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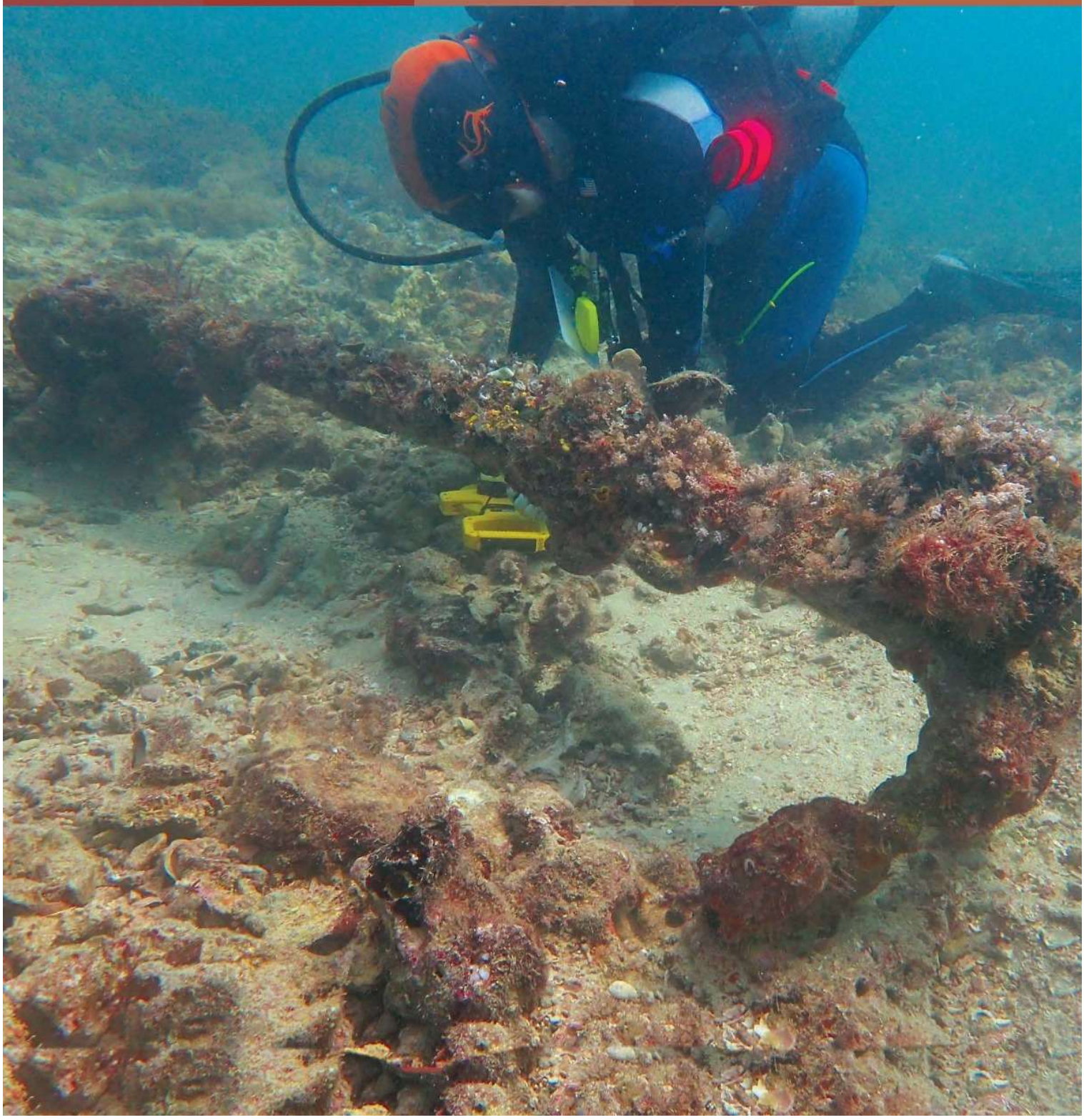

Cover photograph:

Diver investigating submerged anchor with coral outcrops at Chole, Tanzania
(Credit: Caesar Bita)

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CONTENTS

A Portuguese Shipwreck at Ngomeni, Kenya

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Based on our underwater survey off the coast of Kenya, this paper is an assessment of the Ngomeni shipwreck, its history, and its potential interest as a seminal example for the study of the history of early Portuguese ships, in particular galleons. The Ngomeni shipwreck is tentatively identified as the galleon São Jorge, part of Vasco da Gama's third Armada, lost at Malindi in 1524. The authors analyze this shipwreck find in view of the history of the early galleons, the India Route modes of commerce, and the context of its loss in the peak period of the Portuguese India Route's passage along the vibrant and cosmopolitan Swahili coast.

Starting with Vasco da Gama's voyage to India in 1497-1499, the India Route was a maritime trade route between Portugal and the Indian Subcontinent, a major development in the history of world commerce, and a pathway between cultures that had almost no previous contact.

During the reigns of Kings João-II (1481-1495) and Manuel-I (1495-1521), this maritime trade route introduced new scents, tastes, sounds, drugs, jewels, furniture, works of art, cotton and silk cloth, porcelain, and a countless number of other goods from all over Asia, but above all, it brought ideas from Asia to Europe, and vice-versa.

The Portuguese sought control over the lucrative spice trade and other commodities, such as gold and ivory, and due to this they challenged the established dominance of Arab and Indian Ocean traders in the Swahili coast. By deploying superior naval technology and establishing strategic outposts, they disrupted traditional trade networks. Key Swahili city-states like Kilwa, Mombasa, and Zanzibar became targets for Portuguese raids and subjugation. Mombasa, in particular, faced several assaults, leading to its capture in 1505 under Francisco de Almeida's expedition. The Portuguese enforced a system of tribute

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Muhtasari wa karatasi

Jarida hili ni tathmini ya meli ya Ngomeni, historia yake, na uwezekano wa maslahi yake kama mfano mzuri wa utafiti wa historia ya meli za kitambo za Ureno, hususan galoni, ikiwa kitambulisho chake cha kugunduliwa kiwe galleon São Jorge, mojawapo ya Armada ya tatu ya Vasco da Gama, na iliyopotea Malindi mnamo 1524.Waandishi wanachambua matokeo haya ya kugunduliwa kwa hii meli kwa kuzingatia historia ya galoni za awali, njia ya India na aina za biashara, na muktadha wa upotevu wake katika kipindi cha kilele cha Wareno kwenye bahari ya Hindi na katika biashara changamfu na ya kimataifa ya pwani ya Waswahili.

Sumário

Este artigo é uma avaliação do naufrágio do navio Ngomeni, da sua história e do seu potencial interesse como exemplo seminal para o estudo da história dos primeiros navios portugueses, em particular dos galeões, caso a sua identificação definitiva seja o galeão São Jorge, que fez parte da terceira Armada de Vasco da Gama e se perdeu em Melinde em 1524. Os autores analisam este achado tendo em conta a história dos primeiros galeões, as rotas e modos de comércio da Rota da Índia, e o contexto da sua perda no período de apogeu da Rota da Índia Portuguesa, bem como no vibrante e cosmopolita comércio da costa suaíli.

and established forts, including Fort Jesus in Mombasa in 1593, to consolidate control. Their dominance, however, was met with resistance and strained relations, ultimately leaving a legacy of disrupted trade and weakened Swahili city-states (Pissarra 2017).

