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ORIGINAL ARTICLE

Mtepe: Documentation and Analysis of a Sewn-Boat Reconstruction from Zanzibar, Tanzania

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Abstract In one form or another, the sewn-plank boats have been in existence along the Swahili coast of East Africa since at least the first century CE. Although the last such vessel type known later as *mtepe* vanished in the mid-1930s in Lamu Archipelago, Kenya, a research reconstruction was built in Zanzibar in 2003. It was originally housed in the House of Wonders as part of a large exhibit on the Dhow Cultures of the Indian Ocean. Due to a tragic collapse of the museum's roof, the *mtepe* reconstruction named *Shungwaya* had to be moved to an open outdoor space in 2020. Since then, it has remained unprotected and exposed to the elements, which contributed to further deterioration and damage. The aim of this article is to expand on the initial work related to the reconstruction of *Shungwaya*, provide documentation and analysis of the structure of this research model and museum exhibit, produce a digital record, and provide ship lines and drawings. The article also draws attention to the importance of preserving vernacular shipbuilding traditions and culture through models, full-scale reconstructions, documentations, interpretations, and museum exhibitions.

Résumé Sous une forme ou une autre, les bateaux en planches cousues existent le long de la côte Swahili de l'Afrique de l'Est depuis au moins le 1er siècle de notre ère. Bien que le dernier type de navire connu plus tard sous le nom de *mtepe* ait disparu au milieu des années 1930 dans l'Archipel de Lamu, au Kenya, une reconstruction de recherche a été construite à Zanzibar en 2003. Il était à l'origine installé dans la Maison des Merveilles dans le cadre d'une grande exposition sur le boutre. Cultures de l'océan Indien. En raison d'un effondrement tragique du toit du musée, le *mtepe* reconstitué nommé *Shungwaya* a dû être déplacé vers un espace extérieur ouvert en 2020. Depuis lors, il est resté sans protection et exposé aux éléments, ce qui a contribué à davantage de détérioration et de

Archaeological time period Late 19th to twentieth century

Country and region discussed Tanzania, Unguja (Zanzibar)

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dommages. Le but de cet article est de développer les travaux initiaux liés à la reconstruction de *Shungwaya*, de fournir une documentation et une analyse de la structure de ce modèle de recherche et de cette exposition muséale, de produire un enregistrement numérique et de fournir des lignes et des dessins de navires. L'article attire également l'attention sur l'importance de préserver les traditions et la culture vernaculaires de la construction navale à travers des maquettes, des reconstructions à grande échelle, des documentations, des interprétations et des expositions de musée.

Keywords *Mtepe* · *Shungwaya* · Boat Reconstruction · Swahili Coast · East Africa · Zanzibar

Introduction

This project came together as part of a larger research program on ship ethnography in Zanzibar, Tanzania (Fig. 1). In 2023, while conducting fieldwork on Unguja (Zanzibar), the authors evaluated the physical structure and condition of a research reconstruction

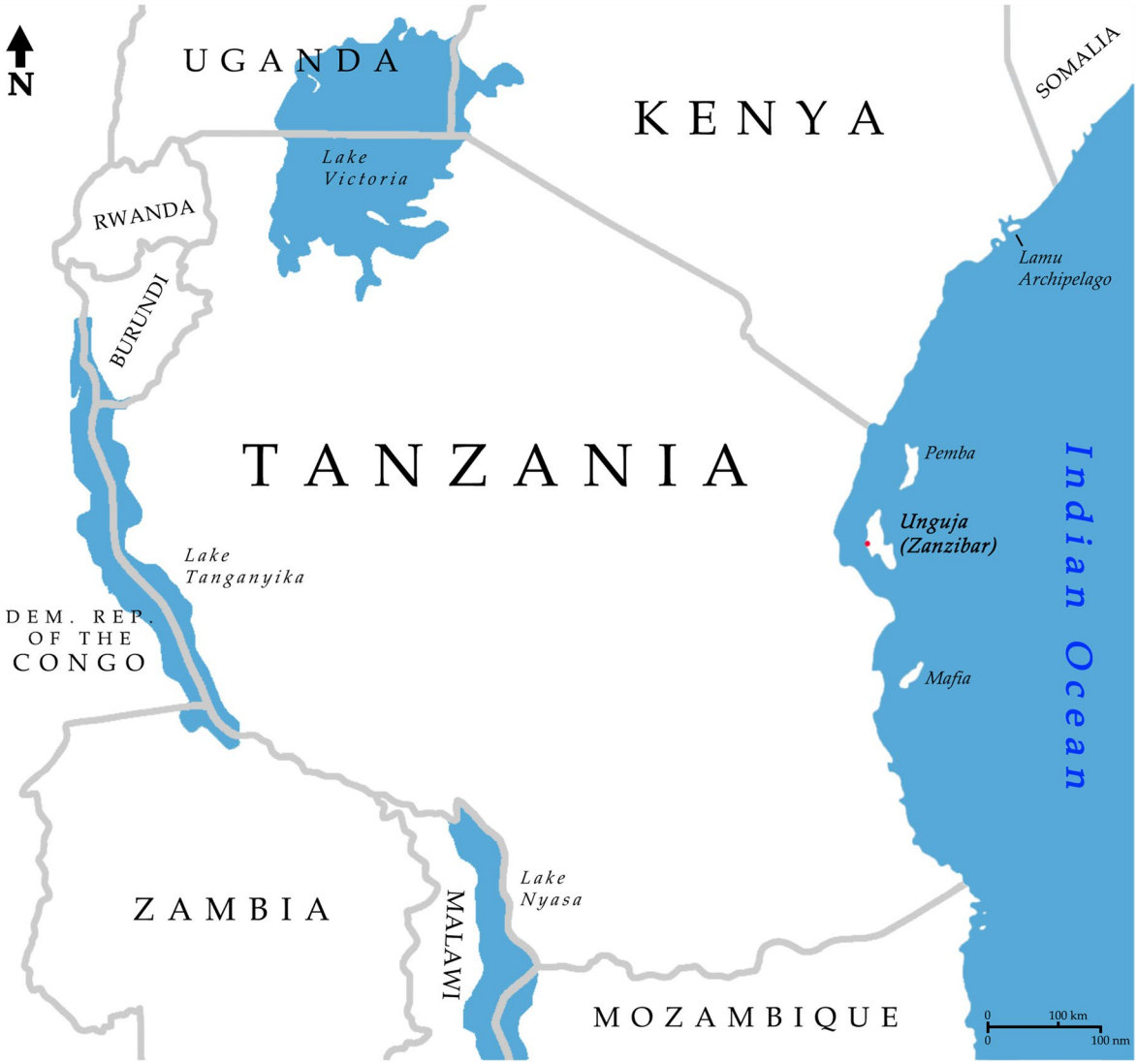

Fig. 1 Location of Unguja (Zanzibar) Island, Tanzania, and Lamu Archipelago, Kenya. Illustration modified by P. Bojakowski

of a double-ended sewn-plank boat *mtepe*. The overarching goal of this project was to systematically document and analyze the boat under the guidelines of nautical archaeology and heritage preservation as a standalone unique example of a vernacular craft. Although this *mtepe* was built as a museum reconstruction and local adaptation of now-extinct construction methods, it adds to our understanding of these adaptations, access to and availability of limited resources, materials, and expertise at hand. These adaptations have likely occurred throughout history. Additionally, this project aimed to understand the current level of deterioration of various parts of this boat and provide recommendations on its storage and anticipated preservation needs. The boat was originally displayed in the House of Wonders in Zanzibar City, where it was a focal part of an educational exhibit on the Dhow Cultures of the Indian Ocean. Due to a catastrophic collapse of the roof of the museum in 2020, the *mtepe* reconstruction, along with all the other museum objects, had to be relocated (Lichtenstein, 2020). Because of its substantial size, the boat was moved to an outdoor space, as no other museum storage facility on the island could accommodate it. Sometime in early 2021, the *mtepe* was placed in the courtyard of the Peace Memorial Museum in Zanzibar City. It is currently supported by a temporary wooden cradle, tied with ratchet straps and ropes, positioned directly on its port side, and loosely covered with two large tarpaulins (Figs. 2 and 3). According to museum authorities, this move was envisioned as a temporary solution; however, it quickly became permanent. At present, there is no clear vision nor financial means to support future long-term preservations and protection of this boat. Although the consensus is that the *mtepe* should be exhibited to the public as before, there is no solution or specific plan of how to accomplish this before the full restoration of the museum building is completed. Even then, it is not certain if the *mtepe* reconstruction will ever return to the House of Wonders.

Fig. 2 Mtepe reconstruction covered with tarpaulins in the courtyard of the Peace Memorial Museum, Zanzibar City

Fig. 3 Mtepe reconstruction (starboard view) prepared for the study by the authors. The courtyard of Peace Memorial Museum, Zanzibar City

Together with representatives from the Ministry of Heritage and Tourism, Department of Museums and Antiquities, the authors assessed the *mtepe's* reconstruction. Since the last move, the boat has remained exposed to the elements (a seasonal combination of very wet and very dry conditions throughout the year) and suffered further deterioration and damage to its structure. It was evident that the wood, particularly the external planking, showed areas of extensive termite damage; while the coir rope stitching broke, it was chewed through by rodents, or simply disintegrated at various sections along the seams between planks. Working with local partners, the authors initiated a study. The team collaborated with other researchers and historians, including Abdul Sheriff who was the original force behind the experimental reconstruction of the *mtepe* and the creation of the educational exhibit surrounding it at the House of Wonders in 2003. Sheriff offered not only an extensive oral account of the original construction process but also a collection of data (both published and unpublished sources) relevant to this project.

