Shipwrecks of flat-bottom vessels used in local transport in the Gulf of Gdańsk from the 16th to the 19th century

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Abstract: Out of nearly 30 wooden shipwrecks identified and examined at the bottom of the Gulf of Gdańsk, dated back to the 15th–19th centuries, five are flat-bottom vessels presented in this article. They were used to reload goods, transport cargo between the ports within this area, or operated as an inland means of transport for timber floated down the Vistula River. The most interesting vessel is the F53.26 shipwreck, identified as the remains of the 17th-century reloading ship, discovered with its cargo of quern stones and lead ingots. The article also discusses four other flat-bottom wrecks, F53.9, F53.12, F32.9 and F53.20.

Keywords: wreck, flat-bottom, local transport, Vistula River, Gulf of Gdansk

In the waters of the Gulf of Gdańsk, we have identified and examined five wrecks constituting the remains of flat-bottomed vessels of similar shape, size, and construction details. The wrecks date back to the period between the 16th and 19th century. They all survived only in part in the form of structural bottom elements, including one with its cargo.

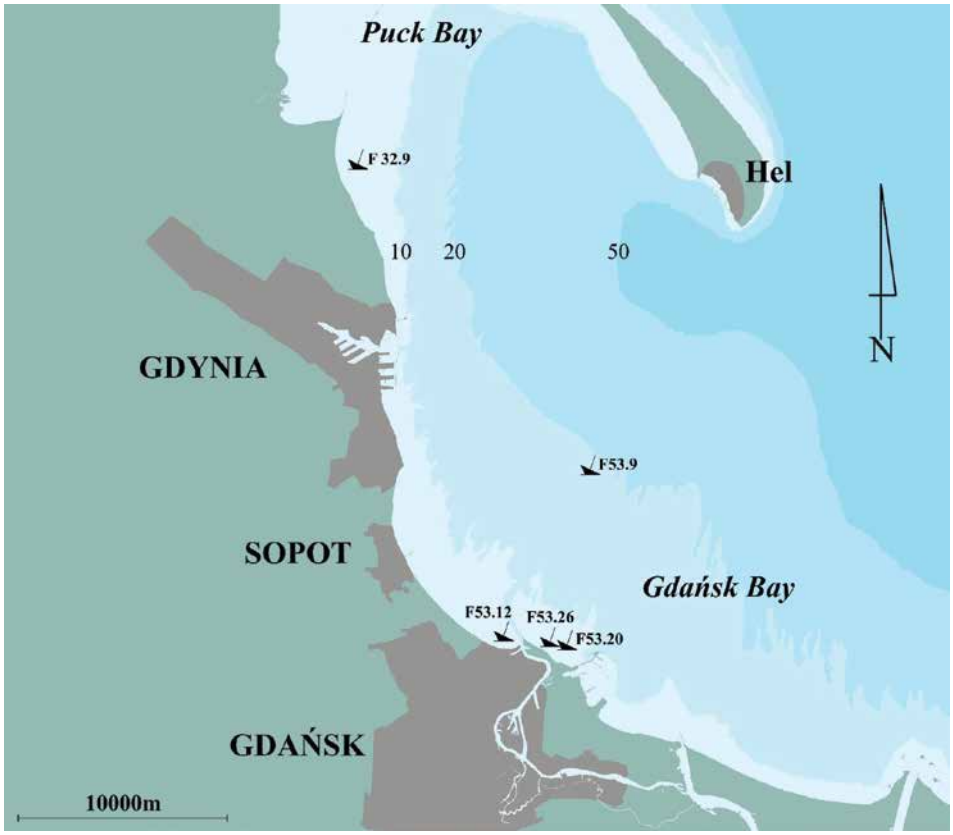

Fig. 1 Location of the wrecks F53.26, F53.20, F53.12, F53.9 and F32.9 in the Bay of Gdańsk (map: K. Treder, T. Bednarz)

Two of the discussed group of wrecks, marked as F53.26 and F53.20, were discovered in the immediate vicinity of the shore of the Gulf of Gdańsk, west of the North Port, near Westerplatte, between 2009 and 2010, at a depth of 4.5 and 5 m. This is the area of the former entrance to the port of Gdańsk, the so-called North Deep, used as one of the entrance channels until the 18th century, when it ultimately became silted and shallow (Podgórski 1998: 49). Two other wrecks are located at a similar distance from the shore and at a similar depth; the first of them, near Brzeźno, marked as F53.12 and the other, F32.9 near Mechelinki, north of Gdynia. The last, fifth wreck from this group, marked as F53.9, is the only one lying at a deeper depth of 16 meters, further away from the shore (Fig. 1).

Wreck F53.26

The most characteristic and the most interesting in terms of research potential is the wreck F53.26 „West B" discovered in September 2010 by the employees of the Maritime Office in Gdynia. The wreck lies at a depth of 4.5 m near Westerplatte at a distance of 100 m from the current coastline.