The European oceanic expansion in the 15th and 16th centuries provoked contacts and exchanges between populations and expanded the already cosmopolitan Indian Ocean trade. Large ships, built for long voyages, made European contact with the peoples of the Indian and Pacific Oceans possible, but information is scarce regarding how these ships were designed, built, navigated, and inhabited. We also know little about how they were loaded, or how their cargo was moved around the ship as food and water were consumed along the voyages.

This paper focuses on the technological and scientific capacity required to build 16th century ships and take them to India. The process of cultural change that began with the 15th century voyages had a technical and practical foundation, developed by a competent and cosmopolitan scientific community. The Portuguese were forced to find solutions to a wide range of problems in a relatively short period of time. As noted, these challenges encompassed shipbuilding, logistics and ocean voyage management, science and cartography, navigation, and naval warfare (Madrid and Leitão 2025). The study of the Portuguese contribution to this naval trade is fundamental for the understanding of modern maritime history. The history of ship design and construction is a fundamental component of this contribution. Portuguese ships are the result of cultural contacts with northern Europe and the Mediterranean, and include structural solutions from both regions (Castro 2008).

In the 1490s, Columbus sailed to the Americas and Vasco da Gama reached the west coast of India, circumnavigating the African continent. These voyages ushered in a new era of open-ocean navigation. The ships sailing from Portugal to India evolved throughout the 16th century, but there are no technical texts until the end of the century, and both archaeology and iconography are rare and not always reliable (Castro 2008, 2012a, 2012b).

In the last quarter of the 16th century, several technical texts address the theoretical basis of Portuguese shipbuilding. Around 1600, João Baptista Lavanha used the expression "naval architecture" in the title of his manuscript on the design of a 600-ton ship designed for the India route (Lavanha 1996). These texts (Schwindinger *et al.* 2022) are useful for understanding the general design of ocean-going ships at the turn of the 16th and 17th centuries, but they are not very enlightening in what pertains to the hull structure and construction sequence, let alone the operational chain required to design and build one Indiaman.

Without a plausible model of these ships' structure, it is difficult to calculate the hull weight and assess the ship's intact stability, and even more difficult to perform any simulation that would allow us to assess the plausibility of our reconstructions (Santos *et al.* 2007, 2012; Fonseca *et al.* 2005; Castro and Fonseca 2006).

The Portuguese ships of the Asian trade routes are better known through iconography than through archaeology or technical documents. Their influence on the history of the western world was considerable, and they are part of a technological evolution that changed Europe forever (Almeida 2018; Madrid and Leitão 2025). Long-distance navigation drastically altered the European worldviews, and technological development allowed an increase in the length of voyages, creating conditions for an intensification of trade, and the circulation of people and ideas.

The work of reconstructing the *naus,* caravels, and galleons of the India route is complicated. The variations in shipbuilding between shipyards, the differences in methods and units of measurement used, the importance of the materials available for shipbuilding, matters of taste, the constant innovations, and the influences of ships from other regions in a porous and cosmopolitan environment make it difficult to detail the development of ocean-going ships in the early 16th century. Existing texts are few and appear late in the century, and archaeological remains are even scarcer. There are very few cases studied and published, and iconographical sources are the most important basis for reconstructing the evolution of ocean-going ships of the 16th and 17th centuries.

THE NGOMENI SHIPWRECK

The discovery of a 16th-century Portuguese shipwreck in Ngomeni, near Malindi, Kenya, on the Swahili coast, triggered the study of Portuguese ships. It is possible that the ship found at Ngomeni is the *São Jorge*, from

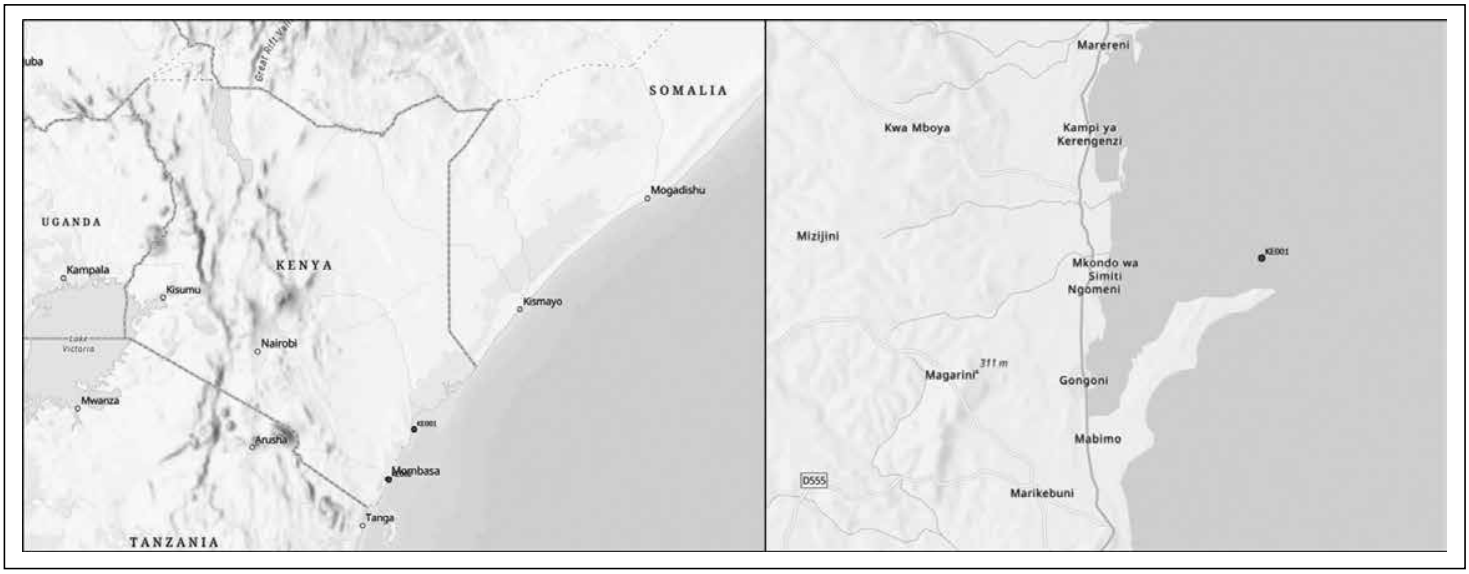

Fig. 1: Location of the Ngomeni Shipwreck (Courtesy: Filipe Castro)

Vasco da Gama's third armada, lost in 1524 enroute to India, and likely one of the earliest examples of a Portuguese galleon, a type of warship introduced by the Portuguese state from 1518 onwards (Pissarra 1999, 2017). The Ngomeni shipwreck inspired us thus to revisit existing data on the ships of this period, and to focus our research on the technological advances of the first half of the 16th century, particularly the design of better, safer, more powerful, and faster ships, such as the *naus*, galleons, and caravels.

The Ngomeni shipwreck is located off the coast of Malindi, in Kenya, near Ras Ngomeni, lying at a 6 to 7 m depth (Fig. 1). It was discovered in 2007 by local fishermen. The site was probably continuously salvaged and certainly looted in recent times. Two shipwrecks occurred in this area, making the identification difficult, at least for the time being. The first was the ship *São Jorge*, from the third Armada of Vasco da Gama, lost on its way to India, in 1524, and the second was the *nau Santa Maria da Graça*, lost in the same area in 1544.

A survey and trenching of the site were conducted by the Kenyan Government in collaboration with the Chinese government in 2013/2014, under the direction of Caesar Bita, and showed that the site occupies an area of at least 40 x 20 m (Bita 2013, 2014a, 2014b, 2015, 2018).