Due to time constraints, the first step in the process was to collect data for 3D photogrammetry using a small, but highly capable, DJI Mini 3 Pro drone and two Canon PowerShot G7 X Mark III digital cameras. The drone was particularly useful; it enabled the team to conduct a detailed photogrammetry survey and data collection that would otherwise be logistically difficult. This level of digital documentation has never been achieved for this *mtepe* reconstruction. The results were processed in the field (in low resolution as a draft) to evaluate the coverage, and later in the laboratory, using a RealityCapture® software package. The data was also post-processed and analyzed using Rhinoceros 3D® and AutoCAD® software to produce the ship lines and detailed construction drawings. One of the limitations of the photogrammetry recording was the position of the boat. Because of the wooden support cradle, only the exposed starboard of the boat could be photographed and digitally modeled.

The next step of this research was to record the *mtepe* using traditional archaeological methods (e.g., using tape measures, and calipers) by directly measuring and documenting all visible timbers, fasteners, joinery, and construction features. It should be emphasized that only the starboard and some selected visible structural elements of the port side could be recorded, as no disassembly of any part of the boat was permitted. The inside of the boat was recorded in its entirety. By working with a dataset provided by Sheriff, the authors were able to compare their data collected during 2023 with the original records collected during the construction of the *mtepe* in 2002–2003. Although not part of the initial project, the authors also advised local museum specialists and conservators in Zanzibar about proposed avenues for long-term storage and preservation of this unique boat, including a proposal for restoration treatment. In addition to studying research reconstruction of the full-size boat, the authors had a chance to review the scale model of a *mtepe*. Originally displayed in the House of Wonders, the scale model had to be moved and is currently stored at the offsite museum facility in Dunga, Zanzibar. At the time of writing this article, the full-scale research reconstruction of the *mtepe* and the scale model was not available to the public.

Literature Review

Although early texts are sparse, it is generally accepted that one of the first references to the presence of sewn-plank boats along the coast of East Africa comes from *Periplus Maris Erythraei* (*Periplus of the Eritrean Sea*), a 30–40 CE sailing guide for merchants. In the *Periplus*, an unknown author mentioned craft called "*rhaptôn ploiariôn*" (or "sewed boats"). The craft appeared so prevalent that even the last port of call along this trading route was referred to as "*Rhapta*" (or "sewn") (Schoff, 1974: 28; Casson, 1989: 59–61; Huntingford, 2010). Later, medieval islamic travelers, sea captains, and scores of geographers also cited the familiar sewn boats in the Red Sea, eastern Africa, and other places along the shores of the Indian Ocean. They often remarked on specific details related to their character, sailing qualities, and why these craft were so suited to the shallow waters and coastal environment (see El-Tahtawy, 1972: 285; Poumailloux, 1999: 232–3; Ibn Batuta & Bivar 2000; Pedersen, 2003: 80–2, 2004: 231; Hughes & Post, 2016; Ghidoni, 2023).

Early-16th-century Portuguese nautical manuscripts substantiated the reports on these crafts. The Portuguese explorers who sailed around the tip of Africa and into the Indian Ocean referred to them, likely incorrectly, as "sambuken," which might be reminiscent of the watercraft of southern Arabia (Fig. 4). Through translation of Portuguese sources,

Fig. 4 Example of an Arabian sewn seagoing craft setting out for Omân, a scene illustrating the beginning of the "Thirty-ninth Maqâma," by Abu Mohammed al-Harīrī, Baghdad (Iraq), c. 1225–1235. Modified after Ettinghausen (1962, 108)

Ravenstein (1898, 26) indicated that these boats were built without any iron fasteners. Instead, they utilized only wooden treenails throughout their structure, while the seams between their planks were sewn with fiber ropes. A number of European explorers also mentioned other craft of very similar construction that carried characteristic single mast and square matting sail (Chittick, 1974: 250; Weisauer, 1976: 73–4; Prins, 1986: 5, 67). Thus far, these early sources have been conventionally accepted as proof of the existence of a very early sewn-plank boatbuilding tradition along what has been known as the Swahili coast of East Africa (Hourani, 1963: 92–3). However, no indication has been given as to any specific type or perhaps even types of boats in question; although, a sewn boat *mtepe* has been generally viewed as a distant continuation of similar construction methods (see Chittick, 1980: 297–8; Gilbert, 1998: 43–4; Poumailloux, 1999: 228).

Important to this study are late-19th and early-20th-century scholarly accounts, which provide significantly more information in terms of construction details and name-based typology. Although descriptions are still vague, these sources generally distinguish two types of sewn-plank boats characteristic of the regional tradition. With a narrow, sharply angled, and highly ornated stem shaped in the form of a bird's neck (often ending in almost an elongated beak-like fashion or a camel's head fashion, depending on the interpretation), the first type seemed to be known simply as a *mtepe*. In this context, it is only natural to question whether the interpretation of the boat's prow as somehow resembling the "neck of a bird" or the "head of a camel" was a view held by the Swahili people or if it was a product of outsider's imagination. Having a leveled, somewhat jutting bowsprit, absence of any decorations on the stem, and less pronounced angle of the bow entry, the second type seemed to be known as a *dau la mtepe* (or *dau la utango*) (Burton, 1872: 74; Weisauer, 1976: 83–4; Gilbert, 1998: 46).

Prins (1965, 121) pointed out that both types were small, although the *mtepe* was generally considered to be larger than *dau la mtepe*. Hornell (1941, 63) reproduced rudimentary ship lines, but for a *dau la mtepe*. Both types carried a single mast and a plaited mat square sail made of strips of dried palm leaves. Due to the common confusion among early authors, it is not easy to determine whether various descriptions or even illustrations were related to one or the other type. Although not a nautical expert, Voeltzkow (1923, 42) presented a personal account by witnessing the construction of what he believed was a *mtepe* in the shipyard in Faza on the island of Pate, part of Lamu Archipelago. Weisauer (1976, 74) seemed to question this interpretation indicating that the boat Voeltzkow illustrated likely represented *dau la mtepe*. Overall, we should perhaps acknowledge that the approach of differentiating between *mtepe* and *dau la mtepe* may be quite rigid and overly prescriptive. While Prins' (1965) interpretation is important, it is unclear whether the boatbuilders in Faza observed by Voeltzkow made the same distinction. Later, Prins (1959, 210) himself indicated that these two types were largely based on a specific appearance, but generally built along the same principles. As such, it is possible that the shipwrights referred to a *dau la mtepe* simply as a *mtepe*, or they used both names interchangeably depending on the context. The variety in naming conventions should not necessarily imply confusion among the original boatbuilders.

All sources seem to be consistent regarding the main geographical areas associated with this shipbuilding tradition. The sewn boats of *mtepe*-type were predominantly built around Lamu Archipelago (Patta, Faza, Siu, Tikuni, and Kizingitini [the island of Pate]), Lamu, Maguniani (the island of Lamu), and the small island of Ndau north of Pate, reaching as far north as some of the islands off the southern Somali coast. The boatbuilders were traditionally Bajuni or Wagunya people who inhabited the Lamu Archipelago on the coast of northern Kenya and parts of southern Somalia; these groups spoke a language related to Kiswahili (Weisauer, 1976: 77–8). Baumann (1899, 95) indicated that the sewn boats were also built on the island of Pemba (just north of Unguja [Zanzibar Island]) off the coast of Tanzanian. However, the actual shipbuilders were migrant Wagunya from Lamu.

Currently, some of the materials related to the technical specifications of sewn *mtepe* come from publications by Hornell (1941), Prins (1965), and Grottanelli (1955), among others. These materials indicate that the *mtepe* was a relatively small and slender cargo vessel. Selected late 19th-century accounts show a range anywhere from 16.5 to 30 m in length and 4.5 to 7.4 m in breadth, respectively, and up to 186 tons of carrying capacity (Prins, 1982:

90–1; Gilbert, 1998: 46). Nonetheless, these specifications are very limited and are likely not to provide the entire range for the class of boats.

Mtepe planking was edge-joined with small wooden pegs (or dowels) driven in at an angle. The seams were caulked with some form of softened mango bark and dried palm flax, and the planks were sewn together with coconut-fiber (coir) ropes through the pre-drilled holes. The coir rope was strong, elastic, and considered rot-resistant. Once the coir ropes were made taut, the holes along the plank seams were plugged with wooden treenails (see Elliot, 1926: 258; Hornell, 1941: 28–31; Chittick, 1980: 297–8; Prins, 1982: 91–4). The sources cited by Weisauer (1976, 78–9) indicated that the usual cargo carried by these boats was grain and slaves, but other commodities, such as cattle, salt, and *boriti* (long mangrove poles) were also common. The average carrying capacity of *mtepe* was 1000 *korjas* of *boriti* (10,000 mangrove poles).

