of the Ottoman wreck in that both were typically fastened with two nails per frame, and only butt joints were used in planking the vessel, save for areas where drop strakes and stealers were employed. Neither ship used treenails to fasten the ship's planking, unlike the tradition of a many western European countries at the same time.<sup>104</sup>

In terms of the overall contours and construction of the vessel, however, the Kitten wreck differs from the Ottoman wreck in a number of ways. First, unlike the Ottoman wreck, the Kitten wreck was likely double ended with no transom or counter, although it did have a similar exaggerated sheer line at its stern to prevent waves from reaching the deck level.<sup>105</sup> Second, the Kitten wreck does not share the wide flat bottom of the Ottoman wreck, but instead has sleek contours below the waterline that gives the ship a nearly V-shaped section at midship. Third, the hook scarves found on the Kitten wreck only occur on 27 of the frames in the central part of the ship.<sup>106</sup> In contrast, the Ottoman wreck has hook scarves, or evidence of them, on all of its surviving frames.

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<sup>103</sup> Batchvarov 2009, 76-7

<sup>104</sup> Batchvarov 2009, 99.

<sup>105</sup> Batchvarov 2009, 110, 111.

<sup>106</sup> Batchvarov 2009, 79.

Further, the central floor of the Kitten wreck has a futtock scarved to each side,<sup>107</sup> but on the Ottoman wreck, there are two central frames, each one with its own futtock.

### *The Kadirga*

The *Kadirga*, meaning simply “galley,” is the oldest surviving historic ship and is on display at the Beşiktaş Naval Museum in Istanbul. Commonly called the Sultan’s galley, *Kadirga* was a ceremonial and recreational vessel used only for short excursions on the Bosphorus and the Sea of Marmara during the 16<sup>th</sup> and 17<sup>th</sup> centuries.<sup>108</sup> Although its exact date of construction is unknown (likely early in the seventeenth-century<sup>109</sup>), there are a number of construction commonalities between *Kadirga* and the Ottoman wreck, even though *Kadirga* underwent extensive renovations in the late nineteenth-century.<sup>110</sup>

The most striking commonality is the use of hook scarves to bind the futtocks to the floors (fig. 5.1). Unfortunately, many of *Kadirga*’s frames are not original to the ship, making it difficult to make direct comparisons of dimensions like scarf overlap and fastening patterns with the Ottoman wreck. As with the Ottoman wreck, however, the futtocks sit forward of the floors at the bow and abaft the floors in the stern, and they are secured with three nails, one of which is driven from the opposite face as on the Ottoman

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<sup>107</sup> Batchvarov 2009, 82.

<sup>108</sup> Arcak 2003, 241.

<sup>109</sup> Cemal Pulak, personal communication, October 2009.

<sup>110</sup> Arcak 2003, 242.

wreck.<sup>111</sup> There is no floating futtock between the two master frames, and frame spacing on the vessel is similar to the Ottoman wreck's of 34 cm on average.<sup>112</sup>

While *Kadırga* currently has a straight keel and sternpost, an 1861 drawing of the ship made by French naval officer Le Bas indicates that the ship originally had a rockered, or curved, keel and a curved sternpost.<sup>113</sup> Historic evidence indicates that the rockered keel died out at the beginning of the 17<sup>th</sup> century,<sup>114</sup> making *Kadırga* the closest chronological parallel to the Ottoman wreck.



Fig. 5.1. An interior view of *Kadırga* showing some of the ship's hook scarves. Photo by Erkut Arcaç, courtesy of the *Kadırga* project (INA).

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<sup>111</sup> Arcaç 2003, 244-5.

<sup>112</sup> Cemal Pulak, personal communication, October 2009.

<sup>113</sup> Arcaç 2003, 242.

<sup>114</sup> Arcaç 2003, 248.



*The Sardinaux Wreck*

The Sardinaux wreck was discovered off the coast of France in 1986. Located near the Gulf of St. Tropez at a depth of 52 m, the wreck was found with 3500 complete ceramic vessels and dates to the late seventeenth-century. Analysis of the ceramics indicates that they came from the town of Fréjus in southeast France.<sup>115</sup> Overall, the Sardinaux wreck, likely a coastal trader known as a tartan, is much smaller than the Ottoman wreck with a reconstructed length of 10-12 m.<sup>116</sup>

Evidence of 30 frames, both complete and fragmentary, were found on the wreck.<sup>117</sup> One of the more distinctive features of these frames is that it has hook scarves similar to those of the Ottoman wreck. The overlap of the scarves based on the site plan and framing depictions of the wreck appears to be approximately 40-80 cm,<sup>118</sup> which is more like those of the Ottoman wreck than the Kitten wreck. The hook scarves are secured by two to four nails, all of which appear to have been driven from the same side.<sup>119</sup> Why this small vessel typically had more fasteners on its frames than the Ottoman wreck is unknown.

Though there is similarity in the framing of the two vessels, the Sardinaux wreck's keel is very different than the one from the Ottoman wreck. It is larger in its molded dimension than its sided dimensions (9.8 cm by 7.0 cm respectively), and the smaller, 8 cm wide frames were attached with multiple nails rather than single nails as on the Ottoman wreck. As on the Ottoman wreck, however, the keel of the Sardinaux

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<sup>115</sup> Joncheray 1989, 130.

<sup>116</sup> Joncheray 1988, 65.

<sup>117</sup> Joncheray 1988, 47.

<sup>118</sup> Joncheray 1988, 42-3, 50, 52.

<sup>119</sup> Joncheray 1988, 50, 52.

wreck has treenails which may have been used for the attachment of the ship's keelson.<sup>120</sup>

The Sardinaux wreck has no obvious ties to the Ottoman Empire, which makes the similarities of the two ship's construction features particularly interesting. We've seen previously that the relationship between the Ottoman Empire and the other Mediterranean nations during the seventeenth century was often strained, but the French were one of the Ottomans most accepted and frequent trade partners.<sup>121</sup> It is possible, therefore, that the two nations shared technology, resulting in the presence of hook scarves on both vessels. Although extremely different in form and function to the Ottoman wreck, it is possible that this wreck could shed some light on international trade relations and the spread of technology in the Mediterranean during the seventeenth-century.

### *Padre Island*

When the Ottoman wreck was discovered in 1967, archaeologists recovered a set of chains from the bow of the ship that were probably used as a stay to hold the main mast (fig. 5.2)<sup>122</sup>. An archaeological parallel to the chains found near the Ottoman wreck was found on a wreck near Padre Island in Texas in the 1970's.<sup>123</sup> Measuring 80 cm long, the chain consisted of six links attached to a 39 cm wide central yolk, and was probably used on the forestay of the main mast. The links splay from the central yolk in

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<sup>120</sup> Joncheray 1988, 44.

<sup>121</sup> Ovcharov 1993, 33.

<sup>122</sup> Cemal Pulak, personal communication, September 2009.

<sup>123</sup> Olds 1976, 1.

a Y-shape so that they can be attached to either side of the ship or so that they can pass around a forward mast. The individual links of the chain measured from 48-60 cm in length, and were 5 cm wide. As with the chain from the Ottoman wreck, the links were pinched in the center, probably to minimize their movement, preventing damage to the chain caused by the rubbing together of the links.<sup>124</sup>

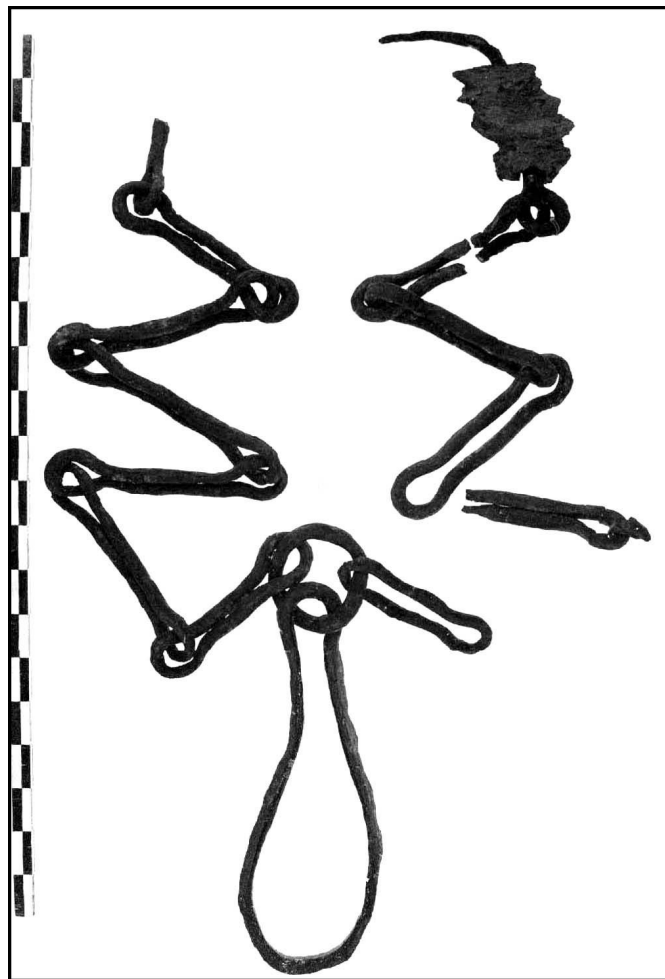


Fig. 5.2. A set of chains found near the bow of the Ottoman wreck in the 1967. Photo courtesy of the Ottoman wreck project (INA).

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<sup>124</sup> Olds 1976, 46.