The 2013 trench covered a 5 x 5 m area, which revealed a relatively well-preserved hull structure and a number of diagnostic artifacts. The absence of large amounts of artifacts is also consistent with a loss that was not catastrophic nor at a high energy surf zone. The ship was salvaged after running aground, and probably salvaged in the following years by the local population, as it broke down during the natural site formation process. The timbers exposed in

2013 were important enough to justify the start of the excavation in this area, which included a section of the ship's structure with floor timbers approximately 25 cm on a side. Lead strips were also found in the planking seams, attesting to the hull caulking method typical of Portuguese ships of this period. A block, likely a halyard block, was found nearly intact (Plate 1).

The ship's condition was assessed in March 2024 (Castro *et al.* 2024), and an exploratory field season was planned for the following November, and carried out from the 2nd to the 23rd of that month. A total of 232 dives, or nearly 306 underwater hours were spent cleaning, tagging, trenching, and recording the site, which consists of a ballast mound oriented roughly NE-SW and covering an area of about 40 x 20 m. The ballast pile, formed by round stones with diameters between 15 and 30 cm, is lodged between four large boulders, and is rich in maritime fauna. Three of the boulders form a triangle, and a fourth is placed to the west of the first three. This site is a fishing spot and there are several large stone anchors apparent. There are also some millstones, and at this stage of the work it is not always easy to tell the difference between anchors and millstones because there are corals and other forms of life attached to them.

A number of large concretions is also apparent, and their study should provide insightful information for the interpretation of the site, although for the time being we do not have a functioning conservation laboratory that can store, X-ray, and identify them all.

Fig. 2: Ivory tusks from shipwreck (Photo: Caesar Bita, 2013)

Parts of the bottom of the hull can be seen under the ballast pile, in other areas, together with the typical lead straps used in the caulking arrangement in Portuguese ships.

Significant portions of the hull are preserved, both under the ballast pile and buried in the sediment. Artifacts recovered include the typical half-moon-shaped copper ingots (Plate 2), some with a mark of the German Fugger banker, large ivory tusks (Fig. 2), cinnabar, milling stones, remains of a pair of dividers, a pewter plate, a wooden bucket, some animal bones and one horn, burnt wood (probably fuel), and small copper alloy objects. A Chinese porcelain sherd (Plate 3) dating to the Hongzhi (1488-1505) or Zhengde (1506-1521) reigns was also

found, suggesting an early date for this shipwreck (personal communication with Teresa Canepa).

In March 2024, the authors visited the shipwreck site and decided to plan a first excavation season for November of that same year. During November 2024, we revisited the area surveyed by Caesar Bita in 2013/2014. The site was cleaned of nets and any other intrusive materials and part of the ballast was removed to evaluate the possibility of excavating a larger portion of the shipwreck.

First, we wanted this project to be an example of a community archaeology project, done by and for the local population. We have organized this excavation as a project of the local community, whom we consider the owners of the shipwreck for all practical purposes. An archaeological site is an organized archive and we are acting as facilitators that guide and help the community to read the site and reconstruct the possible narratives that led to its formation. The Kenyan government is planning to make an interpretation center at Ngomeni and to use the Malindi Museum as a backup institution, providing guidance and means to carry on the conservation of the artifact collection, under the professional guidance of the Mombasa staff of scientifically trained conservators. Caesar Bita and the Kenyan Navy are training a group of local inhabitants – which we call *Team Caesar* – to dive and participate in the excavation. We are operating under the principle that archaeological tourism can create opportunities for Kenya, to expand its touristic resources and allow more people to experience the beauty, the history, the culture, and the magic of Kenya.

Second, we want to make this project public. We want to share our doubts, and the things we don't know with the public and with our peers. We want to share the project with the public through a stream of publications and, where possible, to share the primary data in a website.

Third, we have created a team with computer graphics capabilities, and we want to use the Heritage Lab of the Faculty of Fine Arts, University of Lisbon (FBAUL) to establish standards for the representation and divulgation of nautical archaeology in entertaining and interesting ways.

Fourth, the maritime landscape where this shipwreck occurred has an old culture that sometimes is overlooked in European history narratives. By sailing between Europe and the Swahili coast during the 16th century, the Portuguese became part of a rich and diverse cultural world, an environment where the Mediterranean, the Atlantic, and the Indian Oceans met, and where peoples from Europe, the Middle East, Africa, and Asia, traded goods and ideas.

As the world is getting more diverse, mostly due to an increase in migration between continents, the social value of the cultural heritage is changing, together with our relationship with the environment, its

inhabitants, features, cultures, and artifacts. This century will be marked by migrations, making the planet's population mixed and diverse almost everywhere. In the cosmopolitan world where we are going to live, the significance of narratives, monuments, landscapes, traditions, and artifacts is going to vary from inhabitant to inhabitant, and archaeology will become a kaleidoscopic activity, involving as many narratives and participants as it can.

THE SITE

The ship is lodged between rocks on the margin of a small creek, located near Ras Ngomeni, the nearest village to the site. The coast is not densely inhabited and the site is not frequently visited. The coast around the shipwreck is a fossil coral reef and near Ras Ngomeni there is a mangrove. This section of the coast has changed fast in the last decades, and it is likely that its present configuration is different from the landscape Portuguese seamen encountered 500 years ago. It is difficult to interpret the documental evidence pertaining to location of these shipwrecks. After 1498, Portuguese ships visited the Swahili coast, both to trade and replenish their stores. These contacts were vital to the *Carreira da India*, the round voyage between Lisbon and the Indian subcontinent. The ships lost along this coast form an archive with important information about the chain of operations that made these voyages possible.

The Swahili coast encompasses a significant portion of the Mozambican coast, starting around Sofala, covering the coast of Tanzania and most of the Kenyan coast, all the way to Malindi and Lamu, near the border with today's Somalia. Populated by skilled merchants and sailors, this portion of the western shore of the Indian Ocean has been known for its cosmopolitan culture and rich trade. When the Portuguese arrived in the Indian Ocean, in March 1498, Vasco da Gama established relations with the Sultan of Malindi and built a pillar on its coast, which is still standing.

Malindi is an old city situated at the mouth of the Sabaki River, around 120 kms north of Mombasa in Kenya. Emerging as an important Swahili city from the 5th century onwards, Malindi became a central harbor in the 11th century, attracting merchants from Somalia, Egypt, the Arabian Peninsula, Persia and India.

In 1414, Zeng He's Chinese fleet is believed to have visited Malindi, and is said to have traded gold, silver, porcelain, and silk for ivory and live animals, including a giraffe, never before seen in China. In 1498, Vasco da Gama signed a trading treatise with the Sultan of Malindi. The visits of the Portuguese India Route ships to this coast were just a drop in the cosmopolitan relations at play in the west Indian Ocean. In the early 16th century Malindi was a cosmopolitan place with an old culture, where Arabs, Indians and merchants from all corners of Asia met and traded merchandises and ideas. The slave trade was endemic to the region and the Swahili coast of Africa was a center for

the commerce of human beings, but the Indian Ocean trade went beyond human traffic.

Portuguese ships regularly visited Malindi and José Virgilio Pissarra found records of eight of them being lost on its coast. Two were lost on the return voyage to Lisbon and may be excluded because the artifact collection would be completely different:

- In 1501, the *nau Rei* or *El-Rei*, under captain Sancho de Tovar, was part of Alvares Cabral Armada of 1500 and was lost on the east coast of Africa, possibly near Malindi. The sources place this shipwreck near Kilwa, in Tanzania, or on the Malindi coast. It is not a candidate for this shipwreck's identification, since the type of artifacts carried from Asia to Europe were markedly different from those carried by outbound ships.
- In 1594, the *nau Madre de Deus*, built in India, under captain António Teixeira de Macedo, was beached in a desert on the Malindi coast. The cargo was lost and only a part of the crew and passengers survived.