Weisauer (1976, 82–4) also discussed the *mtepe's* decorations in the form of white geometric oculi or rosettes painted on the bow and stern; carvings on the bow, stern, and rudder; and also tassels, streamers, and colorful flags. It is doubtful, however, that most of the working boats carried much in terms of decorations, and they were likely quite plain. Such decorations, or lack thereof, can be seen in 19th-century engravings, illustrations, photographs, and known boat models. Révoil (1888, 409) reproduced one of the earliest engravings (after a photograph) of what was considered a *mtepe*, while Martin and Martin (1978, 95) cited another photograph of *mtepe* from the Kenya National Archives dated 1890 (see Chittick, 1980: 298; Gilbert, 1998: 44) (Fig. 5). Among later sources, selected illustrations could be found in Hourani (1963), while Garlake and Garlake (1964) and more recently Cooper and Ghidoni (2022) presented an interesting examination of ship graffiti and engravings. Kirkman (1974, 16) and Prins (1982, 97–8) provided information about *mtepe* planking covering the ceiling of the guardroom of Fort Jesus, Mombasa. These remains consist of 12 strakes averaging 0.2 m in width and displaying a clear stitching pattern. As far as the boat models, it appeared that all quality exemplars were associated with craftsmen from Tanga (Tanzania) or Lamu (Kenya). These models are currently in various museums in Kenya, Tanzania, and Europe and represent somewhat exaggerated versions of *mtepe* or *dau la mtepe*. The best models are those from the Museum of Ethnology in Hamburg; the National Maritime Museum in Greenwich; the Institute of Arab and Islamic Studies, the University of Exeter; and two models from the private collections in Groningen, Netherlands (see Chittick, 1980; Prins, 1982; Dixon, 2018, 2019). The authors of this article had an opportunity to review a model from Zanzibar, which was originally housed at the House of Wonders. Collectively, Hourani (1963), and later Chittick (1980), Adams (1985), and Poumailloux (1999) offered an extensive review of relevant literature and historical and ethnographic sources and should be consulted by anyone with an interest in this topic. More recently, Staples and Blue (2019) offered a fresh set of approaches to the study of this shipbuilding tradition, updating the available bibliographical list, while Cooper et al. (2020) offered a comparative recording framework.

Fig. 5 Mtepe boats at anchor in the Old Port, Mombasa, Kenya, in 1890. Modified after Martin and Martin (1978, 95)

Reconstruction of Zanzibar *Mtepe*

According to Sheriff et al. (2006), the concept of using a quintessential local watercraft directly linked to the Swahili Coast of East Africa was introduced in 1994. The craft was supposed to be the centerpiece of a future exhibition and educational programming on the Dhow Culture of the Indian Ocean at the House of Wonders, in Zanzibar. Originally, the design team proposed using a traditional one-masted lateen-rigged Indian Ocean *dhow*, but because these ships were still so prevalent around the bays and harbors of Zanzibar, the idea was quickly dismissed. Sheriff concluded that anyone could see a *dhow* simply by strolling along Zanzibar's waterfront. Then, the team suggested that a far better example of a uniquely Swahili craft would be now an extinct sewn-plank boat known as a *mtepe*. The idea was overwhelmingly accepted as the most appropriate boat type representing the island, the region, and Swahili culture in general. The project of developing the museum exhibition and educational programming around such a life-sized reconstruction was set in motion in 2002.

Because neither such a boat nor its archaeological remains existed, and the last known example of a *mtepe* had reportedly been abandoned on the beach on the island of Lamu, Kenya in 1939, Sheriff et al. (2006) instituted a research program. There were many stories and formal reports about people with knowledge of sewn boat construction methods on the islands of Tumbatu and Pemba (just north of Zanzibar), but no suitable boatbuilder was located there. It was clear that the last place that *mtepe*-type boats were generally associated with was the area of Lamu Archipelago, and the museum staff traveled there to search for a potential boatbuilder. Upon consultation with local researchers and specialists on the Swahili culture from Mombasa, one such candidate with what seemed like a personal knowledge of sewn boat construction was identified. His name was Mohammed Bwana, and his grandfather reportedly used to build *mtepe*-type (either *mtepe* or *dau la mtepe*) boats on Lamu. Due to socio-economic circumstances, Mr. Bwana's grandfather turned to building only *mtepe* scale models for the museums and tourist shops and building various other local ship types when boat orders were available. Like his grandfather, Mr. Bwana was a local craftsman, boatbuilder, and very accomplished model builder (A. Sheriff pers. comm., July 3, 2023).

Mr. Bwana was hired by the museum and moved to Zanzibar for the duration of the project, which took a total of 8 months to complete. Work on the *mtepe* began at the Forodhani Seafront in Stonetown, directly in front of the House of Wonders. The entire project was envisioned as part of the museum's educational programming and an interactive exhibit on the maritime culture of the Swahili coast. From the start, the *mtepe* was conceived as a research reconstruction of a fully functional boat grounded in thorough historical and ethnographic research. The proposed reconstruction was based on a boat captured and run onto a reef by the British Navy in January 1877 (Gilbert, 1998: 46). As recorded in the Vice-Admiralty Court documents in Zanzibar, the boat in question measured 97 ft (29.5 m) long, 24 ft (7.4 m) wide, and 9.5 ft (2.0 m) deep. Because these original dimensions were significantly too large to accommodate such a vessel in the courtyard of the new museum, Sheriff decided to scale it down to about half that size (A. Sheriff pers. comm., July 3, 2023).

The timber for the keel was laid first and squared off with adzes (Fig. 6). The top of the keel was then marked with a blue chalk line along the port and

Fig. 6 Shaping of the keel with adzes. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

starboard edges to provide long straight lines, which served as guides for cutting the square rabbet. Lydekker (1919, 89) described that the stem and sternpost of a *mtepe* he investigated were made from several shorter scarfed-together timbers and then supported with another longer piece sewn along their outboard faces. However, Mr. Bwana fashioned both posts from longer individual timbers. Sheriff et al., (2006, 39–40) noted that Mr. Bwana also did not follow the recommended angles between the keel and the stem, and the keel and the sternpost. Following Sheriff's advice, these were redone as part of a necessary learning and building process.

Although details are limited, Hornell (1941, 57) indicated that the shipbuilding philosophy behind the construction of the *mtepe* boats along the Swahili coast followed a shell-first tradition, in which the shell of the external planking was assembled prior to the installation of any internal framing elements. During the reconstruction process, Sheriff noted that Mr. Bwana did not follow this process (A. Sheriff pers. comm., July 3, 2023). He disclosed that he was unfamiliar with the true shell-first method and could not produce a desired boat shape entirely in such a fashion. Instead, Mr. Bwana insisted on following a method that he learned while building other boat types on the island of Lamu. In essence, his method was explained by Sheriff et al., (2006, 40) as a variation on the frame-first shipbuilding philosophy (Fig. 7). It was likely that Mr. Bwana was relying on a personal adaptation of local oral tradition related to *mtepe*-type boats, later modifications to the original shipbuilding methods learned from his grandfather, but also on his own personal experiences with building modern boats and scale models on Lamu.

Each side of the *mtepe* had garboards and eight strakes made of two or three connected planks. Traditionally, the external planks were made of *mkoko* or *mlilena* mangrove timber; however, procuring this material in appropriate dimensions to produce planking was not possible (Lydekker, 1919: 88; Hornell, 1941: 31; Weisauer, 1976: 76–7). Instead, Mr. Bwana used readily available mast wood (*mtondoo*) that was imported from Tanga, on mainland Tanzania. To force the planks to the desired shapes, they were smeared with used engine oil, heated over the fire, and then bent with a wooden vice. The planks were edge-joined and fastened to each other along the seams with small wooden pegs. These were hammered in

Fig. 7 Framing the boat. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

Fig. 8 Method of edge joinery between planks. Note the dark staining caused by heating the planks over the fire to bend them to a desired shape. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

at an angle into the pre-drilled holes. Larger treenails were used to attach planks to the frames (Fig. 8).

The process of shaping and aligning planks to each other with pegs, fastening them to the stem, sternpost,

and framing timbers had to be done as a continuous operation. As the consecutive strakes were being erected, caulking and sewing followed. Caulking consisted of three layers. The first layer was composed of strands of loose coir fiber soaked in shark liver oil, which were driven into the seams with caulking irons. The second layer was a thick paste of pounded mangrove bark (reportedly acting as a preservative to the coir) that was painted over the coir fiber. Finally, the third layer was crushed and dried stems of *doum* palm leaves that covered the seams and functioned as battens. These three layers were then sewn with coir rope into position along the seams (Hornell, 1941: 61). Sewing was done by passing the coir rope through the pre-drilled holes, working from the inside out, and from bow to stern. Once the rope was tightened, a peg was driven from outside into each hole to secure the rope (Figs. 9 and 10).

Hornell (1941, 61) reported that the coir rope that was present along the outboard faces of the planking was normally cut flush, except along the keel and short sections of the stem and stern. However, Sheriff et al., (2006, 41) stated that Mr. Bwana seemed skeptical of this approach. His concerns related to the overall integrity of the boat's structure. Mr. Bwana was worried that by cutting the ropes flush, the planking would simply come apart. It should be noted that

Fig. 9 Sewing the garboard to the keel with a coir rope. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

Fig. 10 Sewing the planks along the seams. Note the pre-drilled holes along the seams being plugged with pegs from the outside, and the frames being installed. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

both methods (leaving the coir rope in place and cutting it flush) have been known to exist and perhaps imply greater variation within this shipbuilding tradition (see Prins, 1986: 28). The *mtepe* reconstruction was finished with four pairs of through-beams. The lower and upper through-beams were lashed together with coir rope and secured with wooden pegs. The cap rail ran the entire length along the sides of the hull and provided longitudinal rigidity. The inside of the *mtepe* was covered with ceiling planks and stringers. Although the sources and scale models did not show or mention any planks inside the vessel, Mr. Bwana insisted on them to strengthen the boat (A. Sheriff pers. comm., July 3, 2023). To seal any small holes and openings, but also to protect the wood, the entire hull was painted on the outside with a mangrove bark solution. The forward and aft sections of the boat had small decks, while the central section was left open. The aft section also featured a small hut-like structure covered with palm leaves.

