

New insights into the Ma'agan Mikhael B shipwreck, Israel

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Abstract: The Ma'agan Mikhael B ship was a lateen-rigged merchantman, about 23 m long, with an estimated displacement of 120 tons, dated to the mid-7th–mid-8th centuries AD. In six excavation seasons so far, from 2016 to 2019, the hull and the artefacts have been recorded underwater, and some of the latter were retrieved and studied on land. Based on its construction details – no planking edge-fasteners, and planks butt-jointed at frame stations – it appears that the ship was built to a 'frame-based' concept. It is thus among the earliest frame-based shipwrecks found to date in the eastern Mediterranean.

Keywords: frame-based, Late Antiquity, lateen-rigged, Mediterranean, transition in construction

1. Introduction

The shallow sandy seafloor off kibbutz Ma'agan Mikhael is characterized by a dynamic sediment regime, which created optimal anaerobic conditions for the preservation of archaeological remains. This is testified by the discovery of two ancient wooden shipwrecks in the area: the 400 BC Ma'agan Mikhael shipwreck, found in 1985 (Linder 2003; Kahanov 2011), followed 20 years later by the 7th–8th centuries AD Ma'agan Mikhael B shipwreck (Cvikel *et al.* 2017).



Fig. 1 Divers on the Ma'agan Mikhael B shipwreck site (photo: A. Yurman)