The other six shipwrecks marked as lost on the Malindi coast were outbound:

- In 1506, the *nau Nossa Senhora da Luz*, under captain João Gomes de Abreu, was part of the Armada of Tristão da Cunha and Afonso de Albuquerque, and was lost at a bay near Pate, Lamu.
- In 1524, the *nau* or galleon *São Jorge*, under captain Fernando de Monroy, in the third Armada of Vasco da Gama, which encompassed 15 ships and carried 3000 men. It was charged with ambitious and important tasks. It was lost on the shallows of Malindi, probably the area that is now Ngomeni, about 30 kms from Malindi (Bita 2013, 2015, 2018). Its cargo included 139 galley oars.
- In 1544, the *nau Santa Maria da Graça*, sailing to India in the Armada of Fernão Peres de Andrade, which was composed of five ships, with Fernão Peres de Andrade in the *nau Espera*, Luiz de Calatayud in the *nau Santo Espírito*, Jácome Tristão in *São Filipe*, Simão Peres de Andrade in *Burgalesa*, and Simão de Melo in *Graça*, which was lost at Baía Formosa, five leagues from Malindi, a description that coincides with the Ngomeni area. Both the cargo and the people were saved. Jácome Tristão was sailing to India as captain of *São Filipe* in a second attempt, after being forced to abort and return to Lisbon in the previous year.
- In 1614, the *nau Nossa Senhora de Guadalupe*, under captain João Soares Henriques, was lost on a sandbar in front of Malindi.
- In 1618, the *nau Jesus*, perhaps *Bom Jesus*, under captain João Soares Henriques, in the Armada of Cristovão de Noronha, was lost at Malindi.
- In 1619, the *nau* or galleon, *Nossa Senhora do Pópulo*, under captain Francisco de Melo, in the Armada of Francisco de Lima, was lost on the Malindi sandbar. All the cargo, artillery, and people were saved.

The two possible candidates to be the Ngomeni shipwreck are *São Jorge* (1524) and *Santa Maria da Graça* (1544). They were both grounded in shallow water and were completely salvaged, something that would explain the lack of artillery on the Ngomeni site.

Even though *São Jorge*'s type of ship – a galleon or a *nau* – has not been settled beyond doubt, the evidence available points towards it being a Portuguese galleon, a type introduced only just five years before *São Jorge's* ill-fated voyage, making it an early and rare example of one of the most significant steps in the evolution of the sailing ship.

Most India Route ships found so far were destroyed by treasure hunters. Only *Nossa Senhora dos Mártires*, sunk at the mouth of the Tagus River in 1606, near Lisbon, and *Santo António de Tana*, sunk in 1697 in front of Fort Jesus, in Mombasa, were archaeologically excavated. These two shipwrecks date to almost one and two centuries after the Ngomeni shipwreck, but *Nossa Senhora dos Mártires* was probably built in a similar way as the Ngomeni ship. What we know from the excavation of *Nossa Senhora dos Mártires* will help in the interpretation of the Ngomeni shipwreck.

Together with another three archaeological sites with hull remains found in Portugal, and dating to the early modern period, and a few timbers of another India Route *nau*, *Bom Jesus*, sunk in 1533 at Oranjemund, Namibia, these two shipwrecks are all we have so far (Castro *et al.* 2024).

Nossa Senhora dos Mártires was reconstructed and the interpretation process was also published, step by step (Castro and Fonseca 2006). We developed a hypothetical reconstruction of the hull based on the values measured on the ship remains and completed with those prescribed in Oliveira's manuscript. The sail plan was based on a text from the 17th century, in a collection of documents titled *Colecção de Vários Documentos e Papéis Régios e Administrativos Repectivos às Armadas e Expedições Marítimas*, attributed to D. António de Ataíde, and dated to *c.* 1633. The reconstruction of *Nossa Senhora dos Mártires* was then used to develop 3D models and tested in a tow tank and virtual wind tunnel, in order to assess its plausibility (Fig. 3).

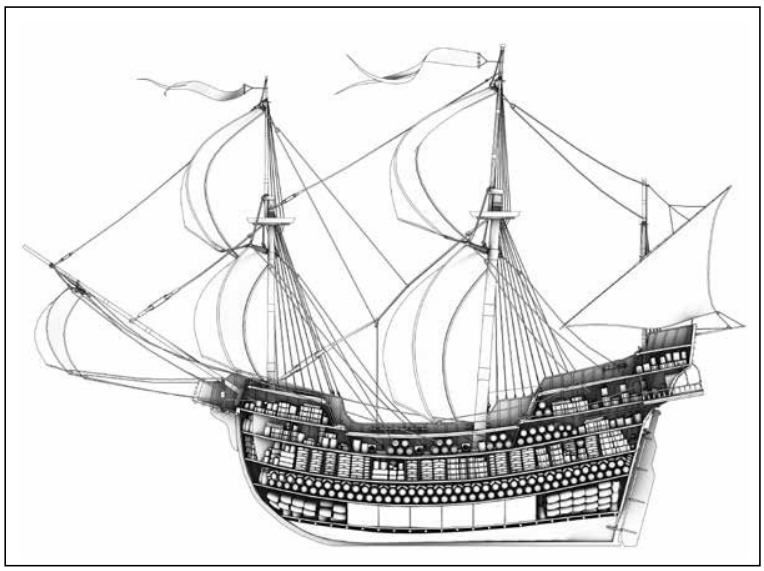

Fig. 3: Reconstruction of the nau *Nossa Senhora dos Mártires* based on the scarce hull remains and data from historical sources (Courtesy: Audrey Wells)

The recording and analysis of the Ngomeni shipwreck will follow the methodology used to reconstruct *Nossa Senhora dos Mártires*. Regardless of its identification, this wreck remains a unique testament to a ship built in the early 16th century in Portugal and represents an opportunity to study and publish a shipwreck from this period.

A small portion of the hull remains was exposed during the November 2024 campaign (Plate 4). This allowed us to measure the average dimensions of the structure, specifically the frames, which had a roughly square cross-section, 25 cm on a side, and the planking was approximately 11 cm thick. These values parallel those found on the ship *N. S. dos Mártires*, whose frames were approximately 25 cm on a side, the arms 22 cm on a side, and the planking 11 cm thick (Castro 2005).

We have tagged and measured some timbers in order to have a preliminary scantling table (Table 1). The 2025 excavation season will entail the elaboration of a site map of the timbers exposed and a timber catalogue.