The stem of the *mtepe* was extended with an additional timber fashioned in the form of the head of a bird (or a camel), which was consistent with the original iconography. The sternpost had a large rudder with a loosely fitted tiller. The rudder was fastened to

the post with coir ropes. Two additional ropes secured the rudder in case it slipped and separated (Lydekker, 1919: 90; Prins, 1959: 211). The boat was equipped with oars made of thin mangrove planks. Instead of rowlocks, rope loops were tied to the cap rails for attaching the oars. The boat also carried mangrove poles used to push the boat in shallow water.

As for the rigging and sail, the mast was traditionally a long mangrove pole held in place by two stays. However, the mast for this reconstruction was made of teak wood. The heel of the mast was shaped to fit into a small mortise inside the mast step. The very top of the mast was carved to accommodate a pully wheel for the halyard. The mast was tied to the forward set of beams, which provided robust support to carry its weight. The mast was raked and stood slightly forward of midship. The *mtepe* carried a square matting sail from *miyaa*, the fiber of the *doum* (or *mkoma*) palm. The sail was stretched over two yards, one on the top and one on the bottom, and tied with a halyard, sheets, and braces (Lydekker, 1919: 90; Prins, 1982: 89).

The reconstruction of the *mtepe* was completed in December 2003, and the boat was given a traditional name *Shungwaya*, after the mythical ancestral homeland of the Northeast Bantu-speaking people from an area of today's Somalia (see Morton, 1972). Although the museum leadership was not convinced it should be launched and tested, the boat was ultimately put into the sea for a trial. Sheriff made an argument that part of the research program and reconstruction was to demonstrate that this vessel was functional and somewhat seaworthy. The *mtepe* was finally launched inside a protected harbor in February 2004 (Fig. 11). Unfortunately, the trial was very brief and provided no conclusive answers to assess the boat's sailing capabilities or performance. In the opinion of Sheriff, this was a missed opportunity that could have turned into a much larger research program related to sailing the *mtepe* on the open ocean (A. Sheriff pers. comm., July 3, 2023). However, the museum leadership did not support such a program. After all, the boat was not built as a true working vessel, but rather as a research reconstruction for a museum exhibit. After what could be defined as a sea demonstration, the *mtepe* was lifted out of the water and prepared for transport. With a bit of engineering ingenuity, it was placed at the center of the exhibition in the House of Wonders.

Fig. 11 Mtepe reconstruction named *Shungwaya* being launched. Modified after the House of Wonders and Zanzibar National Museum of History and Culture (2004)

Documentation and Analyses

In 2023, while conducting a collaborative project related to nautical ethnography and archaeology of the Swahili Coast, the authors reviewed the data related to the reconstruction of *Shungwaya*. This initial assessment turned into recording and documenting the construction features and design methods of this vessel and led to a separate research project (Fig. 12). Although the boat was built as a research reconstruction and museum model, the available materials provided ample evidence to better understand and expand on what has been known and published about this reconstruction, and by extension on the *mtepe*-type boats, so far. After reviewing a few key measurements, it became clear that the Zanzibar *mtepe* was built using an imperial measurement system. This was evident in the scantling of all the timbers and fasteners. As such, the *Shungwaya* was recorded by the authors using the same system that the boat was originally envisioned and built, and then, the measurements were converted to a metric equivalent for ease of comparison.

The Zanzibar reconstruction of the *mtepe* measured 42 ft 2 in. (12.85 m) in total length (from the sternpost to the tip of a beak-head at the stem), 10

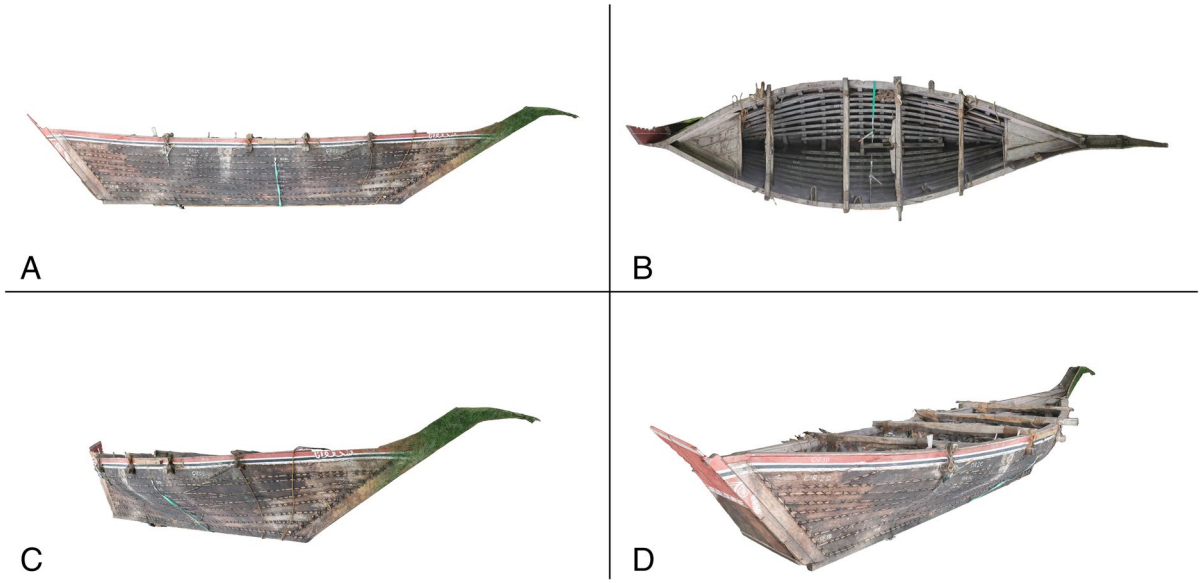

Fig. 12 Photogrammetry model of *Shungwaya* in four views. **A** starboard, **B** top, **C** starboard bow, and **D** starboard stern. Because of the wooden support cradle, the port side of the boat could not be digitally modeled. Images, P. Bojakowski; post-processing, R. Palomino Berrocal (RealityCapture® software)

ft 7–1/4 in. (3.23 m) in maximum breadth, and 5 ft (1.52 m) in depth (from the bottom of the keel to the top of the cap rails along the 9th strake). These dimensions gave a 3.98-to-1 length-to-breadth ratio (L/B), which was primarily due to the boat's elongated prow (Fig. 13). At the time of building, the *mtepe's* cargo capacity or tonnage was not calculated. During a brief sea trial, the boat's waterline was recorded at about 3 ft (0.91 m). However, this was measured without taking into consideration the

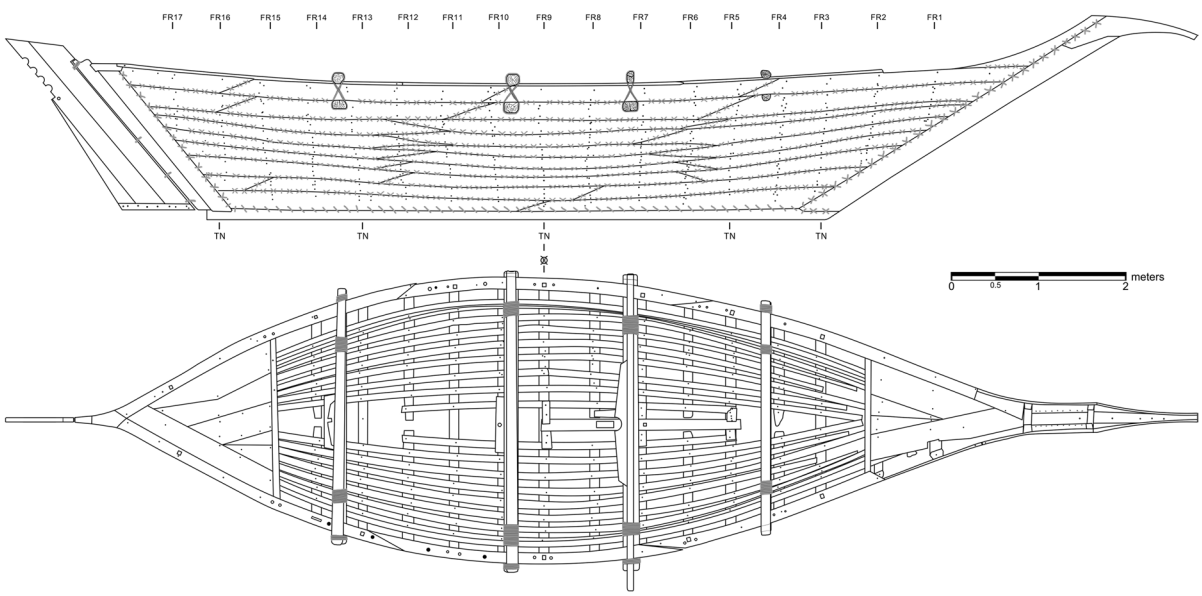

Fig. 13 Construction drawings of *Shungwaya*, starboard, and top view. Image, P. Bojakowski

maximum load capacity, which was never properly tested. Forward and aft, the boat still retained small decks covered with 1-in.-thick (25.4 mm) planks. Although the authors did not conduct any analysis of wood species, original construction records indicated that the boat was made from a range of selected wood species found on the island of Zanzibar or on mainland Tanzania known by their Swahili names: *mtondoo* (*Calophyllum inophyllum*), *muangaa* (*Afrormosia angolensis*), *mwarubaini* (or neem) (*Azadirachta indica*), and to a much lesser degree, *mkeshia* (*Acacia auriculiformis*), and *mkomafi* (*Xylocapus granmatum*). To produce over 3000 pegs, *mpera* (or guava tree, *Psidium guajava*) and *mvinje* (or whistling pine, *Casuarina equisetifolia*) were chosen. The mast was of teak (*Tectona grandis*) and the battens covering the seams between the planking consisted of *doum* palm leaves (*Hyphaene thebaica*). As evident, the combination and variety of various regional wood species was remarkable and reflected local availability, rather than a specific design. In the mind of Mr. Bwana, there were many different and equally suitable shipbuilding wood types that could provide an easy substitute for one another (A. Sheriff pers. comm., July 3, 2023).