The preliminary identification of the object was conducted by archaeologists from the National Maritime Museum (NMM) in Gdańsk between 2010 and 2011. The field survey continued between 2017 and 2020, when the site inventory was performed with the use of 3D photogrammetric documentation, as part of the project Virtual Open-Air Museum of the Gdańsk Bay Shipwrecks (www.wsw.nmm.pl). In 2017, when the survey began, the wreck was completely buried in the sandy bottom. With the use of an air-operated ejector it was possible to expose the middle part of the wreck structure, 9.7 m in length and 2.9 m in width, with processed round stones discovered lying inside and in the immediate vicinity of the structure. Moreover, directly on the wooden structure, seven lead ingots were found. In 2018, the structure identification was continued, moving in a south-westerly direction to find one of the ends of the wreck. When the end of the structure was exposed, on the south-west side, a 3D model of this part of the wreck was performed. In 2019, a similar operation as the year before was conducted on the north-east side of the wreck. The 3D photogrammetric documentation developed for all the three stages of work from between 2017 and 2019 was finally combined to form one 3D model presenting the whole structure and the field of stones (Bednarz 2020: 294; Fig. 2).

Fig. 2 Photogrammetric 3D model of the F53.26 wreck in top view with the uncovering phases of the structure in 2017, 2018 and 2019 (model: T. Bednarz, K. Treder)

As for the F53.26 wreck, we identified the bottom part of a spindle-shaped flat-bottomed vessel, 14 meters in length and up to 2.35 m in width, in the bottom part. The bottom of the wreck is made of five, flat-laid massive pine staves, 10 cm thick and from 46 to 51 cm wide. In the course of the survey no thicker middle stave was detected constituting the vessel's longitudinal axis. The 50-cm-wide stave from the south-west side is rectangular at the end to match the sloping planking and the stem. The other end of the stave is destroyed. The outer sides of the bottom staves are mounted at an angle of ca. 135 to 145 degrees to match the sloping planking. The elements of the bottom part transverse reinforcement are formed with oak floor timbers, 13 to 19 cm wide and 9 to 11 cm thick, spaced every 18 to 20 cm. Some floor timbers are cut flat at an angle of ca. 140 degrees, similar to the outer bottom staves, which forms the shape of sloping sides. From the ship's sides, the floor timbers feature drain culverts. On the floor timbers there are partially preserved inner formwork staves, 30 to 45 cm wide and 3 to 4 cm thick. A 32-44 cm wide and 6-7 cm thick keelson runs through the longitudinal axis of the wreck, along the southwest – northeast direction, preserved at a length of 12.5 m, with a grooved mast step, 25 cm long, 14 cm wide and 3 cm deep. The mast step is situated 5.1 m from the end of the wreck structure on the south-west side. This is the area of the largest width of the ship's bottom, which is situated at ca. 1/3 of its total length. On both sides of the wreck's flat bottom, we can see the preserved fragments of ship's sides in the form of single oak staves. The structural elements are mounted with wooden pegs of 3.5 cm in diameter (Bednarz 2020: 296).

On the wreck structure and in its immediate vicinity there are at least 45 sandstones in the form of low cylinders, with a diameter of 40 to 140 cm in diameter and 8 to 14 cm thick. They constitute the ship's cargo which can be interpreted as semi-finished quern stones. The stone cargo protrudes to 90 cm above the keelson and takes the area of ca. 10 cubic meters, which indicates the stones total weight at ca. 25 t. Taking into account the uncovered stones lying outside the wreck, the weight of the total freight, preserved until now, can be estimated at ca. 30 to 35 t. Four samples collected from the sandstone were subject to detailed petrographic analyses. The survey conducted by Dr Wojciech Bartz of Wrocław University ruled out the possibility that the sandstone came from the Republic of Poland or Scandinavia. Regions of Germany or France were identified as the sandstone's potential origin. This information shows that the ship's cargo was imported to the port of Gdańsk from Germany or France, probably to be distributed further in Pomerania or the whole country (Bednarz 2020: 297).

The above-mentioned lead ingots in the form of oblong loaves also constitute the ship's cargo. On these treasures we can see heart-shaped maker's marks which indicate the merchant's or manufacturer's ownership, and there are from three to eight of them on each ingot. The ingots have a length of 795 to 820 mm and a weight of 57.450 kg to 62.750 kg. They most likely come from England. Lead ingots were discovered on the wreck lying in the Bay of Bengal off the eastern coast of India, some of which were similar in shape to the ingots from the F53.26 wreck. The ingots had markings, one of which was a heart motif. Some of the ingots bear the name of the manufacturer, the English company Blackett. Chemical analyzes have shown that the lead comes from the North Pennine region in Great Britain (Tripati 2015: s. 805).

A total of 14 wood samples were collected from the wreck for dendrochronological analyses. The absolute dates were identified for three oak samples and one of them contained alburnum. The tree was felled in 1632 and the ship was built shortly after that year. It was also identified that the oak wood used to build the ship came from the region of Gdańsk Pomerania (Bednarz 2020: 301).