Table 1: Timber Scantlings

No.	Description	Sided [cm]	Molded [cm]
1	Frame (S)	11	5
2	Frame (S)	-	18
3	Frame (S)	-	19
4	Frame (S)	-	16
5	Frame (S)	-	18
6	Frame (E)	11	18
7	Frame (E)	26	25
8	Frame (E)	15	24
9	Frame (E)	24	24
10	Frame (E)	37	22
11	Frame (E)	23	23
12	Frame (E)	24	25
13	Frame (E)	27	24
14	Frame (E)	22	24
15	Frame (E)	18	24
16	Frame (E)	11	24
17	Frame (E)	18	24
18	Plank (S)	24	11
19	Plank (S)	26	11
20	Plank (S)	34	11
21	Plank (S)	25	11
22	Plank (S)	34	11
23	Plank (S)	24	11
24	Plank (S)	25	11
25	Plank (S)	27	11
26	Plank (S)	16	11
27	Plank (S)	26	11
28	Plank (S)	19	11
29	Plank (S)	23	11
30	Plank (S)	21	11
31	Plank (S)	20	11
32	Plank (S)	20	11
33	Plank (S)	18	11
34	Plank (S)	20	11
35	Plank (S)	20	11
36	Frame (E)	17	17
37	Frame (E)	19	19
38	Frame (E)	25	15
39	Frame (E)	27	27
40	Frame (E)	19	19
41	Frame (E)	19	19
42	Frame (E)	21	21
43	Frame (E)	25	25
44	Frame (E)	25	25
45	Frame (E)	23	23
46	Frame (E)	15	12

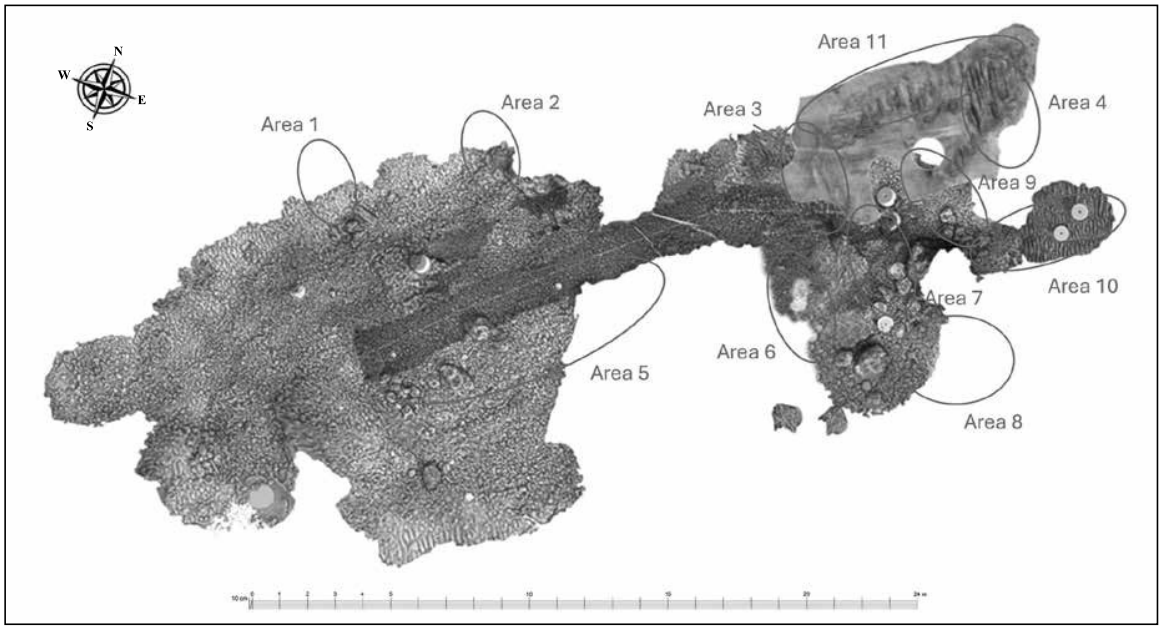

Fig. 4: Site map with the areas marked (Map: Frederico Henriques, Beatrice Frabetti and Ines Lopes)

47	Unidentified timber	29-24	?
48	Frame (S)	-	30
49	Frame (S)	-	24
50	Plank (NW)	-	11
51	Plank (NW)	38	11
52	Plank (NW)	37	11
53	Plank (NW)	32	11

We have numbered the most important concretions exposed, as well as the stone anchors and millstones. A preliminary survey yielded several finds, which were numbered sequentially, as they appeared (Fig. 4). Eleven areas were referenced with a number:

- Area 1 was a trench opened in the first days of work, where a considerable amount of ceramics were found, all broken.
- Area 2 was also a trench opened in the first phase of the work, where a considerable amount of ceramic fragments were found. It is located near concretion C4, which was moved from its original position.
- Area 3 is the SW edge of the hull portion exposed in 2024.
- Area 4 is the NE edge of the exposed hull.
- Area 5 is a stretch of 24 m between Area 6 and the SW extremity of the exposed ship remains. There were shallow and eroded timber remains in this zone. There were lead straps and string from the caulking in this area lying over the ballast, perhaps from part of the structure that collapsed over this area.
- Area 6 is the SW area of the three boulders that mark the main site.
- Area 7 is the S edge of the exposed hull.
- Area 8 is the area between the three main boulders, where several stone anchors and millstones are located.

- Area 9 is the E edge of the exposed hull.
- Area 10 is a stretch of circa 6.5 m between the northernmost millstones, numbered 1 and 2, and concretion 1.
- Area 11 is the NW edge of the hull remains.

The ballast was removed to an area north of the shipwreck, to an area that we are not planning to excavate soon. A smaller part of the ballast was placed over the existing ballast in the area referenced as zone 7, which was not planned to be excavated at this time. We plan to move it next season.

The site map was developed by Frederico Henriques, Inês Simões and Beatrice Farbetti, at the Heritage Lab of the Faculty of Fine Arts, University of Lisbon, Lisbon, Portugal, and the Bergen Maritime Museum, Bergen, Norway (Fig. 4). It was a sizable work, as we did not take pictures, due to the current and visibility conditions, but rather made videos, sometimes without the necessary overlap between lines.

The digital 3D surface mosaics are paramount to document spatial relationships between features, but they also contribute to the long-term preservation and study of the site, preserving each layer exposed. Archaeologists say that excavating is like reading a book where every layer is a page that is subsequently torn and destroyed, and the 3D photomosaic are a precious record of the excavation process. Moreover, as one of the objectives of this excavation is to make it as transparent and public as possible, the 3D photomosaic will make it easy to share the excavation process in much more detail than the traditional reports and papers. We intend to place all primary data in a public website, and invite our peers to review and criticize, helping us to keep a high standard in this project.

The artifacts collected in the 2024 field season are not part of this paper. As mentioned, two test pits – Areas 1 and 2 – were opened in separate areas around the ballast mound. The density of artifacts found was unexpectedly high, although it is early to understand the site formation process and detail the shipwreck site organization.

The hull remains were exposed in a trench of roughly 12 x 9 m, corresponding to an area of the hold that we believe to be near the central axis of the ship. The wooden structure exposed is oriented NE-SW, as the ballast pile, and lodged against three boulders. A large concretion (C2) lies over the timber structure which has protected an area of the hull against scouring. This area was not excavated in November 2024, but rather we have exposed its NE, NW, and SW edges, in the image referenced as Areas 4, 11, and 3, respectively.

The wooden structure exposed at this time consists of about 30 frame timbers, with sections around 25 x 24 cm, fastened to hull planks 11 cm thick and 15 to 35 cm wide. The fasteners seem to be all in iron, with square sections of around 14 mm on a side near the heads. In several areas remains of

a thin layer of ceiling planking, perhaps 1 cm thick, are still visible. Lead straps were nailed on the outer surface of the hull plank seams, and lead strings were introduced in between the planks.