Keel

The keel was hand-hewn from a single timber (Fig. 14). It measured 23 ft 7 and 1/2 in. (7.20 m) in length, and 5 in. (0.13 m) molded by 4 and 1/2 in. (0.11 m) sided. The top face of the keel was flat and had shallow 1/2 in. (12.7 mm) square rabbets to which the edges of the garboards were secured. At the forward and aft extremities, the top face of the keel was scarfed to accept the lower ends of the stem and sternpost. The bottom face of the keel was flat and showed evidence of five unevenly spaced treenails. These measured 1 and 1/4 in. (31.75 mm) in diameter. The treenail near the aft edge fastened the sternpost to the keel; the treenail near the forward edge fastened the stem, while the three treenails in-between fastened floor timbers from the framing stations number 5 (FR 5), 9 (FR 9), and 13 (FR 13), respectively (Fig. 15). It was likely that the function of these key frames was to support the curvature of the bottom planking before other framing elements and upper strakes could be inserted.

Stem

The stem was made of two scarfed-together timbers, the longer one forming the main stem element, while the shorter one was fashioned in the form of an angled beak-like manner reminiscent of a classic *mtepe* prow. Measured along its outboard edge, the stem was 12 ft 7 in. (3.84 m) in length. In cross-section, it was trapezoidal, measuring 4 and 1/2 in. (0.11 m) (inboard) and narrowing to 1 and 1/2 in. (0.04 m) (outboard) sided, and 10 and 1/4 in (0.26 m) molded. The very end of the beak-like stem gently curved outboard and down, narrowing to about 1 in. (25.4 mm) at the very tip. The stem showed a few small dowels along its leading outboard edge, which fastened a small apron-type timber inside. The angle between the keel and the stem was recorded at 145° (Fig. 16).

Fig. 14 Aft extremity of the keel, at the stern. Image not to scale

Fig. 15 Treenail fastening floor timber (FR 9) to the keel

Fig. 16 Scarf between the keel and the stem

Fig. 17 Sternpost and the rudder

Sternpost

The sternpost was made of a single timber measuring 6 ft 9 and 1/2 in. (2.07 m) in length. In cross-section, it was 4 and 1/2 in. (0.11 m) (inboard) narrowing to 2 and 1/2 in. (0.06 m) (outboard) sided, and 6 and 1/2 in. (0.17 m) molded, while the angle between the keel and the sternpost was recorded at 130°.

The sternpost was attached to a rudder post with five dowels spaced every 15 in. (0.38 m) apart. The rudder post was of the same overall length as the sternpost, but slightly narrower. It measured 2 and 1/2 in. (0.06 m) (inboard) narrowing to 1 and 1/4 in. (0.03 m) sided, and 5 and 1/2 in. (0.14 m) molded. The *mtepe* rudder was large, and this one measured 7 ft 8 and 1/2 in. (2.35 m) in length by 35 in. (0.89 m) in maximum width, and 3 and 1/4 in. (82.5 mm) in thickness. It was lashed directly to the rudder post with a coir rope (Fig. 17).

Garboards and Planking

Including the garboards, each side of this *mtepe* had a total of nine strakes made of flat sawn planks measuring 1 in. (25.4 mm) in thickness. On average, these were 8 and 3/4 in. (0.22 m) in width amidships expanding up to 13 and 1/2 in. (0.34 m) along some of the hooding ends. The garboards were seated in the keel rabbets and sewn to it with a coir rope through the pre-drilled holes. The stitching was done with what seemed like a continuous rope from bow to stern (Fig. 18). However, there was no indication of how this stitching was tightened.

The methods of assembly of the consecutive planks relied on careful edge joinery. The planks were adjusted and aligned with small pegs and then cross-stitched along the seams to each other and to the stem and sternpost. Shorter planks were scarfed diagonally and stitched to each other. This process was laborious and required drilling hundreds of small holes, then lacing the coir rope through them from bow to stern and then back. Once the lacing was completed, all holes in the planking, keel, stem, and sternpost were plugged from the outside with pegs; as many of the pegs were currently loose, a representative sample of pegs was retrieved and measured by the authors. These were about 3 in. (80 mm) in length and 1/2 in. (12.57 mm) in diameter of the head, while their tips narrowed to a six-sided tip (Fig. 19).

The boat had to be fully caulked before the stitching was applied. This was accomplished by loose coir fibers (in most cases in the form of a coir rope) driven into the seams and held in place by 1-in.-wide (25 mm) wooden half-round battens made from the stems of the palm leaves (Fig. 20). In addition to caulking from the outside, a few short sections of the seams along the garboards were also caulked in the same fashion from the inside. However, this double caulking did not appear to be a common practice throughout the structure. Sheriff et al., (2006, 40) reported two other layers of the caulking material that were applied by the boat-builder; however, the authors could not independently verify their composition due to poor preservation of the materials. The only visible caulking was strands of coir fiber. The fiber rope used for stitching and caulking was a three-strand twisted

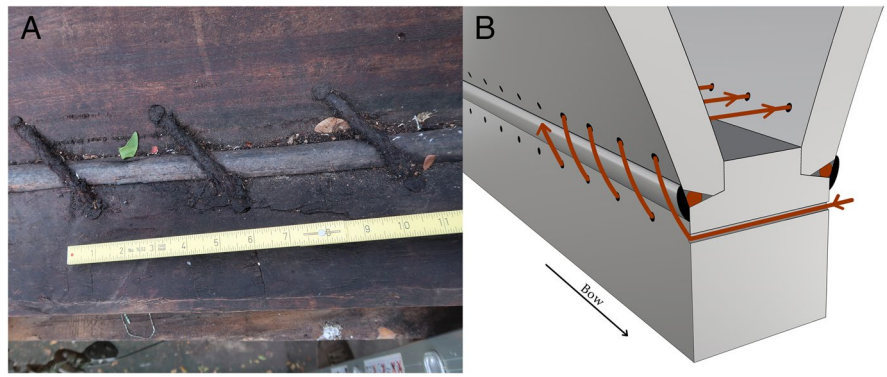

Fig. 18 Overview of the sewing pattern between the keel and the garboards. **A** photograph of the stitching along the starboard of the vessel amidships and **B** schematic overview of the pattern (Rhinoceros 3D® software)

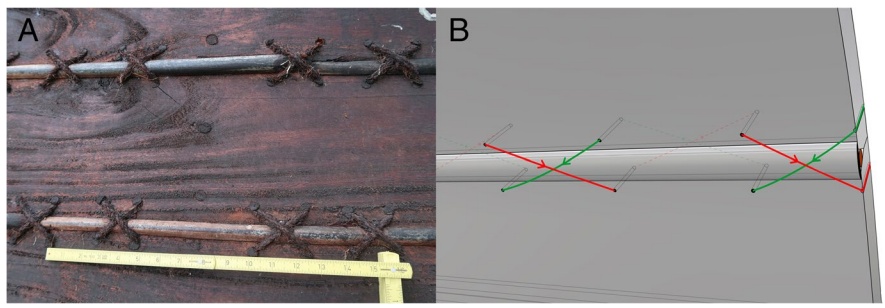

Fig. 19 Overview of the method of sewing planks. **A** photograph of the stitching between planks along one of the frames amidships and **B** schematic overview of the pattern (Rhinoceros 3D® software). Note that the rope marked as green is laced from bow to stern, while on the return run a rope marked as red is laced from stern to bow

Fig. 20 Example of the method of caulking. Note a heavy deterioration of the caulking coir fiber and battens

variety of about 3/8 in. (about 9 mm) in diameter, still hand-made in many villages in Zanzibar. This use of natural fiber coir rope required constant maintenance, resetting, and periodical replacement of the entire stitching system.