*West Turtle Shoal Wreck*

The West Turtle Shoal Wreck (8MO142) was discovered in 1972 south of Grassy Key in Florida at a depth of nine meters. Discovered by a salvage company, the 14 m long wreck was believed to be the remains of an unknown historic American ship, although the dating of the wreck is tenuous due to lack of analysis. The site consists of the aft end of the keel and some of the starboard framing and planking, as well as several anchors (at least three are visible on the limited site plan). Unfortunately, little is known about the wreck and no published information on it exists. A site plan drawn by Gordon Watts and the State of Florida's Master Site File are the only sources of information about this wreck.<sup>125</sup>

As is the case with the Ottoman wreck, the floors of the West Turtle Shoal wreck are fastened to the futtocks with hook scarves that overlap for an average distance of 40-50 cm, based on the site plan. The hooks were held together with two bolts, which both appear to have been driven from the same side of the floor. A stringer was installed on top of the hook scarf intersections, presumably to provide longitudinal strength. This stringer does not appear to be as wide as those used on the Ottoman wreck.

Unlike the Ottoman wreck, however, the West Turtle Shoal wreck has second futtocks. The second futtocks were not fastened to the first futtocks in the same manner as the first futtocks were fastened to the floors. These instead appear to be set side-by-side with the first futtock, and the entire assembly was held together by another stringer.

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<sup>125</sup> Russo, Mark 1972.

This ship also had what appears to be stern deadwood, but details of this timber are scant at best.

#### ICONOGRAPHIC COMPARANDA AND SHIP TYPES

One of the primary goals of the reconstruction was to assess the Ottoman wreck's purpose, specifically, where it came from originally and what function it served. In addition to the examination of comparative shipwrecks, period iconography was consulted to accomplish this task. During the examination of these sources, however, some problems became apparent. Many of the ship types shown in these depictions had a different name in another region, or two ships of similar construction were classified as different types of vessels. Further, on archaeological sites, it is typically the sections of the ship that sat below the water that preserve, while iconographic sources typically depict the portions of the ship above the waterline.<sup>126</sup> In order to overcome these problems it is necessary to first understand what types of ships existed during the period in which the Yassıada Ottoman ship sailed and how these types fit into the larger context of Mediterranean seafaring.

The ceramics discovered on the Ottoman wreck are of the type made at Çanakkale that are commonly found in military contexts, and can thus be used to suggest that the Ottoman wreck was involved with the Ottoman navy.<sup>127</sup> Thus, a majority of the sources examined were those that focused primarily on Ottoman military vessels rather than civilian merchant ships.

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<sup>126</sup> Batchvarov 2009, 105.

<sup>127</sup> Pulak, Cemal. Personal communication September 9, 2009.

In addition to the galley, the Ottoman navy utilized a number of smaller warships and support craft. Many of these support craft were developed as the Ottoman economy grew in the 16<sup>th</sup> century as a means to adapt ships for specific missions or tasks.<sup>128</sup> Among the new ship types developed were four types of vessels that may have been similar in form and function to the Ottoman wreck; these are the *felucca*, the *shebek*, the *polacre*, and the *saique*. All of these ships appear to be similar in hull design and rig, but differ slightly in size and function. In addition, a few other types of ships similar to these are mentioned in historic accounts, but their specifics regarding size and construction were not elaborated on.<sup>129</sup>

### *Felucca*

*Feluccas* were long, low-sheered vessels with a sharp, rising bow and small stern castle that were used for troop transportation and trade. They were most common on the Barbary coast in North Africa.<sup>130</sup> When necessary, they could be equipped with oars, but they were not standard to the ship. They typically had two lateen rigged masts, which were occasionally raked forward. Up to 15 meters long, and four to five meters in breadth, the *felucca* commonly carried a crew of 30 and weighed anywhere from 30 to 150 tons.<sup>131</sup> The Ottoman wreck was probably not a *felucca* for three reasons: First, the Ottoman ship was slightly larger than most descriptions and depictions of *feluccas*. Secondly, *feluccas* typically had a high prow. Evidence from the Ottoman wreck,

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<sup>128</sup> Ovcharov 1993, 81.

<sup>129</sup> Imber 2002, 292.

<sup>130</sup> Güleriyüz 2004, 90.

<sup>131</sup> Ovcharov 1993, 66.

specifically the narrow planks at the bow and the wide planks at the stern, indicates that the stern was far higher than the bow. Third, even though the *felucca* was powered by lateen sails, they could be outfitted with oars. This suggests a long, narrow, low sheered hull, which the Ottoman wreck did not possess.

### *Shebek*

Also known as a *şebek*, *xebec*, or *chebec* in France, these ships were occasionally oared successors to galleys (fig. 5.3). They had long, low hulls and occasionally had a beak and a high, intricately carved stern castle. In this case, the identification of the *shebek* is based on the hull more than the rig. Most *shebeks* had three masts, but could be either lateen or square rigged. It has been suggested that *feluccas* and *shebeks* should be classified as the same type of ship,<sup>132</sup> but there seems to be a general size difference between the two types of vessels.

Built for speed, the *shebek* was the primary ship of Barbary pirates off the coast of Algeria. In addition, the large number of guns these ships could carry made them popular with the Spanish, French, and Italian city states.<sup>133</sup> Based on its proportions, it is possible to say with some certainty that the Ottoman wreck was not a *shebek*. As with the galleys, these vessels were long and narrow, while the Ottoman wreck was wide and clearly not built for speed, but to accommodate large cargos. Further, these types of

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<sup>132</sup> Güleriyüz 2004,82.

<sup>133</sup> Ovcharov 1993, 69.

ships were typically much larger than the Ottoman wreck, sometimes employing crews of 300-400 men.<sup>134</sup>



Fig. 5.3. A depiction of a *shebek*. The stern of this ship may be similar to the Ottoman wreck's stern (After Gülerüz 2004, 48.).

### *Polacre*

A three-masted mixed rig ship, the *polacre* was commonly outfitted with a square main mast and lateen fore and mizzen masts.<sup>135</sup> They were usually used as a

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<sup>134</sup> Ovcharov 1993, 69.

<sup>135</sup> Ovcharov 1993, 70.



support craft and often had a beak and transom.<sup>136</sup> Similar in form to the *shebek* but much smaller in size, the *poleacre* could also function as a small warship.<sup>137</sup>

### *Saique*

Also known as a *sayke*, *saika*, or *saic*, the *saique* was a two or, rarely, three-masted craft similar to a ketch that had a square main sail, lateen mizzen sail, and artemon forward sail.<sup>138</sup> While the *saique* appears to be a combination of a galley and a galleon, it actually developed independently from these other ships. Typically, they were 20-22 meters in length, weighed around 150 tons, and carried a crew of two dozen.<sup>139</sup> They were first mentioned in Turkish sources during the 16<sup>th</sup> century and were still in use when the Russians entered the Black Sea in 1787.<sup>140</sup> As is visible in Nicolas Witsen's 1671 engravings of the *saique*, these ships were two-masted with a disproportionately long main mast and small mizzen mast.<sup>141</sup> They had no upper sails and their shrouds were removable. This is likely because the rig could be changed between square and lateen as needed depending upon weather conditions. Rather than a beak, they typically carried a bowsprit. And did not have a stern castle, but sometimes had a transom. It was one of the rare Ottoman ship types that were not oared.<sup>142</sup>

Of all the ships encountered while studying Ottoman iconography, the *saique* is the closest parallel to the Ottoman wreck (fig. 5.4). The two ships probably had similar

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<sup>136</sup> Casson 1964, 139.

<sup>137</sup> Ovcharov 1993, 69.

<sup>138</sup> Casson 1964, 139.

<sup>139</sup> Ovcharov 1993, 84.

<sup>140</sup> Ovcharov 1993, 78-9.

<sup>141</sup> Moore 1929, Plate VI, Plate VIII.

<sup>142</sup> Ovcharov 1993, 79-80.



Fig. 5.4. A *saique* dating to the reign of Ahmet III (1703-1730). (After Güteryüz 2004, XIV-B).

rigs as well. While excavating the Ottoman wreck, archaeologists found no indication of chain plates (attachment points for the shrouds which support the ships masts). The lack of chain plates on the Ottoman wreck is a good indication that the ship was either lateen rigged or had a mixed rig like a *saique* that could be adapted as needed in extreme weather conditions.

*Plates by Nicholas Witsen (1671)*

In the first edition of his book *Scheepsbouw*, published in 1671, Dutch cartographer Nicholas Witsen produced thirty plates of ships that he had seen around the world.<sup>143</sup> Many of these plates depict Ottoman ships that were near contemporaries of the Ottoman wreck. A number of the plates depict galleys, but other, smaller merchant craft are also represented. Two of the plates contained in this manuscript depict *saiques*, with a third called a *ziember*, which also appears to be very similar to the *saique*.

Two of the plates (IIIa and VIII) show two very similar hulls with different rigs. The first depicts a ship with a high, round stern with a small transom (fig. 5.5). The tiller passes over the top of the transom rather than protruding from a hole at the base or back. The bow is raked at a steep angle and has a bow sprit but no beak. Strangely, the bowsprit does not seem to have a practical function, as no rigging appears attached to it. Its rig consists of two lateen sails with forward raking masts. The caption below the image is “*Ziember of vaartuyg tot Smirna gebruykelyk*” (“*Ziember or vessel used at*

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<sup>143</sup> Moore 1929, 192.