All timbers were numbered 1→*n* sequentially, regardless of their function, and their main dimensions taken: the planks on zone 3 and the frames on zone 4. Where they had preserved their original sections, the frame timbers sections were regular, around 25 cm molded, and 24 cm sided on average, with a minimum of 22 cm and a maximum of 26 cm. The room and space were irregular, measuring from 47 to 63 cm, with an average of 52 cm. The upper surface of the frames was concave, and the deadrise grew towards the NE end. At this point it is difficult to state where in the hull this section belongs. Two sheave coaks and a section of rope were found in 2024.

THE CARGO

The artefact collection recovered so far in the excavation of the Ngomeni ship suggests an early 16th century shipwreck. Although a complete analysis of the artefact collection is not ready yet, this paper presents a very preliminary analysis of its finds. Although a few Indiamen have already been identified, mostly in the Indian Ocean, few are the ones where attention has been given to the cargo or things used on board. In most publications, artefacts are just shown in pictures and no detailed analysis has been published so far. This is for example the case of the possible *Bom Jesus* (1533) wrecked off the coast of Namibia (Werz 2015; Knabe and Noli 2012), the *São João* (1552) and the *São Bento* (1554), both off the coast of South Africa (Auret and Maggs 1982; Maggs 1984) or the Seychelles (Boudeuse Cay) Portuguese shipwreck, probably the *Santo Antonio* of 1589 (Blake and Green 1986).

Some detailed analyses such as the collection of eastern ceramics found in the *Nossa Senhora dos Mártires* (1606) in the Tagus River (Coelho 2008 unpublished; Afonso 1998), the *Nossa Senhora da Luz* (1615) wrecked in the Azores (Bettencourt 2008), or the possible *Esmeralda* (1503) wrecked off the coast of Al- Hallaniyah Island in Oman (Casimiro 2018) have been published in recent times.

This lack of detailed studies of artifacts from Portuguese India Route ships makes the study of the daily lives of people on board difficult. Historical accounts are often personal and exaggerated, betray personal agendas and local politics (Borges 2023). Therefore, the analysis of the Ngomeni collection is of utmost importance.

Ceramics are the most abundant artefacts found so far (Plate 5). The 2013 archaeological intervention yielded 263 sherds, both European and Eastern. The majority of the collection consists of unglazed redwares, and only a total of 27 green glazed sherds. Three objects have eastern origins – two Martaban and one blue on white porcelain.

The majority of the ceramics found at Ngomeni seem to have been made in Lisbon,

from where the ship seems to have left. The types recovered are consistent with an early 16th century ship and the artefact analysis seems to confirm that this is more likely a 1524 shipwreck than one from 1544. Green glazed objects correspond to one bottle base, 14 large, flared bowls and 12 objects shaped of what is usually called chamber pots (*penicos*). These last objects could have had many uses but they are mentioned in a document from 1552 when the priest António de Herédia attended to the sick and mentioned that they used these pots for some of their needs (Borges 2023). An additional record from three years later, concerning the *nau Santa Marta*, notes the priest saying that he collected the pots of the sick (Menezes 1987).

One of the objects presents a cord decoration on the putter outer surfaces, a feature that inspired medieval ceramics but disappeared at the end of the first half of the 16th century (Casimiro *et al.* forthcoming).

We do not believe that these glazed pots were used to store water since the water container ceramics are usually quite different (Casimiro and Newstead 2019). However, one of the most complete objects found in the Ngomeni ship was in fact a water drinking cup. Pottery cups to drink water were used in Portugal since at least the 13th century, an inheritance of the Islamic period. These objects are frequently recovered in shipwrecks (Casimiro 2018) and in some occasions water could be used as a reward. This was the case in 1567, onboard the *Reis Magos*. When the priest onboard was trying to teach sailors their prayers, the ones who knew how to answer the priest's questions on the tenets of faith, recite all the Ten Commandments, the *Pater Noster, Ave Maria, Credo* and *Salve Regina* could drink a cup of water (Casimiro and Borges 2023). Pots would be covered by pottery lids which are represented in this collection by three examples with their tronco-conical shape, flat base, and central knob.

Only one blue on white porcelain sherd was recovered which is consistent with a 1524 wreck. The blossom branches reveal that this was either a Hongzhi or Zhengde object. Two martaban storage jars, present brownish and dark green glazes, with beige or dark grey fabrics (Borell 2014: 257). In 1524 these stoneware containers may have started to be used as water containers. According to the description of Pyrard de Laval of his early 17th century voyages to South Asia, water was stored inside these containers (Borell 2014: 268).

Eight copper ingots were found, one of them with the Fugger mark. Thus far these had been found in the Etoile shipwreck (*c.* 1527), *Bom Jesus* (1533) and *Santo António* (1589) shipwrecks, and illustrate the global nature of the Portuguese Indian Ocean trade network, as the copper ingots are linked to the Fugger family, a prominent German banking and merchant dynasty. These ingots bear the Fugger family mark, indicating they were produced in Central Europe, likely in mines controlled by the Fugger enterprise

in the Tyrol or Slovakia (Kluger 2014). Their presence on a Portuguese ship highlights the interconnectedness of European trade networks and the integration of German industrial goods into the Portuguese trade routes extending to Africa, India, and beyond. This find exemplifies the role of European economic powers like the Fugger in supporting the Portuguese expansion by providing the necessary resources and trade goods to sustain their voyages and trading enterprises.

Several ivory tusks were found (Fig. 2). Pending DNA analysis, these are likely sourced from African elephants in regions connected to Portuguese-controlled trade routes along the Western African coast, as it happened with the *Bom Jesus* ivory, proven by DNA analysis (De Flamingh *et al.* 2021). The tusks were valuable commodities, primarily destined for European and Asian markets, where they were crafted into luxury items such as carvings, religious artefacts, and furniture inlays. In Asia, ivory was also prized in places like India and China, making it a lucrative trade item for Portuguese merchants. These ivory tusks are a testimony of established commerce networks within Africa, which was a major player in the globalization of the Indian Ocean since long before the arrival of the European merchants. These goods were traded for spices and other high-value items in India and throughout Asia, completing the triangular trade circuits that defined early European global exploration and commerce.

IDENTIFICATION

The possibility that the Ngomeni ship is the *São Jorge*, one of the first Portuguese galleons is extraordinarily important, especially if the preserved wooden remains are as extensive as the surveys suggest. No other Portuguese ship type has been the subject of greater controversy regarding its origin, nature, and purpose, although the controversy is related to historiographical misunderstandings rather than any particular complexity, occlusion, or scarcity of documentation, greater than that inherent to any ancient ship type (Pissarra 2017). Indeed, as the primary Portuguese warship of the 16th and 17th centuries, the galleon is reasonably well represented in primary sources and more coherently than its relative, the armada caravel, which—curiously—has never been the subject of similar controversy, despite its unknown origins (Pissarra 1999, 2012, 2017).

São Jorge departed from Lisbon in 1524, in the Armada that took Vasco da Gama to India. This Armada, entrusted with ambitious and important tasks, included 15 ships and carried approximately 3,000 men. *São Jorge* was lost in the shallow waters of Malindi, likely in the area that is now Ngomeni, about 30 kms from Malindi (Bita 2013, 2015, 2018).