Framing

Although the construction sequence of this reconstruction model of *mtepe* was originally envisioned as shell-first, Sheriff et al., (2006, 40) reported that the boat builder's, Mr. Bwana, method was more in line with the frame-first tradition. Based on this interpretation, the authors proposed a somewhat modified approach. After reviewing the photographs and analyzing the structure of the original boat, it appeared that the first three bottom strakes must have been assembled first. These were likely held in place with some type of temporary cleats or shores. Once the bottom of the boat was outlined, the boatbuilder must have fashioned a few key floor timbers strategically placed along the bottom to support the sides. This sequence was evident from the shape and rough nature of the floor timber faces, which appeared to be fitted into the established curvature of the bottom planking, rather than the planking being bent over the pre-assembled frames. Although the floor timbers provided support, they were not the guiding

force behind the geometry of the hull. The inside of the planking showed impressions of temporary fasteners that were later removed, and the holes plugged with small treenails. The rest of the boat was finished in what seemed like a stepwise fashion by adding a few more upper strakes, a few half-frames or futtocks, and more planks higher up, while at the same time, the caulking and stitching of the seams were progressively applied on the outside, and the planks fastened to the frames. Such a construction method was reminiscent of that of local boats known as *jahazi*, among many other types, still built by the shipyards in the region (see De Leeuwe, 2004, 2005; Cooper et al., 2021).

The reconstruction of this *mtepe* had a total of 17 framing stations, which followed an alternating pattern of floor timber with two first futtocks (one on each side) and half-frames with no futtocks. One of the last frames aft, frame 16 (FR 16), also showed a floor choke (a small triangular wedge) in the narrow cavity between the garboards. However, no stern knee or deadwood was present. The room and space between the consecutive framing stations averaged 25 in. (0.63 m). The framing timbers were nicely squared off with all their inboard edges chamfered. The timbers measured between 4 and 1/2 in. and 4 and 3/4 in. (114.3 mm and 120.65 mm) sided and between 2 and 1/4 and 3 in. (57.15 mm and 76.2 mm) molded. Due to the nature of the compass timbers used for the framing, the dimensions were not consistent throughout the length of the timbers (Fig. 21).

The widest section of the boat was associated with framing station 9 (FR 9). It was composed of a floor timber with two first futtocks. This floor timber was fastened to the keel with a treenail. The widest section was located almost at the center of the keel. The distance between the widest section and the bow extremity of the keel was 3.24 m (45% of the total length of the keel), and the distance between the widest section and the stern extremity of the keel was 3.96 m (55% of the total length of the keel). When compared to the total length of the boat, the distance between the widest section and the most forward portion of the bow was 9.63 m, and the distance between the widest section and the most aft portion of the stern was 3.22 cm. In other words, the distance forward was 75% of the total length of the boat, and the distance aft was only 25%.

Amidships, the floor timbers' wrongheads did not extend beyond the level of the third strakes. The floor timbers were joined to the first futtocks via simple diagonal scarves, and then the individual futtocks extended up to the cap rails. The diagonal scarves between the floor timbers and the first futtocks were secured with treenails, which were driven through the ceiling planks. The half-frames were fashioned from the compass timbers and spanned both sides of the hull from the garboards to the cap rails. Finally, each frame was then fastened to the planking with treenails of about 1/2 in. (12.7 mm) in diameter. The number of treenails at each plank-to-frame intersection ranged from one to four per plank. It should be noted that this fastening pattern was recorded only along the starboard side of the boat on the outside. Out of all record treenails, only one was wedged from the outside while all others were unwedged.

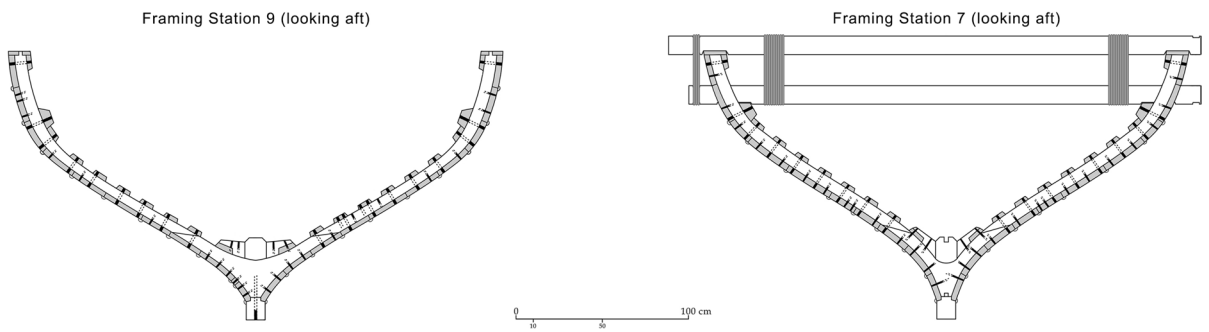

Fig. 21 Construction drawings of two of the framing stations, frame station 9 (FR9) and frame station 7 (FR7). Image, P. Bojakowski

Fig. 22 Overview of the ceiling planks, mast step, and buttresses

Ceiling, Shelf Clamps, and Mast Step

Internally, each side of the hull had eight 1-in.-thick (25.4 mm) ceiling planks. These followed an alternating pattern of 4-in.-wide (101.6 mm) boards and about 4-in. (101.6 mm) spaces (Fig. 22). Right above the uppermost ceiling plank, plank number 8, the hull was reinforced longitudinally with 2 and 1/2 in. by 2 and 1/2 in. (63.5 by 63.5 mm) square shelf clamps that provided support for the lower beams. The shelf clamps ran the entire length of the boat, from stem to sternpost. Another ceiling plank, plank number 9, was positioned directly below the caprail. All upper edges of the internal planks were chamfered. If the ceiling planks or the shelf clamps showed evidence of scarves, these were always simple diagonal joints. The internal planks were fastened to the framing with either one or two 1/2 in. (12.7 mm) in diameter treenails at each of the intersections. It was likely that some of these treenails, though not all, fastened the ceiling planks through the framing timbers to the external planking.

The boat did not have a keelson. However, there was a centrally located mast step that measured 89 in. (2.26 m) in length and 5 and 1/2 in. (139.7 mm) sided by 6 in. (152.4 mm) molded. In the center, the mast step had a small mortice to accept the foot of the mast. The mortice measured 7 and 3/4 in. (196.85 mm) by 2 and 3/4 in. (69.85 mm), and 2 and 1/4 in. (57.15 mm) in depth. Unfortunately, the mast and other rigging elements associated with this *mtepe* were not available to the authors for documentation.

The mast step was notched over the three floor timbers (FR 5, FR 7, and FR 9) and supported laterally by six small wedge-shaped buttresses. These did not exceed 7 and 1/2 in. (190.5 mm) in length and sat directly on the floor timbers. Inboard, the buttresses rested against the mast step, while their undersides had a shallow rebate that was hooked over the first ceiling planks. These planks appeared to function as a longitudinal bilge stringer. To reinforce the entire mast step assembly, the buttresses were fastened to the floor timbers and to the bilge stringer with treenails.

Beams

After the eight strakes were completed and sewn, four through-beams were installed into the notches cut along the plank's upper edges. The through-beams, which measured about 4 and 1/2 in. (114.3 mm) by 6 and 1/2 in. (165.1 mm), rested directly on the shelf clamps and reinforced the hull laterally. Then, the ninth strake was installed, and the upper sides of the boat were finished with cap rails. This provided final support for the second set of through-beams that were notched over the cap rails. As they penetrated the planking, none of the extant beam openings was caulked. However, they were securely lashed together (in four pairs) inside and outside the hull with coir rope (Fig. 23). The centrally located pair of through-beams that corresponded to the location of the mast mortice also functioned as a robust mast partner.

Fig. 23 A pair of forward through-beams lashed with coir rope. Note that the lower beam is notched over the shelf clam while the upper beam is notched over the cap rail

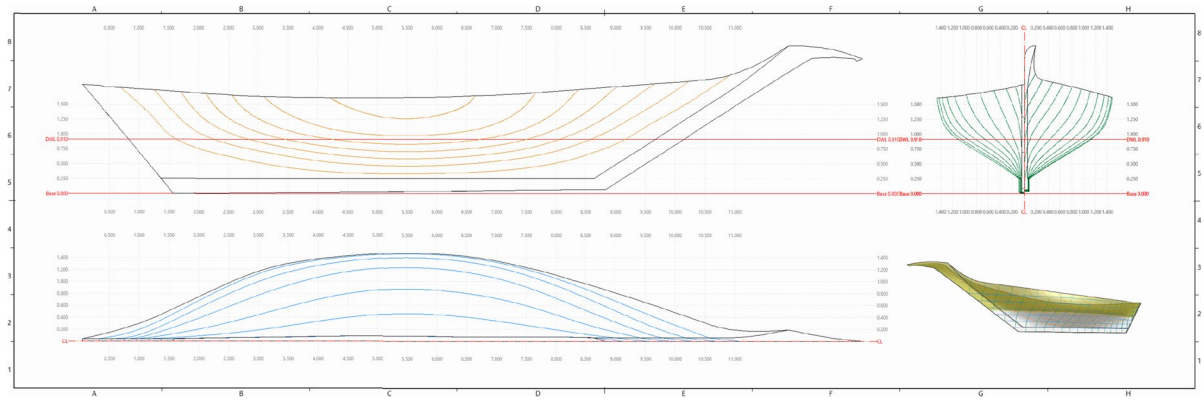

Fig. 24 Reconstructed lines of *Shungwaya* (DelftShip® software)