Smyrna”),<sup>144</sup> and it refers to a type of ship known as a *ziember* that was seen around Smyrna, which is modern day İzmir, Turkey.<sup>145</sup>

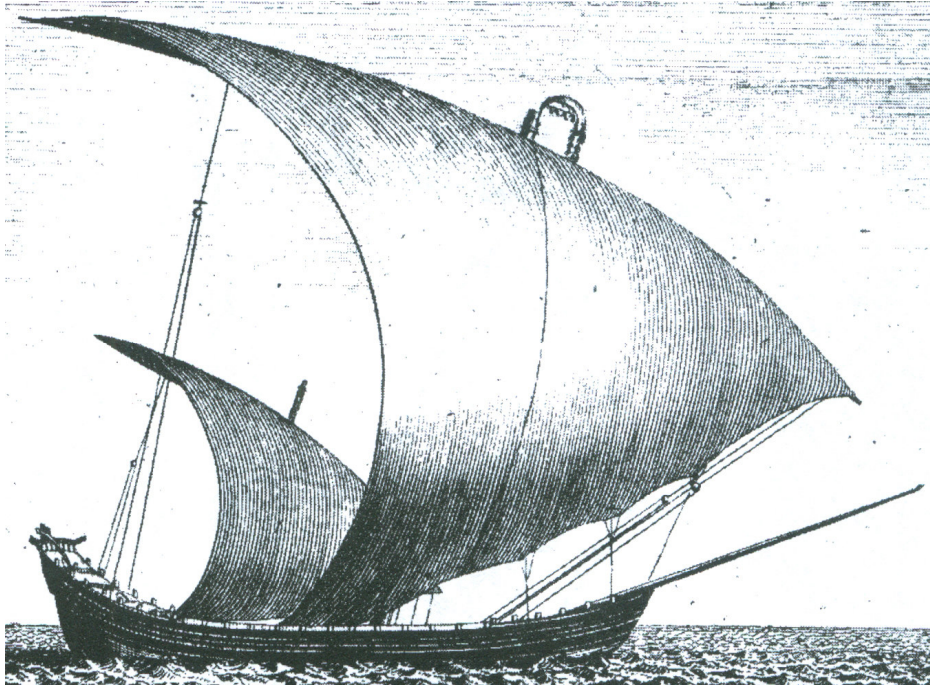


Fig. 5.5. Image of the *ziember* sighted off the coast of Smirna (From Moore 1929, 194).

The other image is a two masted ship with a large square sail on the main mast and a small lateen sail on the mizzen mast (fig. 5.6). Its hull is virtually identical to the one previously described, the only visible difference being that the tiller passes through the back of the transom rather than continuing over the top. The rigging on this ship appears to be far more complex than in the previous image, with a main mast that is disproportionately tall. The mizzen masts are similar in size, although it does not rake

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<sup>144</sup> Moore 1929, 194.

<sup>145</sup> Moore 1929, 194.



forward on the latter image. Its caption reads “*Saika of korenschip op de Swarte Zee, en omtrent de mont van den Donauw gebruikelijk,*” meaning “Saic or grain ship in use in the Black Sea and about the mouth of the Danube.”<sup>146</sup> At the top of the image is a depiction of the ship’s framing in plan view with three sections, presumably one at the bow, one at midship, and one in the stern (fig. 5.7). As with the Ottoman wreck, this ship has a narrow bow, with a relatively flat midship section.

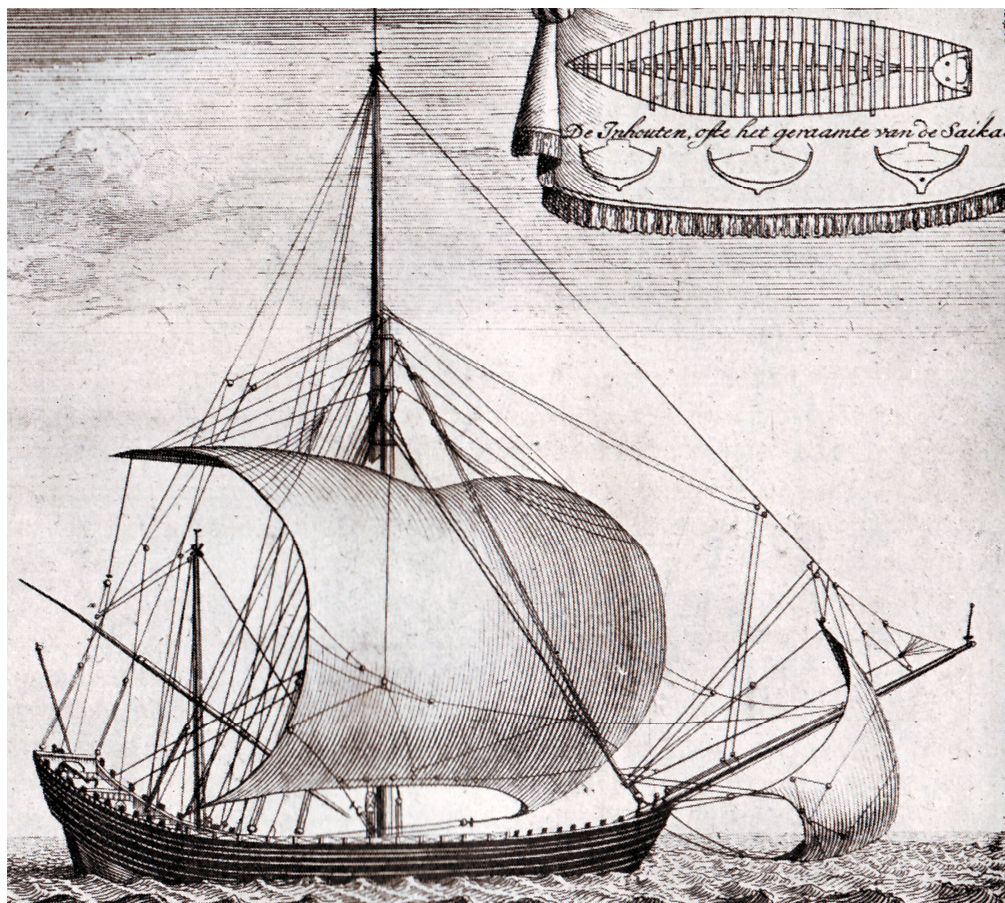


Fig. 5.6. A Turkish *saique* as depicted by Nicolas Witsen (From Moore 1929, 195).

<sup>146</sup> Moore 1929, 195.

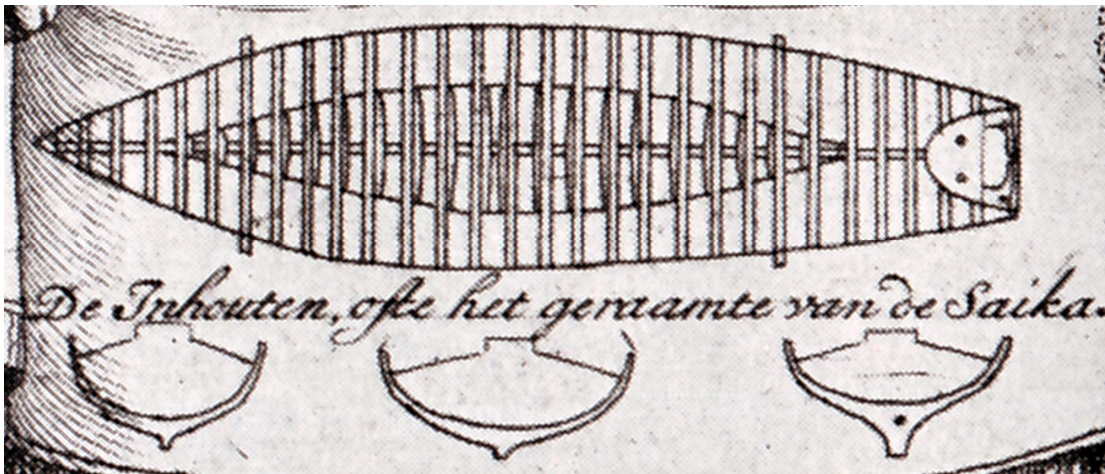


Fig. 5.7. Close up of the framing of the *saique*. (After Moore 1929, 195).

The final image of interest is plate VI, titled *Turksche Sayke* (fig. 5.8). Like the previous plates, the image depicts a vessel with a sharp bow and rounded stern. Its rig is almost an amalgam of the previous two plates, having two disproportionately tall masts that do no rake, with a lateen sail on each mast.<sup>147</sup>

Unlike the other two ships, however, the *saique* has no transom, but an after deck that is built off the wales of the ship. The wales extend far beyond the sternpost of the ship. They are held parallel by what appear to be wooden spacers. It is possible that this design allowed for the masts to be laid down in the even of a storm or other inclement weather. In either event, the differences in the structure of the hull of this ship compared to the one previously described suggests that the classification of *saiques* was dependent more on the composition of its rig rather than the shape of its hull.<sup>148</sup>

<sup>147</sup> Moore 1929, 195.

<sup>148</sup> Moore 1929, 195.