The identification alternative is no less important. The *nau Santa Maria da Graça* set sail for India in 1544, as part of Fernão Peres de Andrade's Armada, which consisted of five ships. Captain-Major Fernão Peres de Andrade was on the Espera, Luiz de Calataiud on the *Santo Espírito*, Jácome

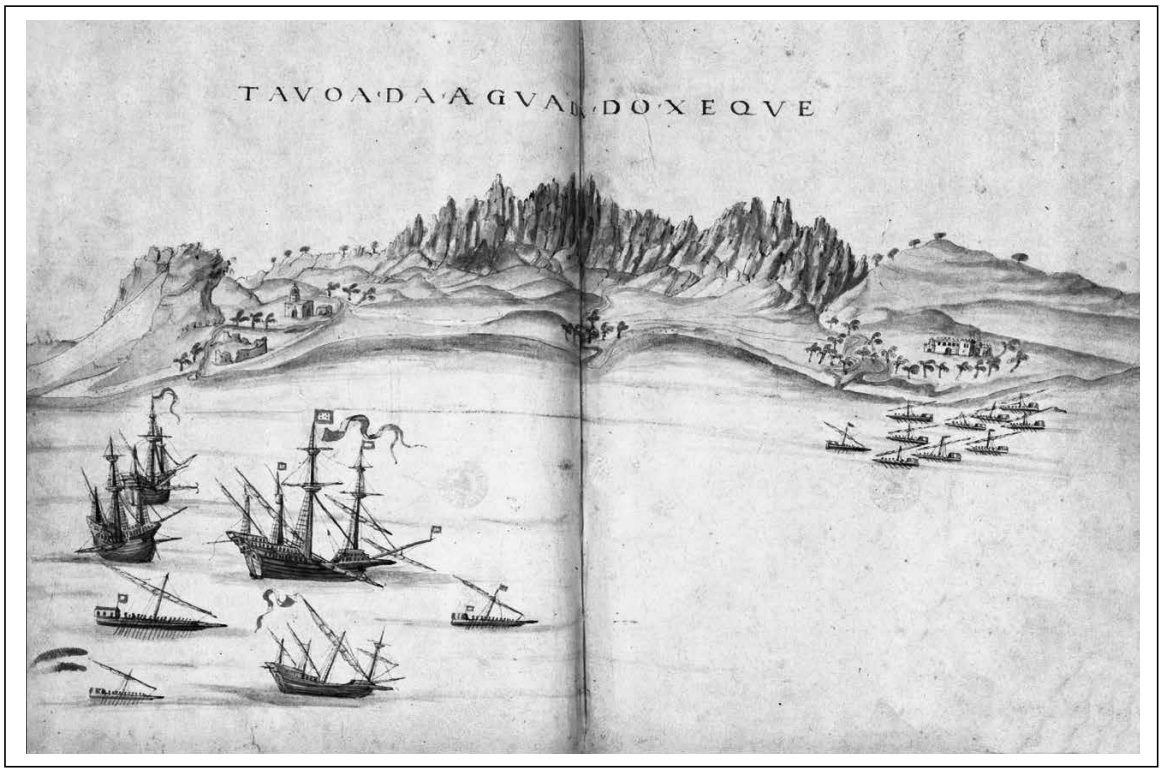

Fig. 5: Galleon, the larger ship, two naus on the left, one caravela de armada, abreast the galleon (to starboard) and several oared vessels (probably a galiot, a *fusta* and brigantine) at Aguada do Xeque (Source: Roteiro de D. João de Castro, c. 1560)

Tristão on the *São Filipe*, on a second attempt after being forced to abort and return to Lisbon the previous year, Simão Peres de Andrade on the *Burgalesa*, and Simão de Melo on the *Santa Maria da Graça* (Castro and Pissarra 2022).

GALLEONS AND NAUS

The interpretation of this shipwreck site requires that we revisit all the data on early Portuguese galleons and focus our research on the technological advances of the first half of the 16th century, in particular in the design of safer, more powerful, and faster ships, namely *naus*, galleons, and *caravelas de armada* (Fig. 5).

As galleons were not around until 1518, the possibility of this shipwreck being *São Jorge* makes it a potentially interesting discovery.

Galleons were warships designed in Portugal for the Indian Ocean, and built in Portugal and in India, from 1518 onwards. Galleon *São Jorge* is also referred in the chronicles as a *nau*, a general word for large ship, but it could have been one of the earliest galleons, and we have no plans nor descriptions to guide us through a hypothetical reconstruction.

No Portuguese galleon has been found so far, and we do not know much about their construction. There are no detailed drawings or descriptions of these ships to help us

Fig. 6: Nau, in the center, and two galleons at the conquest of Tunes (Source: Frans Hogenberg, c. 1550)

understand the iconography. Documents mention that the earliest galleons were not larger than 300 tons burden, but later iconography shows them larger than *naus* (Fig. 6).

Early galleons were not larger than 300 tons burden, but this limit was surpassed *ca.* 1530. Henceforth, their maximum burden never ceased to grow, albeit slowly, reaching impressive marks beyond the 1500 tons in the 17th century, not just in Portugal, but also within the majority of European naval powers. Yet, in Portugal, their maximum tonnage was generally inferior to the maximum tonnage of *naus,* particularly the argosies used in the India Route. A certain exception being the *Padre Eterno* of 1659, of 2000 to 2800 Portuguese tons, depending on the sources (Pissarra 2017).

The ship size should reflect on the timber scantlings, but it is impossible to say at this time. The frames of the Ngomeni ship have square sections, 25 cm on a side and the planking is 11 cm thick. There is not enough information about the early 16th century ships to allow us to propose plausible reconstructions. The available iconographic evidence suggests that the galleons built for the Mediterranean were different from those built to be deployed in the Indian Ocean. The latter did not seem to mount guns on the bow, under the bowsprit.

According to José Virgílio Pissarra, the famous engraver from Malines, Frans Hogenberg (1535-1590), published a series of engravings on the conquest of Tunes (1535), at an undetermined date, which had several editions. The engraving of the Portuguese galleon *São João* on the left (Fig. 6) is a decal of the work of Jan Cornelisz Vermeyen (c. 1504-1559), possibly executed with his direct participation.

Frans Hogenberg obtained a license from the Council of Brabant, on 26th May 1536, to print engravings on the conquest of Tunes, but his series of prints were issued much later, as they were produced from cartons that were only completed in 1550, and remained in Brussels until 1556. In the engraving of Fig. 6, we can see the two galleons that Jan Vermeyen added to the composition, on the port and starboard sides of the *nau Santa Ana,* represented in the center, although not faithfully. The galleon on the starboard side, forward of the bow of the *nau*, is a ship of modest size, but the one on the port side is a large galleon, probably the celebrated galleon of Andreia Doria, which grew considerably in size every time it was represented.

Naus were large cargo vessels. The word *nau* can designate cargo ship or sailing ship in general, and it was sometimes applied to other ship types. India Route *naus* were specially built for the voyage, and after 1570 there are a few treatises on shipbuilding that describe them and give us dimensions, although not in detail.

DISCUSSION

The Ngomeni shipwreck is a rare example of a Portuguese ship with preserved hull remains ready to be recorded and used in tentative reconstructions (Plate 4). Whether or not the shipwreck proves to be that of the galleon *São Jorge*, this find is tremendously important because the association with Vasco da Gama has an undeniable symbolic value. Either way, this shipwreck is a treasure trove for the opportunities and research avenues it opens to a wide community of scholars. We do not know much about mid-16th century Portuguese India Route shipbuilding. There is a lot to learn about *naus* and galleons, but our research questions can be organized along three avenues: the ships as inhabited machines, the modes of Portuguese commerce in the early 16th century India Route, and the cosmopolitan world of the Swahili coast as a maritime landscape and a hub of global commerce. A fourth interesting subject we would like to consider is the study of how the Portuguese saw the Swahili coasts and how they describe it.