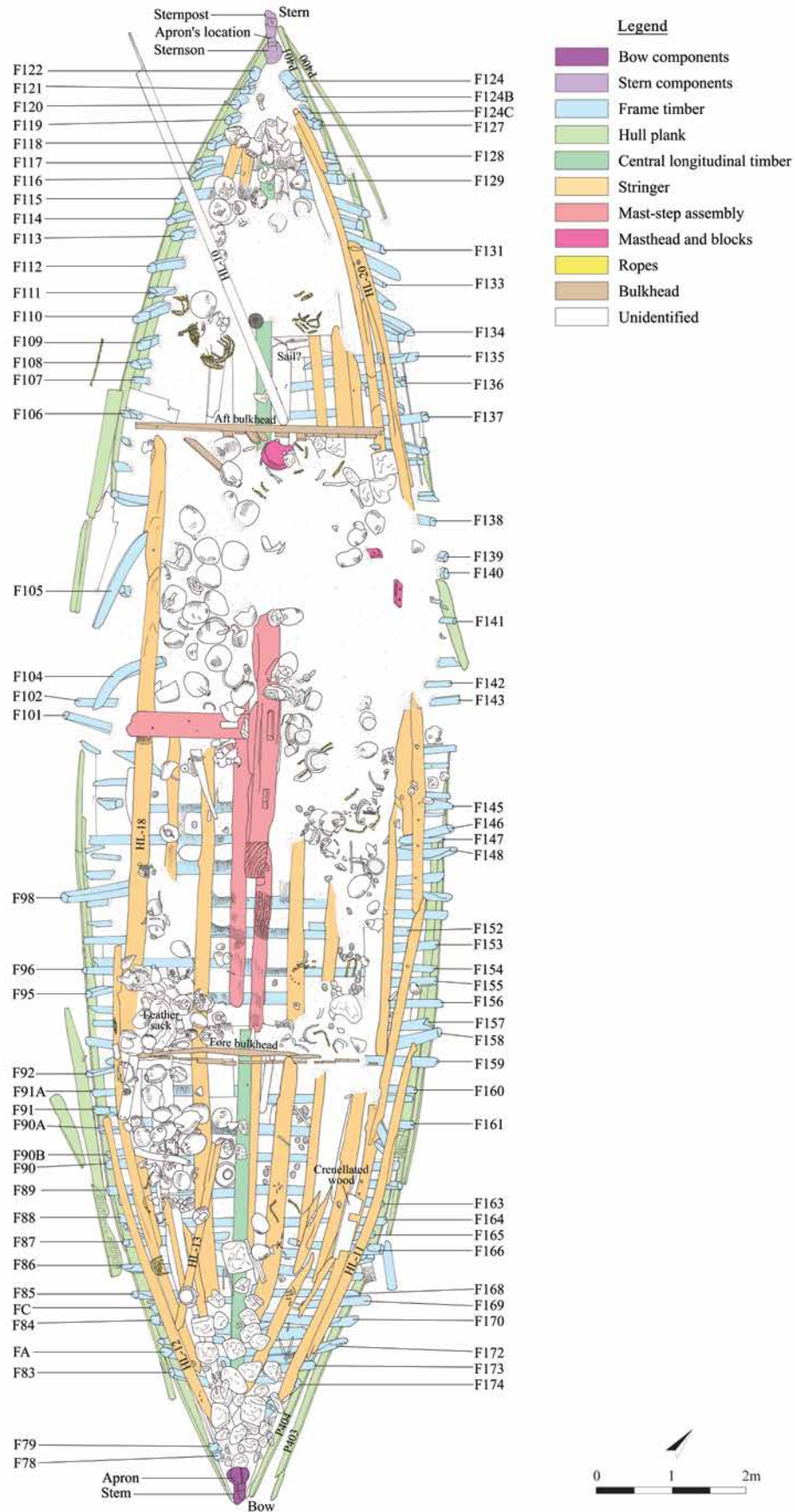


Fig. 2 Plan of the Ma'agan Mikhael B shipwreck (drawing: P. Sibella, adapted by K. Asuli and S. Haad)

In the second half of the 1st millennium AD, there was a transition in ship construction technique from ‘shell-first’ to ‘frame-based’ in Mediterranean shipbuilding. The dating of the Ma’agan Mikhael B ship was a major reason for the long-term programme of underwater excavation and research by the Leon Recanati Institute for Maritime Studies of the University of Haifa (Fig. 1) (Cohen, Cvikel 2019). It had previously been claimed that shipwrecks at Dor/Tantura lagoon, dating from the Byzantine and Islamic periods, could undermine the notion that Serçe Limanı, dated to 1025, was the earliest found using a purely ‘frame-based’ design (Kahanov 2011: 169–172, 176–177; Pomey *et al.* 2012). The dating of the Ma’agan Mikhael B ship supports an earlier dating of the transition.

In the course of the underwater excavations, which were sometimes hampered by harsh weather conditions, the shipwreck remains were revealed at a depth of 3 m and found to be oriented roughly east–west. The hull was 19.6 m long between endposts and 4.9 m wide. The main components of the shipwreck found in a good state of preservation include the keel, endposts, framing timbers, central longitudinal timbers, hull planks, stringers, bulkheads and a mast-step assembly (Fig. 2). A wide array of finds was found, including ceramic sherds and intact amphorae, bricks and ballast stones, matting and baskets, faunal remains, food remains, and rigging elements (Cohen, Cvikel 2019; Creisher *et al.* 2019; Cohen, Cvikel 2020). All wood species were identified by S. Wicha, at Archéobois, Marseilles, and fibre analysis was conducted by A. Rast-Eicher, at Büro für archäologische Textilien, Bern.

2. Hull remains – main components

2.1. Keel

The keel was made of three wood species: fir (*Abies* sp.), sampled in the bow area, sycamore (*Acer pseudoplatanus*) and cypress (*Cupressus sempervirens*), both sampled in the stern area. The use of three different tree species may imply that it was either difficult to obtain suitable timbers for the keel, or perhaps these may indicate repair. However, this requires further investigation. Where measurable, its average dimensions were 18 cm sided and 27 cm moulded. So far, no rabbet or chamfered corners for fitting the garboards have been detected.

2.2. Stem and sternpost

The stem was 1.88 m long, 9–12.5 cm sided and 13–23.5 cm moulded. It was made of two timbers that were joined by a complex keyed hook scarf similar to the ‘Jupiter’ scarf. The upper timber was of Aleppo pine (*Pinus halepensis*), and the bottom timber was of walnut (*Juglans regia*).

The upper timber of the sternpost was not found. The bottom timber, of walnut, was 34 cm long, averaged 13 cm sided and was 10–29 cm moulded, narrowing towards its top. A projection on its upper face, 3 cm long and 3 cm wide, probably secured the upper missing element.