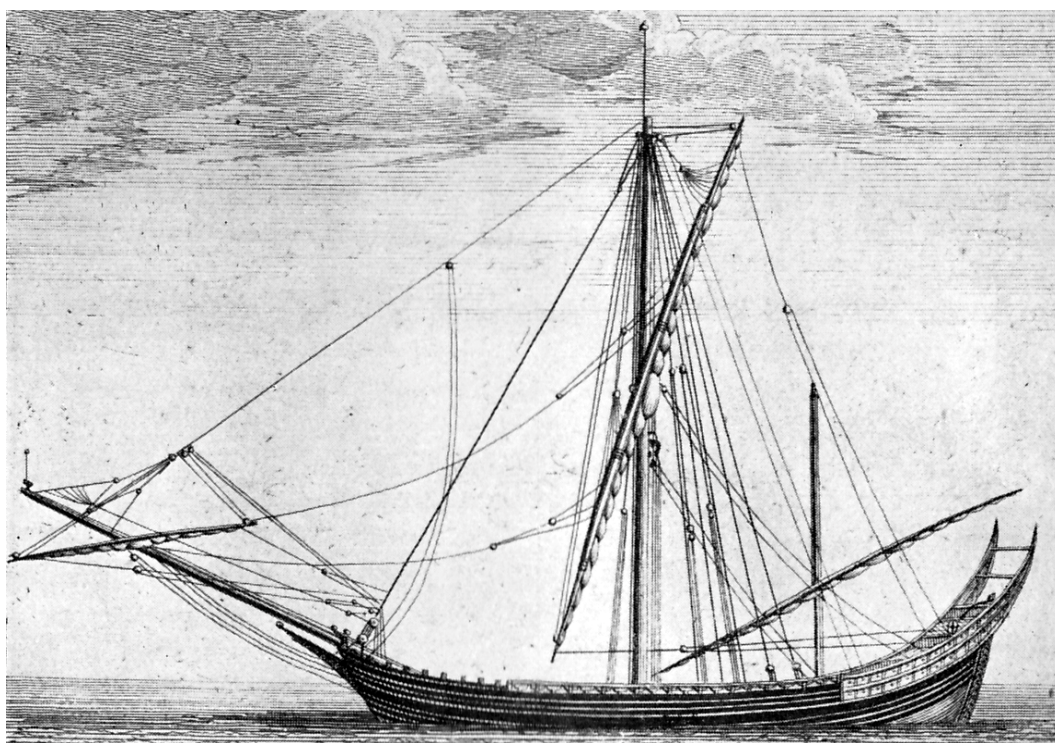


Fig. 5.8. Another Turkish *saique*. Note the extension of the wales to create “wings” reaching beyond the transom (From Moore 1929, 195).

### *Other Vessel Types*

In addition to the iconographic comparanda discussed above, Ottoman documents from the period following the Battle of Lepanto list, but do not describe, two other types of support craft. Among these are stone ships which carried cannonballs and repair materials for harbor fortifications. Another type was the horse ship which had an opening at the stern for the loading of animals or large cargo.<sup>149</sup> Presumably, these latter ships would have been constructed similar to a *saique*, with expanded wales and no

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<sup>149</sup> Imber 2002, 292.

actual transom timbers. Both types had a very shallow draft.<sup>150</sup> This type of vessel is noted here because evidence in the form of unfinished timber in the debris field may suggest that the Ottoman wreck was carrying raw materials for construction purposes.

In addition to these types, brigs and brigantines, along with some other northern European ship types could be found in the Mediterranean during the time the Ottoman ship would have sailed. They were not terribly common, though, as the lateen rig was far too well entrenched in the minds of shipbuilders in the region.<sup>151</sup> Another vessel, named simply “Black Sea ship,” can be found in the plates of Admiral François-Edmond Pâris, who had considerable experience in naval architecture.<sup>152</sup> This vessel was not studied in great detail as it dates to the late 19<sup>th</sup> century, has a rockered keel and a single mast, and, at 13 m, is smaller in overall size than the Ottoman wreck.

### *Problems with Ship Types*

The ships described above are extremely similar in form and function, but differ in size, propulsion methods, and intended function (e.g. commercial trader versus warship). After consulting these iconographic sources, it became apparent that there are a number of discrepancies in the classification of ship types. Among these are issues both practical and philosophical, ranging from the accuracy of the original artist to the non-linear evolution of ships.

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<sup>150</sup> Imber 2002, 292.

<sup>151</sup> Casson 1964, 138.

<sup>152</sup> Paris 1886, plate no. 59.



One of the most obvious problems is the question of whether or not the iconographic sources accurately represent not only the real types of ships that were found in the Mediterranean, but also whether the details of these depictions were accurately copied. Many of the period artists depicting ships were probably not shipwrights or sailors themselves, and so their unfamiliarity with the various ship types and their labeling in the images could result in errors of scale and proportion, in addition to construction details and rigging elements. This is very apparent in ship representations in Ottoman miniatures, which show large ships being occupied by a handful of people who are far larger in scale than the ship being depicted. In order to assess these inaccuracies or exaggerations, it is helpful to have a number of depictions of a particular ship type that can be scaled and compared for particular details.

From a historical perspective, ships are occasionally grouped as a single type based on very broad, general features that may not have held much significance to the people building or using these ships. For example, the *pink* represents one of the more unusual ship types encountered during the study. In the Mediterranean, the *pink* was a lateen-rigged merchant ship with, typically, three masts. Sometimes, the rig was hybridized so that the crew could lower the lateen sails and raise small square sails in a time of need. The hulls were wide and flat bottomed with a high sheer line at the stern and overhanging transom formed from the structure of the ship's wales, as in *Turksche Sayke*, illustrated by Nicolas Witsen (fig. 5.8). Many also carried a beak at the bow. They typically transported goods like oil and cotton and weighed between 200 and 300 tons. An average measurement for these types of ships was 23 meters long, seven meters

in beam, with a draft of 2.3 meters. They were typically armed to fend off Barbary pirates.<sup>153</sup>

Unfortunately, the term *pink* is extremely general and encompasses a large number of different ships that may or may not have rigging or hull elements in common. As a result, the lumping of all ships with three masts and a transom is too general of a typology because it links together ships with very different functions based only on stylistic differences. There is an understandable urge to group elements based on generalities if the specifics are not important (For example, today, if one was describing the types of vehicles they saw on the road, they might list a Dodge truck, a police car, a school bus, and a Hyundai accent. While all of these are common vehicles with specific functions, some of the descriptions are more general than others, with only the Hyundai being listed by its specific model). In the same way, historic artists may have had a general idea of a ship's particular features and function, but not known specifically what "model" it was.

Another problem is more practical than philosophical; namely that what is called a *saique* in the Ottoman Empire, for example, could be called something entirely different in another region. Again, the *pink* is a good example of this type of discrepancy. Over the course of history, the term *pink* has been attributed to Dutch and American fishing vessels, Mediterranean or Northern European traders, English flyboats, or naval transport ships used in the Baltic Sea and North Atlantic Ocean.<sup>154</sup> The name is regional, and refers to a different type of ship in different areas. This is likely a normal

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<sup>153</sup> Sténuît 1976, 319-20.

<sup>154</sup> Sténuît 1976, 317.

result of the translation of the term into various European languages, but makes it difficult for a researcher to know what exactly the definition of a word in a given language is referring to.<sup>155</sup> In some cases, the design for a ship could be inspired by foreign influences, but adapted for use far from their native location. For example, the design of a commercial cargo ship could easily be adapted by the navy to carry supplies for restocking and repairing a fleet far from their normal shipyard. This suggests that two ships could have been built exactly the same way, but have different names because of their function.

Regardless of Turkish naval prowess, the Ottomans were not known to be innovators in the area of ship design. There are two primary reasons why this was the case. First, during the Age of Exploration, the Mediterranean was largely forgotten by northern Europeans due to its distance from major shipping routes. Second, a large number of Ottoman ships were built in the Black Sea, which essentially became an isolated “Turkish lake” from the occupation of Constantinople in 1453 until the mid eighteenth-century.<sup>156</sup> The Ottomans typically did not write ship construction treatises and Europeans had little access to the area. As a result, locals in the Black Sea region were limited in their need to adapt to new construction techniques and philosophies regarding shipbuilding traditions. For this reason, some archaic ship construction forms, including features as old as the fourteenth or fifteenth century, from the area survived

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<sup>155</sup> Fortunately, there are a number of works that address the problems of translating nautical terms into various languages. For Mediterranean languages, one of the most helpful is *The Lingua Franca in the Levant* by Henry & Renee Kahane, and Andreas Tietze.

<sup>156</sup> Casson 1964, 73.

into the twentieth-century in the form of private craft built on the shores of the Black Sea.<sup>157</sup>

Unfortunately, the Ottomans found that the popular western European carracks sat too low in the water to be of much use on the shores of the Black Sea, and their rigs were simply more complex than needed. As a result, the design of the *saique* was a means to adapt the idea of a larger cargo carrier for use in the Black Sea.<sup>158</sup> In some instances two ships of similar construction were called different types due to differences in size. This is very clear in the case of the *shebek* which was constructed and propelled in a manner very similar to the *saique*, but is simply larger and not as wide.

The biggest problem with identifying ship types is the fact that no comprehensive typology of ship types exists because the evolution of ships did not progress in a linear manner. To some extent, certain design trends (the invention of the stern mounted rudder, for example) slowly diffused across Europe, but these trends were not adopted entirely or in any sort of organized manner. Many types did not spring out of isolation; they were adapted from foreign influences, developed based on need, or an existing type was gradually changed as cost or style fluctuated. Compounding the problem is the fact that many of the eastern Mediterranean ships were amalgams of one another, having the hull of one type of ship and the rig of another, for example.<sup>159</sup>

Ultimately, the issue of the classification of ship types is largely one of semantics. Some authors and artists seem to group types based on their rig, others by

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<sup>157</sup> Ovcharov 1993, 58.

<sup>158</sup> Ovcharov 1993, 117.

<sup>159</sup> Ovcharov 1993, 65.

their hulls. Because the owners of ships had no real need to distinguish between vessel types, no absolute typology was created, and there is room for discussion regarding modern classification of historic ships. Ideally, archaeologists should attempt to place their ships in the context of their region, but also find a way to link them to the larger tradition of seafaring. This means that it is acceptable if a close parallel to a wreck can not be found because there could possibly have been specialization that developed in one region that did not pass to another, and thus no close archaeological parallels are to be found. On the other hand, a wreck may fit several historic types that cannot be narrowed down further. The researcher needs to balance these extremes by attempting to trace the design characteristics of their particular wrecks and remain aware that a vessel may not easily fall into a specific type, but some clues regarding its origin should be evident nonetheless.