Our project will follow a specific methodology, with three main research objectives: (i) the excavation and recording of the ship's hull remains, (ii) the artifact collection and (iii) the history of the Portuguese in the Indian Ocean.

The next steps in our research will focus on the two basic tasks, the study of the hull remains and the study of the artifact collection. As the Kenyan government

develops plans for a local museum, we are getting feedback from the local fishermen and the promises of exposing artifacts they may have found and kept from this site in a natural and ancestral process. Nautical archaeology studies the construction, life, and demise of ships, as well as the lives of their remains after being lost or abandoned. Archaeology is anthropology and as such it is concerned with our relations with artifacts, big and small, known or exotic, new or old, with practical or symbolical uses. This shipwreck belongs to the Ngomeni maritime landscape, and its story encompasses its design, construction, sailing life, demise, decomposition, and the use of its remains.

CONCLUSION

The Ngomeni ship is an extraordinary find, with enormous potential for the study of 16th century Portuguese ships, whether it was the galleon *São Jorge* or the *nau Santa Maria da Graça*. The excavation of this site is the responsibility of Museums of Kenya, co-directed by Caesar Bita and Filipe Castro, and funded by Museums of Kenya, the Sines Municipal Council, and Mr. Gary Philbrick, an American benefactor who is also part of the team.

Most of the fieldwork is the responsibility of the residents of Ngomeni, whom we consider to be the owners and best custodians of the shipwreck and the bay where it lies. This project is theirs and for them. This is a community archaeology project, carried out by the residents and framed by us and Museums of Kenya. An interpretation center is planned for the site, as well as a museum at the Malindi Museum, located next to the Vasco da Gama monument. Through this shipwreck, the history of Portugal becomes part of the history of Kenya, and one of the goals of this project is to bring the story of Vasco da Gama and the Portuguese expansion to the local population. To this end, we have already held several conferences at the Malindi Museum, which is serving as the first stop for the recovered artifacts. The conservation of the artifacts is the responsibility of the Mombasa conservation laboratory, whose expertise is internationally recognized, notably through the treatment of the collection of the Portuguese ship *Santo António de Taná*, excavated in Mombasa by the Institute of Nautical Archaeology in the 1970s. With the sponsorship of the Sines City Council, the birthplace of Vasco da Gama, we are also creating a center for the virtual reconstruction of ships at the Faculty of Fine Arts of the University of Lisbon (FBAUL), where we intend to develop a set of digital models that will allow us to improve our understanding of the ships of the Portuguese discoveries and voyages.

The study of Portuguese ships and their histories is important for the history of Europe and the world, and the media coverage of this project outside Portugal has already generated interest from the German television network ZDF and the Franco-German television network ARTE, which are producing a documentary about the life of Vasco da Gama and the shipwreck of Ngomeni. If it is possible to identify

Ngomeni's ship as Vasco da Gama's galleon *São Jorge*, the interest of this site will be even greater, as a physical artifact of the navigator's life.

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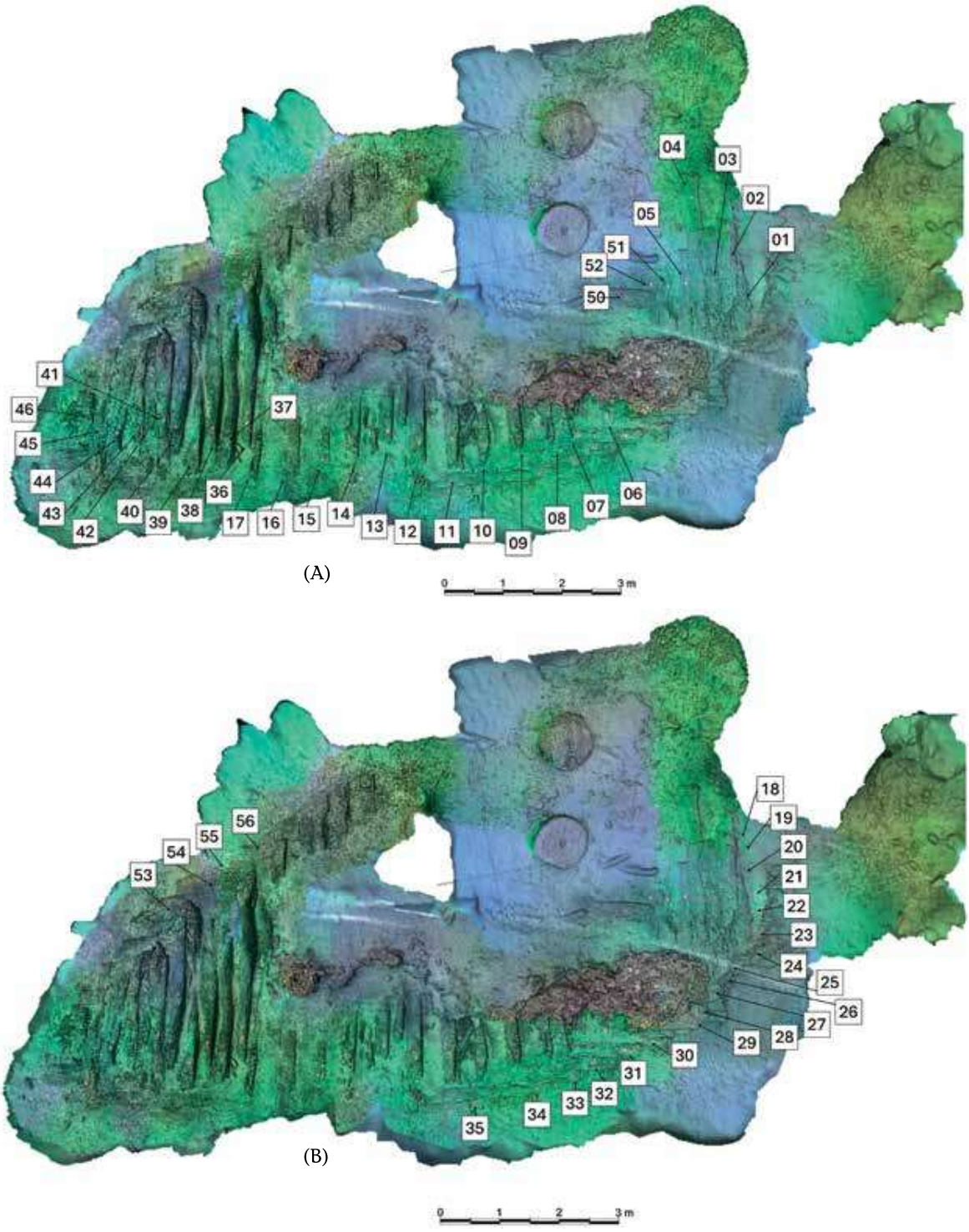
Filipe Castro *et al.*, Plate 1: The 2013 shipwreck excavation showing the portion of the hull exposed (Photo: Caesar Bita)

Filipe Castro *et al.*, Plate 2: Copper ingot from the shipwreck. The diameter is about 19 cm (Photo: Caesar Bita)

Filipe Castro *et al.*, Plate 3: Chinese Sherd from the Hongzhi (1488-1505) or Zhengde (1506-1521) reigns (Photo: Caesar Bita, 2013)



Filipe Castro *et al.*, Plate 4: Detail of the hull remains exposed in November 2024 (A) The frames and (B) The planks (Map: Beatrice Frabetti)

Filipe Castro *et al.*, Plate 5: Pot, sometimes interpreted as a chamber pot (Photo: Caesar Bita)