2.3. Framing timbers

The remains of 60 framing timbers were revealed on the starboard side and 63 framing timbers on the port side. There was evidence of at least 30 frame-stations. They were of walnut, except for two which were of holly oak (*Quercus ilex*) – perhaps a repair. On average the framing timbers were 12 cm sided and 14 cm moulded, with room and space of 43 cm. Some of the framing timbers were simply partially worked branches, while others were more carefully worked, with rectangular cross sections and a smooth face fitting an adjacent frame or hull plank. Carpenter’s tool marks, such as a saw and an adze, were visible. A layer of yellowish paint (of unknown composition) and a pine pitch layer were preserved on most of the framing timbers.

2.4. Hull planks

Thirty-one hull planks of fir were exposed: 20 on the starboard side and 11 on the port side. They were on average 19 cm wide and 3 cm thick. They were butt-jointed to strakes at frame-stations, and fastened to frames by two square iron nails, driven from the outside. No edge-fasteners of any type were found.

2.5. Central longitudinal timbers

Two central longitudinal timbers were installed, one at the bow and the other at the stern. These beams were separate, not forming a traditional keelson. The bow timber was of fir. Its entire length was 4.9 m, and it was on average

16 cm wide and 25 cm thick. The stern timber was of Aleppo or Turkish pine. It was about 5 m long, averaging 18 cm sided and 30 cm moulded.

2.6. Stringers

At least three stringers made of fir half-logs were found on each side of the keel. They were on average 18 cm wide and 13 cm thick, and the longest one was 4.9 m long (Cohen *et al.* 2021: 168).

2.7. Bulkheads

Two bulkheads made of vertical planks were found. The top extremities of all the planks were broken. The fore bulkhead was located 13.8 m from the sternpost and was made of 19 planks, all of fir, except for one which was of Aleppo or Turkish pine. The longest measured plank was 1.31 m. The average width of the planks was 13 cm and the average thickness was 3.6 cm. Charred clay bricks found near the fore bulkhead indicate the possible location of the galley.

The aft bulkhead was 5.5 m from the sternpost. It was made of 15 planks; eight of cypress, four of fir or cypress and two of fig. The longest measured plank was 1.54 m. The average width of the planks was 14.4 cm and the average thickness was 3.7 cm.

2.8. Mast-step assembly

The mast-step assembly comprised the mast-step itself, two longitudinal support timbers, and a lateral buttress. The mast-step and support timbers were of walnut and the buttress of fir. The forward end of the mast-step was located about 8.1 m from the stem. The mast-step was 3.5 m long, 25 cm wide and 19 cm thick. Two mortises were cut into its upper surface: the smaller forward one was 27 × 8 cm, and 12 cm deep, probably securing a stanchion supporting a mast partner. The aft mortise, 37 × 10 cm and 6 cm deep, sloped downwards towards the stern, and most likely held the mast heel (Cohen, Cvikel 2020: 298).