## SUMMARY

The seventeenth century was a time of transition in ship construction techniques in the eastern Mediterranean. After the battle of Lepanto in 1571, the galley began to fall out of favor as the lynchpin in Mediterranean navies. As northern and western European nations moved into the Mediterranean, it quickly became apparent that the low sheered galleys could not compete with larger carracks and caravels that sat much higher in the water and were more heavily armed. As a result, these new ship types slowly became integrated into Mediterranean navies. The Ottoman wreck, thus, may represent one of these transitional forms – constructed with the high stern sheer that resembles some of

the higher sheered western European ships, but with the versatility of a ship that had more cargo space than a galley. By the mid 18<sup>th</sup> century, for example, the galley had been replaced as the Ottoman fleet's ship of choice by the *shebek*, and could commonly be found on the western coasts of the Black Sea.<sup>160</sup>

There are not many comparative shipwrecks for the Ottoman wreck because very few Ottoman wrecks have been excavated and analyzed. Even so, evidence for hook scarves was found on four wrecks, of which two, the Kitten wreck and the *Kadırga*, can be directly linked to the Ottoman Empire. Parallels for some of the ship's rigging were found on the Padre Island wreck, a contemporary of the Ottoman wreck.

Since the investigation of archaeological comparanda produced limited results, historic iconography relating to Ottoman ships was consulted. During the course of this study, four specific ship types were found in iconographic sources that seem to have been similar in design, construction, and function to the Ottoman wreck. Among these were the *felucca*, *shebek*, *polacre*, and *saique*.

Most of the ships in the iconographic study are far different from the Ottoman wreck for the mere fact that they were oared. The shape of the Ottoman wreck's hull is not conducive to rowing, and so it probably was only used as a last resort, if at all. This immediately eliminated the *shebek* as a possibility, as they tend to have long, sleek hulls. The *felucca* and *polacre* were eliminated as possibilities because they were smaller than the Ottoman wreck. Additionally, the *felucca* typically had a high prow; whereas

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<sup>160</sup> Ovcharov 1993, 69

evidence from the modeling of the Ottoman wreck indicated that the bow was much closer to the water than the stern.

The *saique* is the closest parallel to the Ottoman wreck for a number of reasons. First, it is of the right size and shape for the Ottoman wreck. Second, like the Ottoman wreck, these were wide, cargo carrying vessels with exaggerated sheer lines that resulted in a very high stern. We know the Ottoman wreck had a high stern because the planking at the stern did not narrow in the same way as the planking at the bow. These wider stern planks resulted in a high stern for the vessel. Finally, the lack of chain plates on the Ottoman wreck may indicate that the vessel originally had a versatile rig, and study of the *saique* indicated that this type of ship's rig could be changed in cases of inclement weather.

## CHAPTER VI

### CONCLUSION

#### SUMMARY

Reconstructing a ship involves understanding the extent of the archaeological evidence and attempting to link data, which, at first, may seem random and unrelated. Over time, however, apparent clues for the reconstruction slowly fall into place giving an indication of how the various timbers were joined to one another before disintegrating and becoming disarticulated on the seabed. At first glance, however, the Ottoman wreck's site plan suggest the main surviving portions of the ship is somewhat well preserved with most of its timbers in their original location, having moved very little after their deposition on the seabed. The forward port side of the ship appears especially well preserved, but critical clues as to the ship's design and function are somewhat elusive. The stem is missing entirely, and the keel and frames give few indications as to the ship's original appearance. While part of the sternpost had survived, it was not attached to the keel. The lower pintle that would give the best indication as to its original configuration had been separated from the sternpost and dragged away from the site. The lack of frames crossing the keel makes it difficult to obtain accurate sections for the hull, and much of the starboard side remains are a jumbled, chaotic mass of unidentified timber.

As the reconstruction project continued, however, a number of clues were found that made it possible to establish with some certainty what the ship looked like and what



its intended purpose may have been. Presented here is the most likely sequence of events from the time of the ship's construction to its sinking and subsequent disintegration.

### *Conception and Construction*

Following the battle of Lepanto in 1571, the Ottoman navy was in a state of disrepair. Due to the large number of warships lost during the battle, the empire scrambled to rebuild their ailing fleet. The Ottoman wreck was built shortly after this restructuring. Dendrochronological analysis of a slice through the keel revealed that the ship could not have been built before 1572, but could have been constructed any time after this time, most likely on the shores of the Black Sea or the west coast of Turkey.

The shipwright overseeing the construction of the vessel had a specific design in mind, and used some form of geometric progression, likely a whole-molding technique, to project the rising and narrowing of the frames. We know this because the long spikes used to fasten the futtocks to the floors indicate the frames had to have been assembled before they were raised and nailed to the keel, and were thus pre-designed.

Unfortunately, the measurement system used in designing the ship is not known. Due to the fact that the Ottomans commonly hired shipwrights from outside the empire, it is possible that a combination of different measurement systems were used. Artifacts on the wreck, particularly the ceramics, connect the vessel directly to the Ottoman realm, and perhaps indirectly to its navy. Either the ship was built in an imperial dock yard or the vessel was privately built and conscripted for service in the navy, although the former seems more likely.

Either way, the ship was designed with specific function in mind. The wide, flat bottom of the ship indicates a concerted effort to maximize cargo capacity and is very similar in design to the *saique*, which was commonly found around the west coast of Turkey and the Black Sea in the seventeenth-century. What cargo the ship was carrying when it struck the reef cannot be said with certainty, but the presence of unfinished timbers lacking any sort of fasteners in the debris field may indicate that the vessel was carrying timber to a dockyard or some other construction site. The presence of two stone cannon balls and one piece of cast iron shot on the wreck site suggests that the vessel was armed, or that these materials were also part of the ship's cargo. A more likely possibility is that they were used as ballast, since they are made of different materials and have no consistency in the gauge of the shot. There are still a number of questions regarding the ship's function and destination, some of which may be answered by continued analysis of the ship's artifacts.

The construction of the ship commenced with the laying of the keel and carving of the rabbets at its extremities. The length of the forelock bolts in the keel indicate that the ship was supported off the ground during construction, probably on wooden stocks or logs, high enough off the ground that the forelock bolts could be installed vertically. If the keel consisted of more than one piece, which it probably was due to the length of the vessel, they would have been scarved together at this time.

After the keel was in place, the endposts were raised and secured to it. In addition to any scarves that would have held them in place, the endposts were supported, temporarily, by timber buttresses nailed directly to the posts. Evidence of this is found

on the outer face of the sternpost which has nail holes that were empty at the time of the ship's sinking and that appear to serve no other practical purpose. Once the endposts were in place, the apron was notched and installed along with the inner sternpost.

Once the keel and endposts were erected, work began on the shaping of the ship's framing. The order of the installation of the frames is unknown, but it is probable that the two midship frames, F and 1, were installed first followed by frames at intervals predetermined by the shipwright, possibly every third or fourth frame. Another possibility is that after the midship frames, some frames near the extremities of the vessel were first installed, and the rest of the hull's curves were determined by running battens of wood between the pre-erected frames. The ship's wales may also have been installed at this point to help stabilize the framing before it was planked. Either way, frame AA and frame 21, which abut the apron and inner sternpost, respectively, were probably the last pre-erected frames because after these points, the crotch timbers, or Y-shaped frames, would have to be deliberately fashioned to fit in the tight areas at the ship's extremities where they meet the end posts. The presence of these crotch timbers can also be inferred from the notches on the ship's apron, which are not wide enough to house canted frames or half frames.

The presence of battens in either scenario can be inferred from the extraneous nail holes in the framing. These battens were installed to judge the bevel for the frames at the ends of the ship and to provide temporary stabilization before the installation of the planking and stringers. Once the battens were in place, the frames forward of frame AA and aft of frame 21 were hewn and set in place.

When all of the frames were cut to shape, they were immediately secured to the keel by a single nail and their outer faces beveled to accommodate the curving of the planking. The ship's keelson was then installed. Holes were drilled through the top of the keelson all the way through the keel, and were secured with trenails. This was done to solidly secure the frames in place as the planking and deck beams were installed. The stringers, shelf clamps, wales, deck beams and any transom timbers would have been installed at this time.

Once the skeletal structure of the ship was completed, carpenters began installing the planking. The order of installation is unknown, but stakers at the bow and drop stakes near the turn of the bilge at midships would have required installation from the bottom upwards to control the rising sheer line near the stern, but keep it relatively level at the bow. Once the majority of the planking was completed, work would have begun on the finishing details such as hatch covers, decking, and ornamental carvings, if any existed. As construction of the ship neared completion, the workers would have begun outfitting the ship with its rigging elements and other fixtures such as the ship's bilge pump. Once the ship was launched into the water, spars and sails would have been attached, and the construction of the Ottoman wreck was complete.

After the ship went into service, it appears to have been used for some time, as it was an old ship when it sank. Although dendrochronological analysis revealed that the ship was built some time after 1572, the number of repairs to the ship's planking in the bow and elsewhere indicate that the ship had been in use for some time and went through one or more major repairs, suggesting that its sinking likely occurred some time

during the beginning of the seventeenth-century. The ship did not have a formal name, as the practice of naming ships did not begin in the Ottoman Empire until the 18<sup>th</sup> century.<sup>161</sup>

The proximity of Yassıada to Bodrum on the Turkish mainland may indicate that the vessel was either coming from or headed to Bodrum during its final voyage, although there is no definitive evidence for this theory other than the location of the island, and the fact that the ship was likely fully loaded when it hit the reef. Other possible origin points or destinations include the nearby towns of Kos on the island of Kos, Greece, and Turgut Reis at the tip of the Bodrum peninsula, directly across from Yassıada. It is also possible that the captain of the vessel used the deeper water south of the island to protect the ship, unsuccessfully, from a storm.