Hydrostatical Analysis

Once the recording was completed, the collected data was used by the authors to produce a set of ship lines and a 3D digital mesh model for hydrostatical analyses, which was essential to calculate the basic coefficients of form and relative performance of the boat using DelftShip® software package (Fig. 24). It should be noted that these analyses were considered theoretical and conducted for *Shungwaya* as built. Based on the data collected during a brief sea trial in February 2004, the draft of the fully rigged boat with 17 individuals on board and no ballast was 0.91 m. At about 80 kg per person, such a configuration was the equivalent of 1360 kg of added weight. Based on these parameters, the midship coefficient was 0.4156, which was relatively low and could be correlated with a low cargo capacity but increased geometrical efficiency of the hull in terms of potential speed. The low waterplane coefficient of 0.3542 was also related to potentially low stability, which could have been easily resolved with the correct application and distribution of future ballast and cargo. To the knowledge of the authors, no ballast was used during the test in February 2004. Finally, the low prismatic coefficient of 0.4193 and the block coefficient of 0.1742 verified that this hull had a streamlined and efficient shape. The latter parameters also supported the low midship coefficient (Parsons, 2003: 11–5; Tupper, 2004: 37). As for the displacement of the hull, at the draft of 0.91 m, which could be considered light, the amount of water displaced by the boat was 6.277 m^3 or 6434 kg (Fig. 25) (Table 1). At the expense of reduced

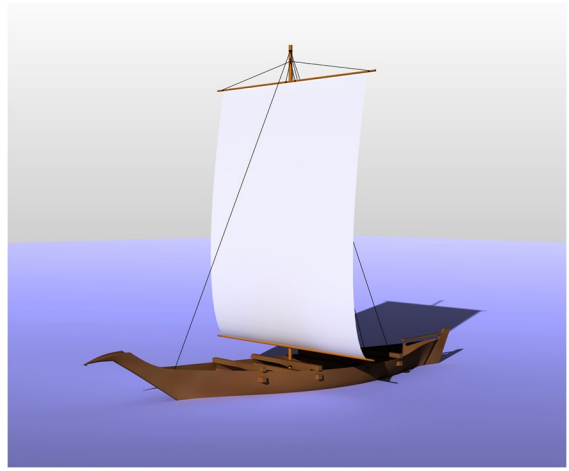

Fig. 25 3D digital model of *Shungwaya* at a draft of 0.91 m (Rhinoceros 3D® software)

Table 1 General parameters, vessel conditions, and coefficients

Vessel condition	Light displacement
Draft	0.91 m
Freeboard (midships)	0.64 m
Freeboard (to the lower beams)	0.35 m
Waterline length	9.33 m
Midship coefficient	0.4156
Waterplane coefficient	0.3542
Prismatic coefficient (Cp)	0.4193
Block coefficient (Cb)	0.1742
Wetted surface area	20.85 m^2
Displacement	6434 kg

cargo capacity and stability, at least at the tested light displacement, this reconstruction of a *mtepe* appeared to be fast and rather efficient. For future research, it would be interesting to test increased levels and various placement options of the internal ballast, which theoretically should only increase the initial stability of the vessel.

Scale Model

In addition to documenting the reconstruction of *Shungwaya*, the authors reviewed the scale model of the *mtepe* stored at the offsite museum storage facility in Dunga (Zanzibar) (Fig. 26). It should be noted that both the original full-scale reconstruction and the scale model of *mtepe* were built by the same boatbuilder, Mr. Bwana. Although models of sewn-plank vessels can be found in various museums and collections around the world and they often reveal important construction details, the one from Zanzibar appeared to be a poor representation of the original *mtepe*-type boats (see Dixon, 2019). The model was very long and narrow. It measured 2.32 m in maximum length, 0.23 m in maximum breadth, and 0.21 m in height (from the bottom of the keel to the rails). The depth inside the hull was 0.14 m. These dimensions gave it a 10-to-1 length-to-breadth ratio (L/B).

Fig. 26 Scale model of the mtepe from Zanzibar. At the time of this project, the model was stored at the offsite museum facility in Dunga (Zanzibar)

The keel was 1.37 m long and was composed of a single timber. In cross section, it measured 10 mm sided by 40 mm molded. The stem and sternpost were made of individual timbers and were both set at the same angle of 140° to the keel. Each side of the model had only four large strakes measuring 50 mm in width and 15 mm in thickness. These were sewn to the posts and to each other with a stitching pattern reminiscent of the one presented by Prins (1982, 96). This stitching pattern was different than the one used by Mr. Bwana on the original reconstruction of *Shungwaya* and perhaps indicated that both techniques were known and accepted alternative solutions (Fig. 27). The frames were also lashed to the planking and fastened with small treenails. The model was finished with four pairs of through-beams, a short deck forward, no deck aft, and a small hut aft. It carried a large mast about 1.3 m in length and a square matting sail, which measured 0.98 by 0.81 m (0.81 m was also the total length of the spar).

Conclusion

Nearly a hundred years after the last recorded use of these watercraft of the Swahili Coast, the knowledge of sewn-plank *mtepe* and its construction methods have effectively faded from living memory. Following the narrative of loss and recovery, the main goal behind the *Shungwaya* was to use thorough academic research to reconstruct a *mtepe*-type boat as part of

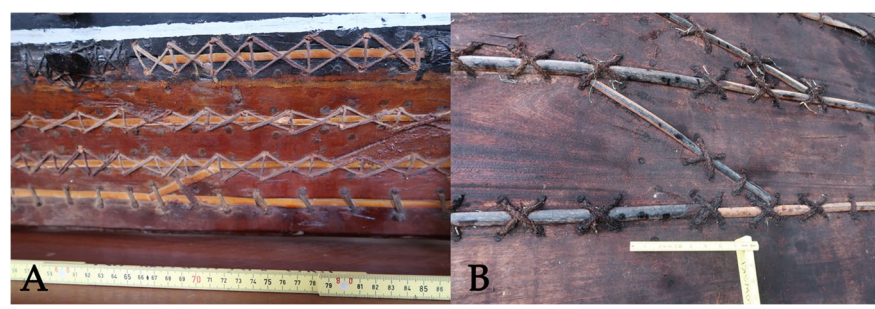

Fig. 27 Details of the sewing pattern of the mtepe scale model from Zanzibar (**A**) and of the original *Shungwaya* (**B**)

an educational exhibit at the House of Wonders, in Zanzibar (Sawyer, 2013: 248). Mr. Bwana, the boat-builder from Lamu, the last known home of these boats, offered his expertise, personal perspective, and traditional knowledge. That agency was symbolic as Mr. Bwana learned the craft from his grandfather, one of the last builders of such boat types. In the process, he demonstrated a remarkable insight into the original construction of the sewn-plank boats and into modern adaptations of this ancient shipbuilding tradition.

While the original publication on the construction of the *Shungwaya* was important, it was also limited. As such, the study presented here greatly expanded the scope of the documentation and analyses of this unique research reconstruction, and by extension of the *mtepe*-type boats in general. The study provided a much-needed revision on the vessel's design and building process, geometry of the hull, analysis of the assembly methods, and use of the materials. It was also supplemented by 2D and 3D models, detailed photographs, construction drawings, and drafted lines. Because *Shungwaya's* sea trial did not produce meaningful results, the study also included a hydrostatical analysis of the hull. While the underlying focus of the research was to better understand traditional shipbuilding and the craftsmanship that goes into these complex objects, the authors used an advanced methodological approach by applying new tools and techniques (both in terms of hardware and software).

This level of recording, analysis, and the resolution of the collected data is important because the original reconstruction of the *Shungwaya* is rapidly deteriorating. Although no wooden boat is truly symmetrical, the temporary cradle system that currently supports the boat exacerbates a significant distortion of the hull along the longitudinal and transverse axes. Due to inadequate storage conditions and lack of environmental controls at its current outdoor location, the coir rope stitching is disintegrating, while the planks show extensive termite damage and loss of structural integrity. Ideally, these ship elements should be replaced, but this requires proper planning and expertise. Most of all, it requires a continuous financial commitment. Unfortunately, such a commitment is hard to secure. At present, it is not clear if this boat can ever return to the museum, even after the roof of the House of Wonders is eventually rebuilt.

Given the lack of archaeological evidence, detailed studies of reconstructions such as *Shungwaya* open new avenues in comparative academic research of *mtepe*-type boats and other vernacular shipbuilding traditions in the region. Certainty, a full-scale restoration and proper museum storage should be viewed as the most responsible curatorship, but the cost of such undertaking is often prohibitive. For many museums, decisions related to the preservation of cultural resources seems like a balancing act. The museum exhibits bring not only cultural growth but are often even more valuable for the community in terms of business potential, particularly tourism. Because museums without major exhibits are not attractive, in-depth documentation and preservation of objects like the *Shungwaya*, the last *mtepe* of the Swahili coast, should be seen as assets of immense value to the entire community that create museums, to the researchers, educators, students, tourists, and visitors alike.

Acknowledgements The authors would like to thank the House of Wonders, the Peace Memorial Museum, and the Ministry of Heritage and Tourism, Department of Museums and Antiquities in Zanzibar for the support these institutions provided to this project and a larger (ongoing) ship ethnography initiative in Zanzibar, Tanzania. In particular, the authors would like to thank Dr. Abdul Sheriff, other associated museum personnel, and local volunteers who lent their time and expertise. As per agreement with the authors, Sheriff offered an extensive oral account and a collection of published and unpublished sources related to the construction process of *Shungwaya*. The permission for the project was granted by the Ministry of Heritage and Tourism, Department of Museums and Antiquities, Zanzibar.

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Data Availability The data that support the findings of this study are available by request through J. Richard Steffy Ship Reconstruction Laboratory, Nautical Archaeology Program, Department of Anthropology, Texas A&M University.

References

Adams, R. M. (1985). Designed flexibility in a sewn boat of the western Indian Ocean. In S. McGrail & E. Kentley (Eds.), *Sewn plank boats: Archaeological and ethnographic papers based on those presented to a conference at Greenwich in November* (pp. 289–302). BAR Publishing.