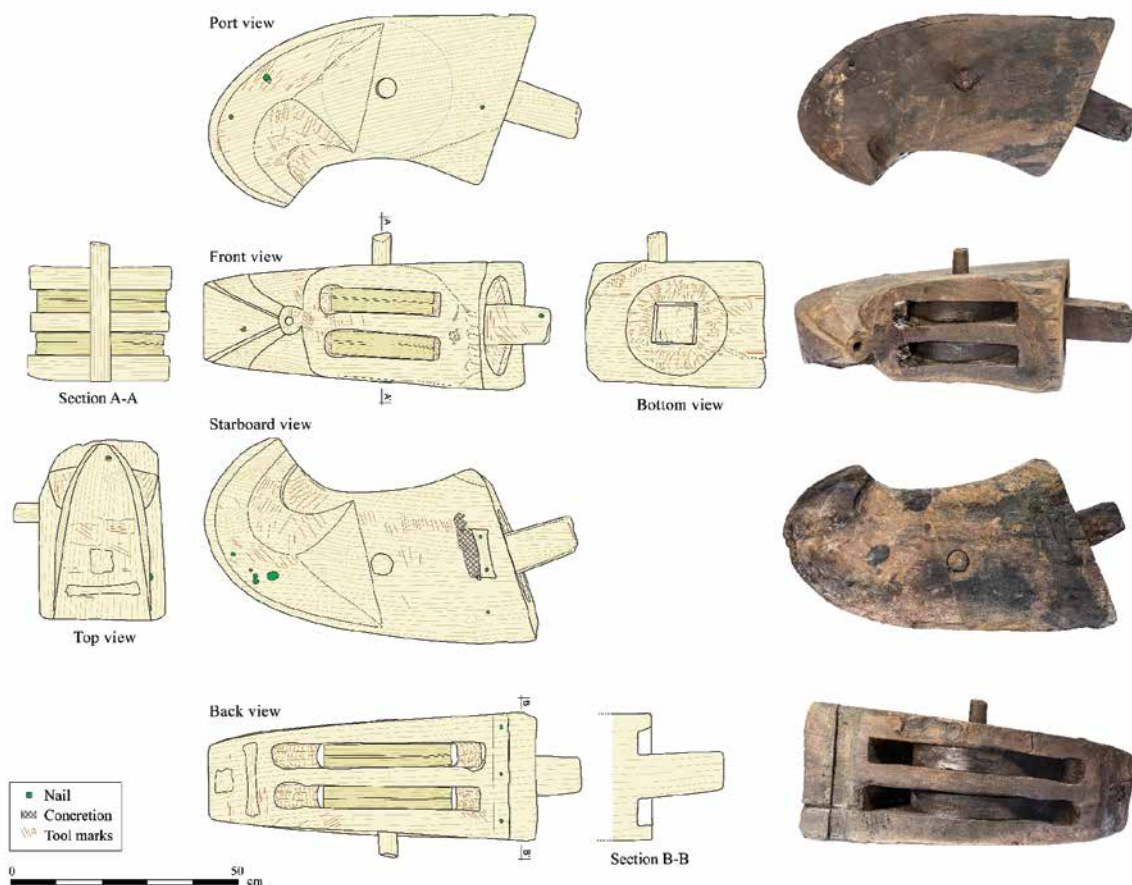


Fig. 3 The hook-shaped masthead (photos: A. Efremov, drawings: S. Haad)

3. Finds

The Ma'agan Mikhael B shipwreck excavations revealed a wide variety of finds, providing information about the date of the ship and its route.

3.1. Hook-shaped masthead

An unattached hook-shaped masthead was discovered in the hold of the shipwreck, in a superb state of preservation (Fig. 3). As far as archaeological records go, this is the only hook-shaped masthead found in context (Beltrame, Medas 2021). It was made of walnut and was 73.5 cm long, 40.3 cm wide at its base and 24.9 cm thick. The lower face of the masthead bore a 20 cm-long tenon bearing a square cross-section of 9.5 × 9.8 cm protruding from a round indentation 23 cm in diameter with apparent adze marks. The masthead contained two sheaves of walnut, both 30 cm diameter and 4.6 cm thick (Cohen, Cvikel 2020: 291, 293). Its location inside the hull suggests that it was a spare part or meant for sale.

3.2. Rigging elements – blocks, ropes and sail

Four wooden rigging elements were found: two turning blocks similar in shape and size, 35 cm long and 10 cm wide; a smaller turning block, 14 cm long and 5.5 cm wide; and a three-sheave block, 42 cm long and 12 cm wide (Cohen, Cvikel 2019: 194–195; Cohen, Cvikel 2020: 295). The outer shell of the two large turning blocks was of walnut and that of the small turning block was of holly or cork oak (*Quercus suber*). Their sheaves were all of holly oak. The parts of the three-sheave block were all holly or cork oak, except for one sheave which was of walnut.

Ropes of various lengths and diameters were discovered, from short fragments up to coils, parts of the standing and running rigging of the ship. The rope fibres were identified as hemp (*Cannabis sativa*), halfa grass (*Desmostachya bipinnata*), sedge (*Cyperaceae*), coir (coconut fibre), and bast (unidentifiable species) (Cohen, Cvikel 2020: 295).