### *Deterioration*

Unfortunately, we will never know exactly why the Ottoman ship hit the reef at Yassıada, although there are a number of possibilities for this. One of the most telling pieces of evidence is the damage to the keel at the bow of the ship. The bent forelock bolt and possible damaged planking suggest the ship was moving at a reasonable speed when it hit the reef, and that the crew was unaware of its existence. This could have been because they were sailing at night, in fog, pushed there by a storm, or they were lost and in an unfamiliar area. Regardless of the cause, the fact is that once the crew realized their

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<sup>161</sup> Güteryüz 2004, 87.

ship had suffered heavy damage, they had to take action immediately in order to avoid losing such a large investment as a ship's cargo.

Very few artifacts were found on the wreck, none of which had any real value, indicating that there was sufficient time to unload everything from the ship. Further, the lack of ballast on board indicates the ship was carrying an unidentified cargo when it sank, since no ship sails without ballast of some type, be it cargo or stone. The crew probably began unloading the ship themselves and storing all equipment on the island if they had a small boat or tender. The area around Bodrum was a relatively well-traveled area in the seventeenth-century, and they probably would not have had to wait very long before rescue or additional help arrived. If they had any kind of support craft on board, it would have been possible to send a messenger to the mainland for help. When it arrived, they abandoned the ship, loading their cargo and possessions onto the rescue ship.

Once the ship became waterlogged, it would have sat lower in the water eventually attaining a state of neutral buoyancy. Wave action on the reef finally dislodged it and it floated a short distance before it lost all buoyancy and sank. The bow of the ship came to rest on top of the fourth-century shipwreck's cargo of amphorae with enough force to crush some of them and the rest of the ship began to settle into the sand on the seabed. Over the years, the ship was attacked by various microorganisms and wood boring teredo worms.

The upper works, completely exposed to the moving, thriving ocean bore the brunt of the damage, whereas sand began to seep into the hold of the ship, covering the wood at the base of the vessel and creating an anaerobic environment. Over the years,

some of the planking nails lost their hold on the soggy wood, and some of the planks began to splay outward as they reached their saturation point and began to straighten. One by one, they began to fall from the upper areas of the ship. In some instances, the collapse would have been more dramatic, as large sections of the ship's upper works could not support their own weight and collapsed. This was particularly evident on the starboard side where they began to pile up forming the debris field, specifically the area around grids O2 and O3. On the port side, they fell onto the fourth-century amphorae where they were eventually consumed by marine organisms.

As the planking continued to weaken, the sides of the ship began to slump outward, putting enormous stress on the keel. Eventually, the floors gave way and broke. The sides of the ship, as well as the sternpost, would have fallen to the seabed, exposing the bottom ends of the floors. On the port side, sediment began to build up between the frames, covering the planking. The midsections of the floors that would have been attached to the keel, however, would have remained above the sediment, where they were destroyed by the normal course of decomposition. On the starboard side, the frames remained exposed and were entirely destroyed, while much of its associated planking, flat on the seabed, was covered and protected. This probably did not happen to all areas of the ship at once, but in stages. The preservation on the seven upper futtocks on the port side of the ship along with their associated, splayed out planking probably represents one area that collapsed independently of the rest of the structure, resulting in their preservation.

Gradually, sediment continued to build up over the entire site, covering the wreck completely. It laid virtually undisturbed, save for the occasional intrusion of a fishing boat net, which probably dragged the ship's lower pintle a short distance from the wreck.<sup>162</sup> The ship then sat on the seabed, forgotten, for over three centuries.

#### SUGGESTIONS FOR FURTHER RESEARCH

During the reconstruction of the Ottoman wreck, a number of questions regarding the ship's construction and crew were raised that had no obvious answers. Simply put, the Ottoman wreck is moderately well preserved, but a number of important clues regarding the vessel's origin and usage were not preserved in the archaeological record. Additionally, the fact that the ship was unloaded before it sank deprived archaeologists of vital cultural materials. Presented here are some of the lingering questions about the Ottoman wreck, and some possibilities for how these questions might be answered in the future.

Although it may not be possible due to the sinking of the Lebanese freighter in 1993, another season of excavation at the site could provide more information regarding the wreck. In particular, the raising of the aft planking from the port side may help to better understand the ship's stern configuration even though it is jumbled and poorly preserved. There may also be a few personal objects located near or under the planking, which would be welcome on a wreck with so few personal artifacts. These personal

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<sup>162</sup> Cemal Pulak, personal communication, September 2009.



artifacts could make it possible to identify the ethnicity of the Ottoman ship's crew or give some clue as to the vessel's origin.

Although many dives were conducted on the reef itself to locate possible remains of the ship or its cargo, additional inspection of the reef at Yassıada may turn up more artifacts from the Ottoman wreck, providing information on the ship's course when it struck the reef. It would also be useful to determine whether some large diameter cannonballs found on the reef that are larger than those found on the Ottoman wreck as well as a large anchor are associated with the wreck or if another Ottoman ship sunk in the area. It seems unlikely that the anchor and cannonballs are associated with the Ottoman wreck as the anchor's type suggests it is of a later date than the Ottoman wreck, and the diameter of the cannonballs does not match the gauge of those found on the wreck. When the detailed results of the artifact analysis are published in the final excavation report, however, we will have a better understanding of the role of these artifacts on board the Ottoman ship, and we will be better able to differentiate the assemblage of artifacts linked to the Ottoman wreck and those found on the reef that may have been dumped when the ship struck the reef or when the ship was unloaded.

A reconstruction of the ship's rig would be difficult with so few elements of the ship's rigging preserved, but would not be impossible. Combining this information with iconographic research could help create a relatively accurate rigging reconstruction. The spacing of the fasteners on the keel, for example, could help locate the position of the ship's mast step(s).

A closer inspection and re-assembly of the starboard side debris field timbers may provide further information about the ship's upper works. A major obstacle to this task, however, would be the need to identify the timbers currently cataloged as unknown structural members. This would require a close inspection of the field notebooks and access to the timbers themselves in Bodrum. Though the task would be challenging, the reward would be an accurate depiction of the ship's upper works at the stern.

While reconstructing the Ottoman wreck, no evidence of what type of metrology was used to build the ship was detected, but we know that the Ottomans commonly hired shipwrights from outside the empire, so the metrology used may be something other than the Ottoman *Arşın*, such as a combination of measurement systems. An in depth publication should include information regarding the metrology since it can help in the calculations of both the ship's overall size and cargo capacity. Access to the information regarding the metrology used to construct the vessel would also provide worthwhile information regarding the shipwright's design philosophy and technique.

## CONCLUSION

The Yassıada Ottoman wreck is significant for two major reasons: First, it is the only Ottoman ship ever to be completely excavated and partially raised from the seabed, allowing archaeologists to analyze and understand Ottoman ship construction in a way that is not possible with archival documents alone. Second, when researching the Ottoman navy, it quickly became apparent that the primary focus of most historians is on the construction and use of the galley as the Ottoman's premier tool in naval warfare and

supremacy. While immediately identifiable and important, what is often forgotten is that the galley was but one tool in the naval arsenal. As an example of an Ottoman naval support craft, possibly a *saique*, the sixteenth century wreck at Yassıada allows us to ponder the larger context of the realities of naval warfare; namely how the fleet was equipped, repaired, and maintained. Further, its significance is accented by the fact that the time period in which the ship sank is considered by most historians to be the apex of Ottoman cultural and technological development. Hopefully, other Ottoman wrecks from this time period will be excavated in the future, allowing for the comparison of information garnered from the wreck with others.

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APPENDIX A

PLATES



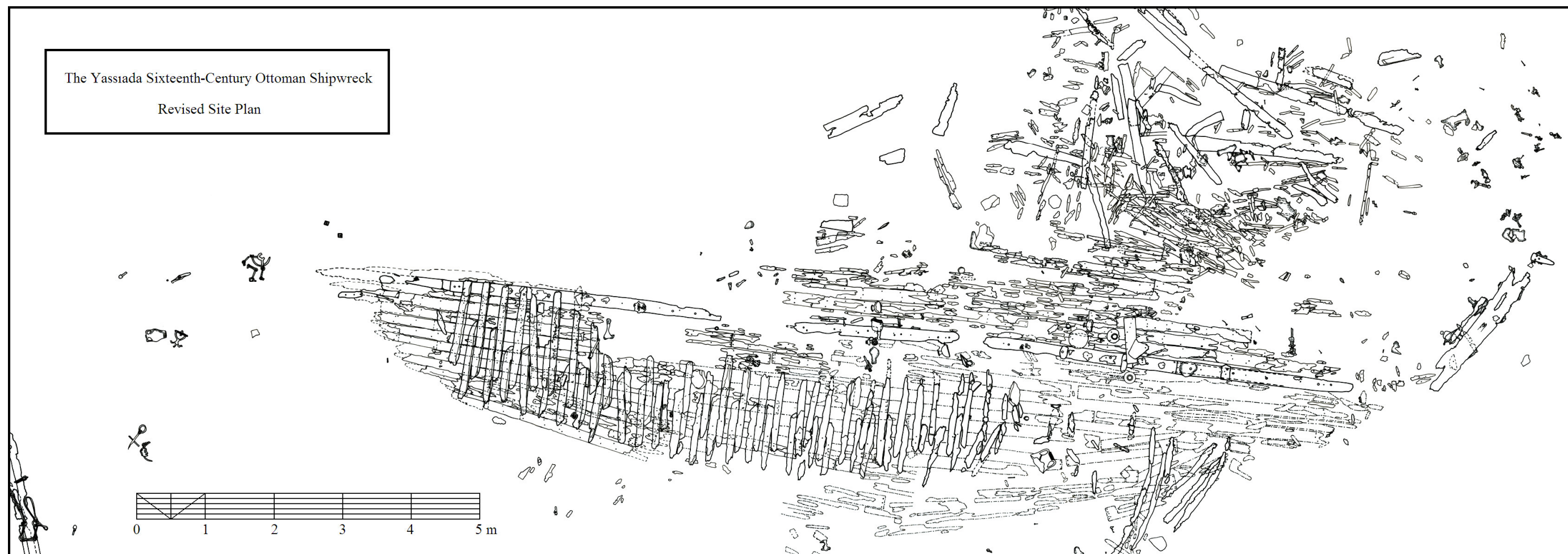


Fig. A.1. Revised Site Plan.