Batuta, Ibn, & Bivar, A. D. H. (2000). *The travels of Ibn Baṭṭūṭa, A.D. 1325–1354*. Hakluyt Society.

Baumann, O. (1899). *Der Sansibar-Archipel: Ergebnisse einer mit Unterstützung des Vereins für Erdkunde zu Leipzig 1895/96 ausgeführten Forschungsreise*. Duncker & Humbolt.

Burton, R. F. (1872). *Zanzibar: City island and coast* (Vol. 1). Tinsley Brothers.

Casson, L. (1989). *The Periplus Maris Erythraei: Text with introduction, translation, and commentary*. Princeton University Press.

Chittick, N. (1974). *Kilwa: An islamic trading city on the East African coast*. British Institute in Eastern Africa.

Chittick, N. (1980). Sewn boats in the western Indian Ocean, and a survival in Somalia. *International Journal of Nautical Archaeology, 9*(4), 297–309.

Cooper, J. P., & Ghidoni, A. (2022). Ship graffiti at the Zanzibar Gereza (Old Fort), Stone Town, Unguja, Tanzania. *Azania: Archaeological Research in Africa, 57*(1), 90–120. https://doi.org/10.1080/0067270X.2022.2047526

Cooper, J. P., Ghidoni, A., Zazzaro, C., & Ombrato, L. (2020). Sewn boats in the Qatar Museums collection, Doha: Baggāras and kettuvallams as records of a western Indian Ocean technological tradition. *International Journal of Nautical Archaeology, 49*(2), 371–405. https://doi.org/10.1111/1095-9270.12422

Cooper, J. P., Blue, L., Ghidoni, A., & Ichumbaki, E. B. (2021). Contemporary wooden watercraft of the Zanzibar channel, Tanzania: Type and technology, continuity and innovation. *International Journal of Nautical Archaeology, 50*(2), 243–271. https://doi.org/10.1080/10572414.2021.2015913

De Leeuwe, R. (2005). Constructing sailing ships on the Swahili shores. *Azania: Journal of the British Institute in Eastern Africa, 40*(1), 107–113. https://doi.org/10.1080/00672700509480416

De Leeuwe, R. (2004). *Seascape and sailing ships of the Swahili shores*. Master's dissertation. University of Leiden.

Dixon, C. (2019). Models as evidence for sewn-boat traditions. *International Journal of Nautical Archaeology, 48*(2), 286–301. https://doi.org/10.1111/1095-9270.12363

Dixon, C. (2018). *Sailing the monsoon winds in miniature: Model boats as evidence for boat building technologies, cultures and collecting*. Doctoral thesis: 385. University of Southampton.

Elliot, J. A. G. (1926). A visit to the Bajun Islands: Part II. *Journal of the Royal African Society, 25*(99), 245–263.

El-Tahtawy, H. (1972). *Die Ausfuhrgüter Der Ostafrikanischen Küste Im Mittelalter Nach Zeitgenössischen Berichten Islamischer Autoren Ein Beitrag Zur Geschichte Des Afrikanischen Handels*. Verlag Notring.

Ettinghausen, R. (1962). *Arab painting*. The World Publishing Company.

Garlake, P., & Garlake, M. (1964). Early ship engravings of the East African coast. *Tanz Notes Records, 63*, 197–206.

Ghidoni, A. (2023). *Ship timbers from the Islamic sites of al-Balid and Qalhat, Oman: Sewn-plank technology in the Indian Ocean during the 10–16th centuries CE*. BAR Publishing. https://doi.org/10.30861/9781407360577

Gilbert, E. (1998). The Mtepe: Regional trade and the late survival of sewn ships in East African waters. *International Journal of Nautical Archaeology, 27*(1), 43–50.

Grottanelli, V. L. (1955). *Pescatori dell'oceano indiano: saggio etnologico preliminare sui bagiuni, bantu costieri dell'oltregiuba*. Roma, Edizione Cremonese.

Hornell, J. (1941). The sea-going Mtepe and Dau of the Lamu Archipelago. *Mariner's Mirror, 27*(1), 54–68.

Hourani, G. F. (1963). *Arab seafaring in the Indian Ocean in ancient and early medieval times*. Princeton Oriental Studies.

House of Wonders, & Zanzibar National Museum of History and Culture. (2004). *The Mtepe 'Shungwaya,' an ancient Swahili vessel, sails again* [printed poster]. Zanzibar: Bega kwa bega production.

Hughes, C., & Post, R. (2016). A GIS Approach to finding the metropolis of Rhapta. In G. Campbell (Ed.), *Early exchange between Africa and the wider Indian Ocean world* (pp. 135–155). Palgrave Macmillan.

Huntingford, G. W. B. (Ed.). (2010). *The Periplus of the Erythraean Sea, by an unknown author: With some extracts from Agatharkhides 'on the Erythraean Sea.'* Hakluyt Society. https://doi.org/10.4324/9781315554754

Kirkman, J. S. (1974). *Fort Jesus: A Portuguese fortress on the east African coast*. Clarendon Press.

Lichtenstein, A. (2020*). Iconic House of Wonders collapse leaves Zanzibaris wondering about fate of cultural heritage*. GlobalVoices. https://globalvoices.org/2020/12/28/iconic-house-of-wonders-collapse-leaves-zanzibaris-wondering-about-fate-of-cultural-heritage/#:~:text=The%20collapse%20came%20as%20a,collapse%20on%20December%2025%2C%202020. Accessed 22 Aug 2023.

Lydekker, C. J. W. (1919). 46. The 'Mtepe' Dhau of the Bajun Islands. *Man, 19*, 88–92. https://doi.org/10.2307/2840608. JSTOR.

Martin, E. B., & Martin, C. P. (1978). *Cargoes of the east*. Elm Tree Books.

Morton, R. F. (1972). The Shungwaya myth of Miji Kenda origins: A problem of late nineteenth-century Kenya coastal history. *The International Journal of African Historical Studies, 5*(3), 397–423. https://doi.org/10.2307/217092

Parsons, M. G. (2003). Chapter 11: Parametric design. In T. Lamb (Ed.), *Ship design and construction vol. 1 and 2*. (pp. 11: 15). Jersey City: Society of Naval Architects and Marine Engineers. https://www.highlightcomputer.com/NArch%20502%20%20Ship%20Design%20and%20Construction.pdf. Accessed 4 Oct 2023.

Pedersen, R. K. (2003). *The boatbuilding sequence in the Gilgamesh epic and the sewn boat relation anthropology*. Doctoral thesis. Texas A&M University.

Pedersen, R. K. (2004). Traditional Arabian watercraft and the ark of the Gilgamesh epic: interpretations and realizations. *Proceedings of the Seminar for Arabian Studies*, *34*, 231–238. http://www.jstor.org/stable/41223820. Accessed 15 Sep 2023.

Poumailloux, P. (1999). Le "Mtepe", bateau cousu des Swahili, suivi d'un glossaire technique. *Études Océan Indien, 27–28*, 227–328.

Prins, A. H. J. (1959). Uncertainties in coastal history: The Ngalawa and the Mtepe. Tanganyika. *Notes and Records, 53*, 205–213.

Prins, A. H. J. (1965). *Sailing from Lamu: A study of maritime culture in Islamic East Africa*. Van Gorcum.

Prins, A. H. J. (1982). The Mtepe of Lamu, Mombasa and the Zanzibar sea. *Paideuma Nitteilungen Zur Kulturkunde, 28*, 85–100.

Prins, A. H. J. (1986). *A handbook of sewn boats: The ethnography and archaeology of archaic plank-built craft*. Trustees of the National Maritime Museum.

Ravenstein, E. (Ed. and Trans.) (1898). *Journal of the first voyage of Vasco da Gama 1497–1498*. Translated from Portuguese. Hakluyt Society. https://ia800703.us.archive.org/15/items/worksissuedbyha00unkngoog/worksissuedbyha00unkngoog.pdf. Accessed 23 Dec 2023.

Révoil, G. (1888). Voyage chez les Benadirs, les Comalis et les Bayouns en 1882 et 1883. *La Tour Du Monde, 56*, 385–416.

Sawyer, A. (2013). Salvage stories, preserving narratives, and museum ships. *Museum and Society, 11*(3), 242–257.

Schoff, W. H. (1974). *The periplus of the Erythraean Sea: Travel and trade in the Indian Ocean by a merchant of the first century*. Oriental Books.

Sheriff, A., Abdalla, K. A., & Mshenga, A. I. (2006). The mtepe 'Shungwaya' sails again. *Ziff Journal, 3*, 35–44.

Staples, E., & Blue, L. (2019). Archaeological, historical, and ethnographic approaches to the study of sewn boats: Past, present, and future. *International Journal of Nautical Archaeology, 48*(2), 269–285. https://doi.org/10.1111/1095-9270.12361

Tupper, E. C. (2004). *Introduction to naval architecture*. Elsevier Butterworth Heinemann.

Voeltzkow, A. (1923). *Witu-Inseln und Zanzibar-Archipel.* (pp. 42–44, Abb. 18). Stuttgart: E. Schweizerbartsche.

Weisauer, E. (1976). Die genähten boote der Ostafrikanischen küste anhand von quellen des 19. und frühen 20. Jahrhunderts. *Wiener Ethnohistorische Blätter, 11*, 73–96.