Pieces of fabric, maybe remains of the sail, were found near the aft bulkhead. The fabric was a high-quality sheep wool weft-faced tabby. It was most probably made in the Levant or southern Europe (Cohen, Cvikel 2020: 296–298).

3.3. Amphorae

The ceramic assemblage of this shipwreck is the largest maritime cargo collection to be discovered along the Israeli coast from this period. Typological studies of the amphorae have identified several types, including Late Roman Types 1, 2, 4, and 5 (Fig. 4). Table ware, cooking ware and one lamp were also found. Based on petrography, the origin of the clay is Cyprus, Egypt and the Levant coast. Many of the amphorae still contained some of their final contents, mainly food products such as raisins/grapes, olives, dates, pistachio, walnuts and pine nuts (Creisher *et al.* 2019).

3.4. Bricks and ballast stones

Ten reddish-brown clay bricks (Munsell 5YR 4/4 to Munsell 2.5YR 5/6) were found near the fore bulkhead. They were on average 18.5 cm long, 9.4 cm wide and 5.5 cm thick. Petrographic analysis indicated that the clay originated from Cyprus or Egypt.

Some of the ship's ballast: 108 hewn stones, about 30 cm long, 23 cm wide and 15.6 cm thick, weighing about 1.5 tons, were discovered in the fore part of the hull. Petrographic analysis suggests some of the stones to have been local, while others were from the northern Levant.

3.5. Baskets and matting

Seven baskets were discovered in the shipwreck; two were in an excellent state of preservation. Their original contents were not preserved. The basket fibres were identified as halfa and other grasses. Matting lay on the stringers and mast-step. The matting fibres were identified as halfa and other grasses, reeds (*Gramineae/Cyperaceae*), spiny rush (*Juncus acutus*) and papyrus (*Cyperus papyrus/rotundus*). The fibres used in making the baskets and matting grow mostly in northern Africa, specifically Egypt, implying that these artefacts were made in Egypt, or that their raw material was from Egypt.



Fig. 4 Late Roman 5 amphora as found in the shipwreck (photo: A. Yurman)

3.6. Faunal remains

Faunal remains were identified by S. Harding as belonging to a goat, donkey, pigeon, chicken, turtle and tortoise – and probably indicate the crew's diet. The remains of five rats were discovered in the hold.

3.7. Food remains

The food remains – typical of daily life aboard a ship of this period, and possibly part of the crew's diet, consisted of well-preserved olive pits, walnuts, grape seeds, peach stones, carob pods and pine cones. Some were found inside amphorae, while others were discovered as clusters, indicating that they were stored in baskets and sacks. The remnants of fresh fruit suggest that the ship sailed between September and December.

4. Proposed reconstruction

Based on the archaeological data, the hull of the Ma'agan Mikhael B ship is estimated to be 23 m long, with a beam of 7 m and a displacement of 120 tons (Fig. 5). The directions of the bow and the stern were determined by the slope of the larger aft mortise found in the mast-step. The mast-step assembly found in the Ma'agan Mikhael B ship resembles that of the Tantura F ship. The large mortise in the Tantura F ship slopes down towards the south-east, and researchers suggested that this was the direction of the stern (Barkai, Kahanov 2016: 7, 14–15). The large mortise of the Ma'agan Mikhael B ship sloped down to the west, also suggesting that the bow faced east.

As illustrated in different depictions, mosaics and graffiti – hook-shaped mastheads are characteristic of lateen-rigged ships of the Mediterranean during Late Antiquity up to the 12th century (for example: Basch 1991a; Basch 1991b;

Acknowledgments

The underwater excavations (IAA permits G-41/2016, G-40/2017, G-26/2018 and G-34/2019) and research of the Ma'agan Mikhael B shipwreck were supported by the Israel Science Foundation (grant no. 1891/16), the Honor Frost Foundation, a Dov Shafrir Fellowship, a Natan Rotenstreich Scholarship, a Sir Maurice Hatter Fellowship, the Research Authority of the University of Haifa, and anonymous donors, to whom the authors are grateful. The authors would like to thank Y. Goren for his valuable assistance, J. B. Tresman for the English editing, and the anonymous reviewers for the constructive comments.

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