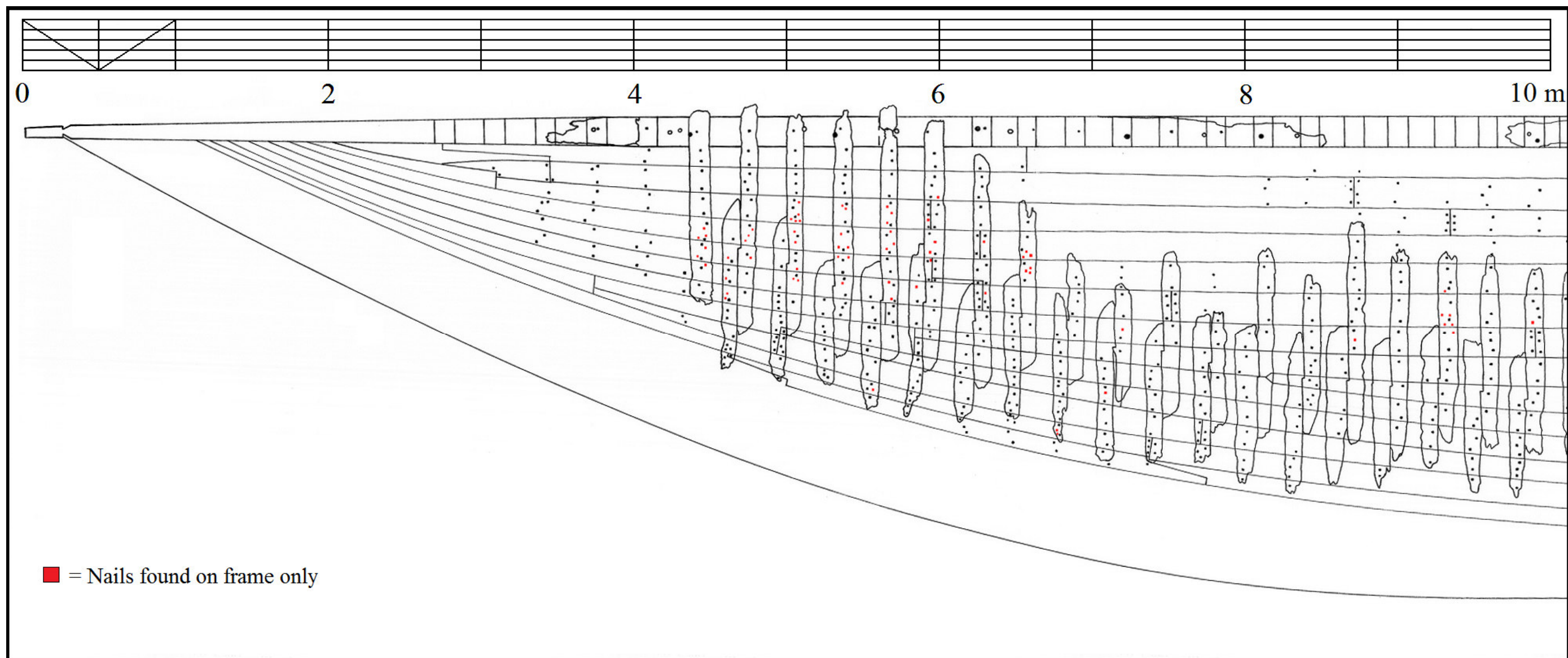


Fig. A.2. Planking Diagram (Bow).



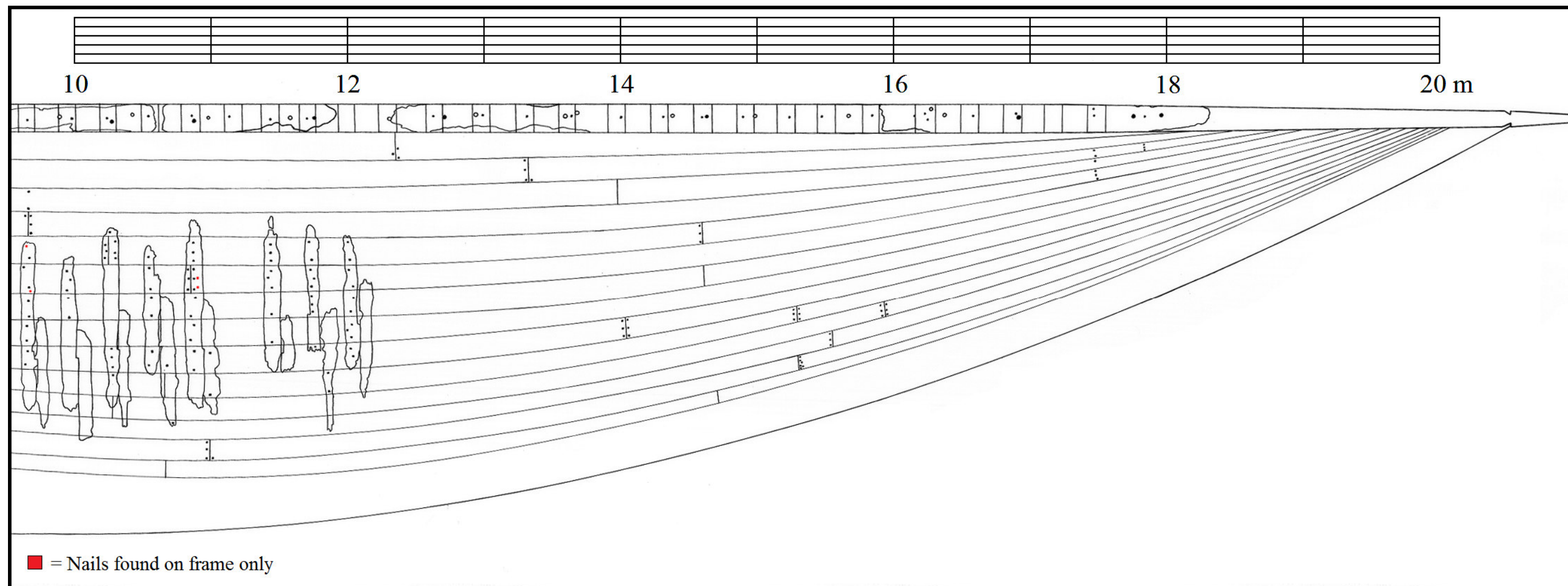


Fig. A.3. Planking Diagram (Stern).

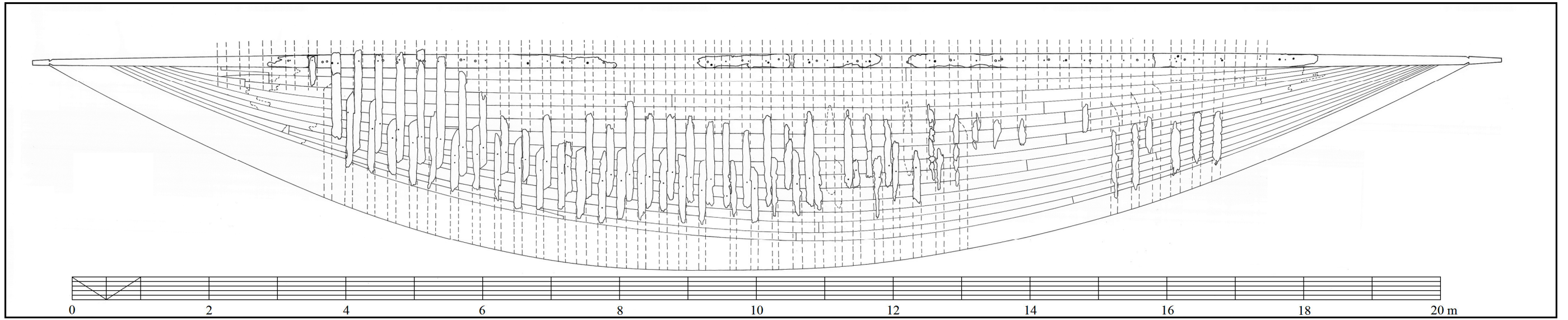


Fig. A.4. Framing Pattern.

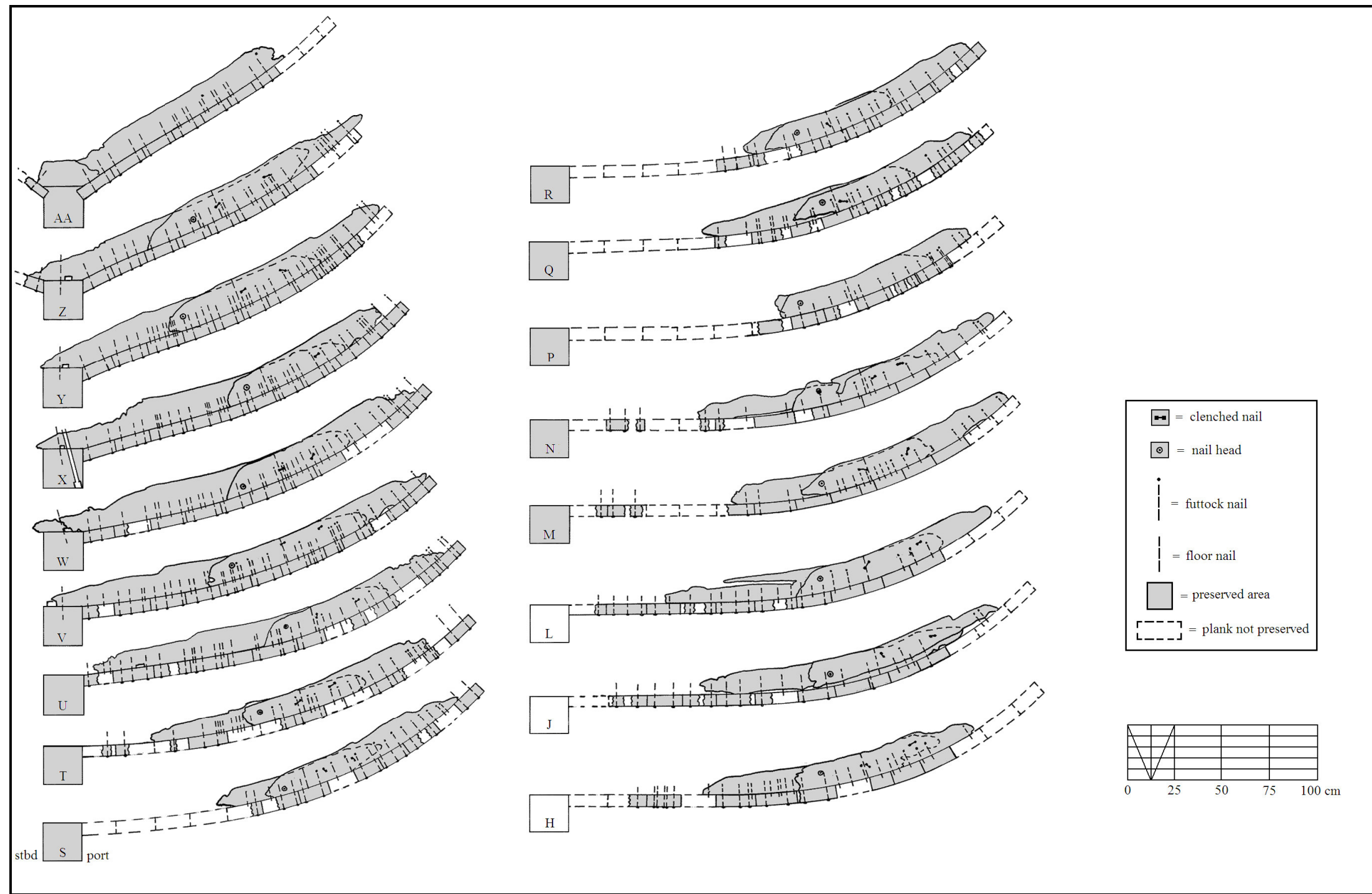


Fig. A.5. Reconstructed Hull Sections (Bow).

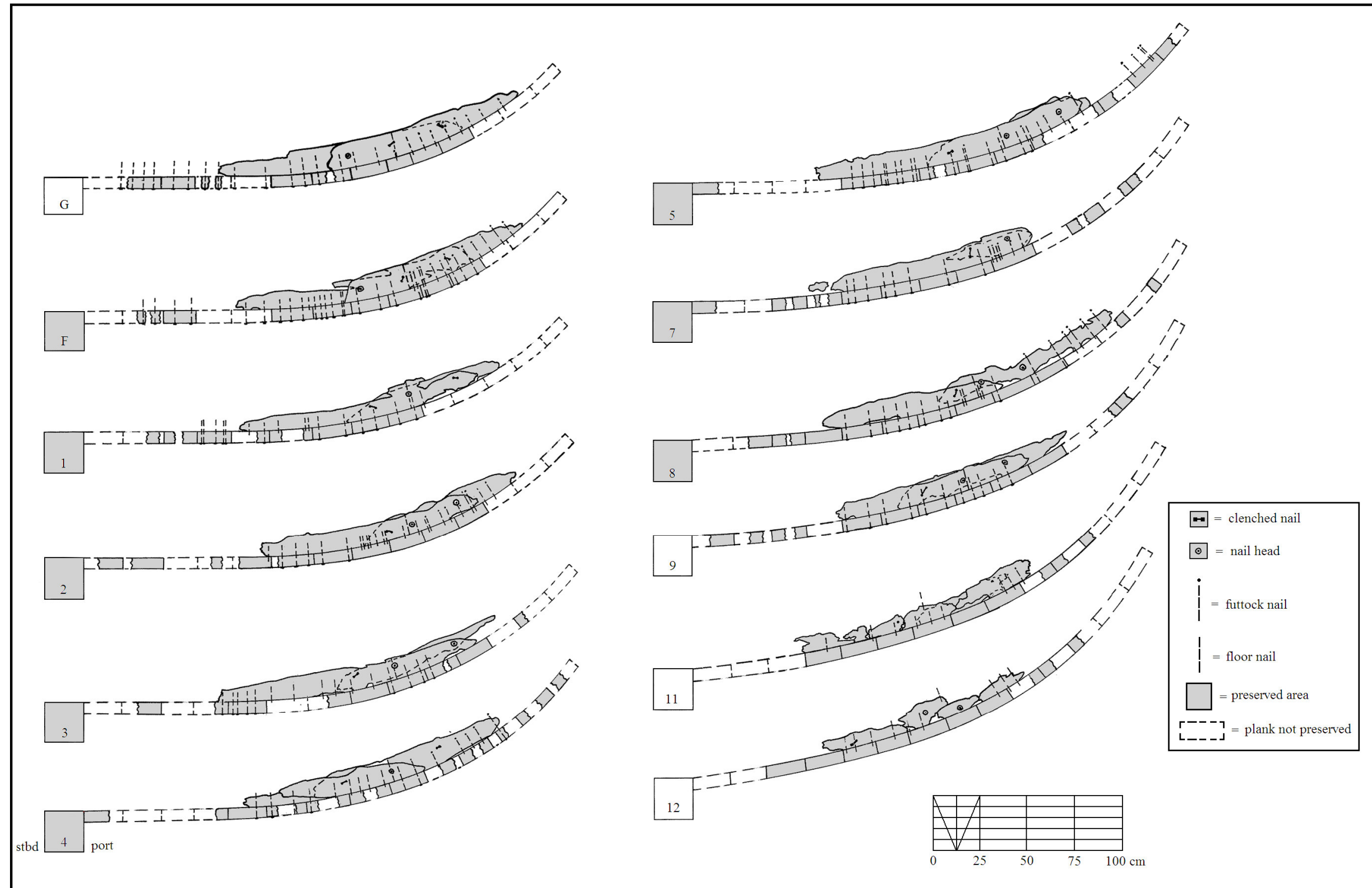


Fig. A.6. Reconstructed Hull Sections (Stern).



The Yassıada  
Ottoman Shipwreck  
Late Sixteenth-Century

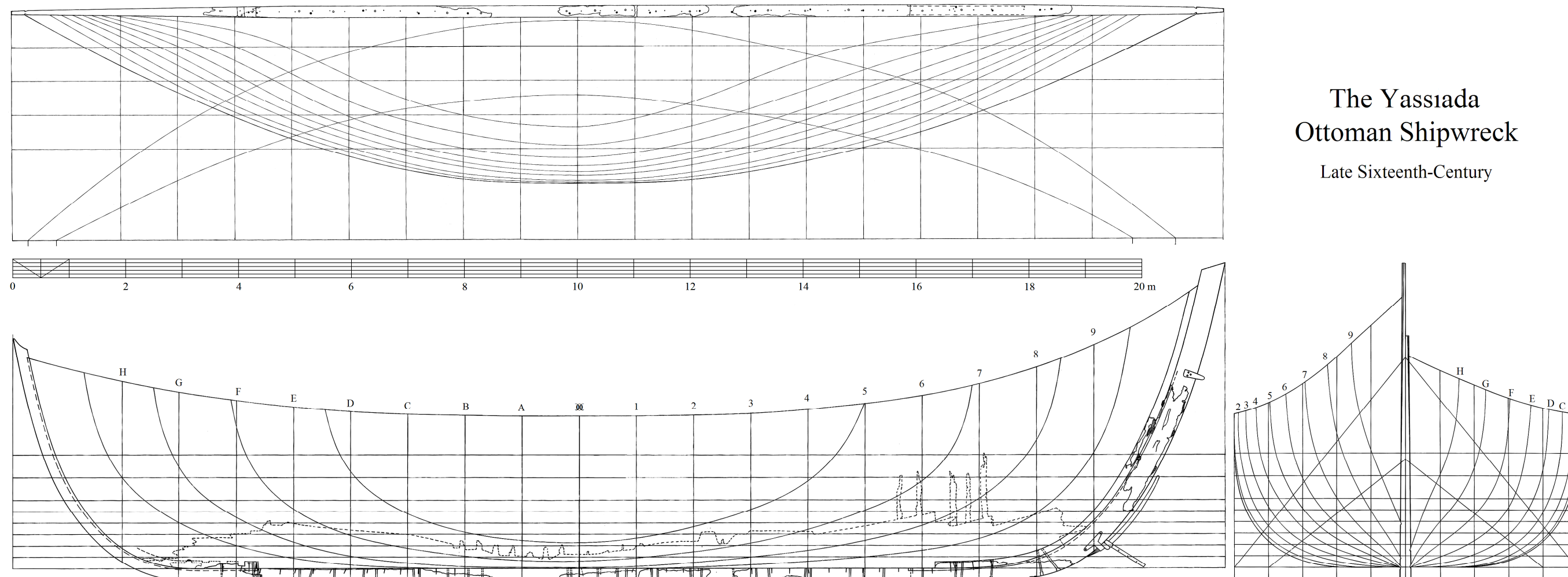


Fig. A.7. Lines Drawings.

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