The analysis of the boat structure and the nature of its cargo indicates that the F53.26 wreck constitutes the remains of a *bordyna*-type vessel i.e., flat-bottomed watercraft used to load or unload seagoing ships, which due to deep draught could not operate within the port of Gdańsk. These operations were performed at the roadstead by the members of *bordyna* guild, operating in Gdańsk since the mid-fifteenth century, using *bordyna* and keel boats. The written sources mention the term *burdynek, bordyna* (in German – bording), *byrding* already in the 13th century and refer inter alia to inland vessels from the Upper Vistula basin and port vessels used for reloading of goods (lighterage) and in coastal shipping (Ossowski 2012: 19).

The first wreck unambiguously identified as the remains of *bordyna*-type vessel was discovered in 2008 at Dead Vistula (Martwa Wisła). The boat was ca. 18-20 meters in length, 6.3 m in width, with 4.7-m-high sternpost. The trees to build the boat were felled in the 1720s. It was a spindle-shaped flat-bottomed boat made of seven carvel-built planks. The boat was built by the shell method or flat bottom method (Ossowski 2012: 16). This interpretation can also be applied for the construction of vessel known as the remains of F53.26 wreck, as it belongs to the same type.

Bordyna-type vessels had one mast and were additionally propelled and steered with quant poles, the so-called setting poles (Fig. 3). The boats had a flat bottom, block coefficient of the hull, large cargo hold with high coamings and narrow communication decks.

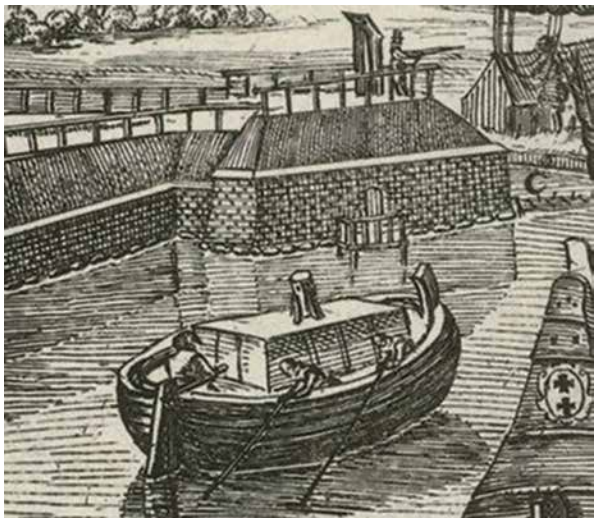

Fig. 3 Bordyna type vessel in the area of the Wisłoujście fortress on the drawing of Aedigius Dickmann from 1617. Bordina's crew moves the vessel using quant poles, the so-called setting poles (Herzog Anton Ulrich Museum).

In the 15th century in Gdańsk the reloading of goods could only be performed by the residents of Gdańsk; however, from the end of the 16th century, after obtaining the consent from the mayor of Gdańsk, non-residents of the city by the Motława River could also do it for a living. The members of bordyna guild also included the owners of seagoing vessels and granaries, who decreased the costs of service of their own vessels by investing in the transport of goods. Since 1724, in the St. John's Church in Gdańsk below the southern gallery there was the bordyna guild lodge (brotherhood). The lodge survived until modern times as the only one out of several lodges placed in this church (Bednarz 2020: 304).

Already in the 16th century, bordyna-type vessels used in the port of Gdańsk were divided into three classes by their size and capacity. The largest of them fell into class I of the capacity from 60 to 100 lasts, smaller ones fell into class II of the capacity from 30 to 60 lasts and the smallest class III of less than 30 lasts in capacity. In 1733, the mayor of Gdansk instructed the guild to build new bordyna-type vessels of the capacity up to 70 lasts. In 1765, there were 85 bordyna-type vessels and ballast boats used in Gdańsk (Matysik 1958: 107, 117).

Although in the case of the F53.26 wreck we only have a partially preserved structure, we can try to approximate the tonnage of the vessel. For this purpose, the dimensions of the unit must be determined in order to subject them to appropriate calculation methods. Length of the bottom part (keel) – 14 m, width of the bottom part 2.35 m, of which, by analogy to the Bordyna wreck from Dead Vistula (Martwa Wisła), we can indicate that the width of the unit was about 5.3– 5.5 m, and the maximum draft can be approximately point at approximately 2 m1. The above dimensions in feet2 divided by 100 with 1/3 of the value added to the result indicate the approximate tonnage of the unit (Ossowski 2012: 21). The conversion rate is as follows (48 length × 19 width × 7 maximum draft / 100) + 1/3, which gives a result of approximately 80 lasts. Comparatively using another conversion factor used to calculate the load capacity of units, where the length and width of the hull and the height of the hold in feet are divided by 2003, we get a result of about 60 lasts. As for the F53.26 wreck, its capacity can be estimated at ca. 60–80 lasts (120–160 t). This indicates that the boat belonged to class I i.e., the largest bordyna-type vessels used for reloading in the port of Gdańsk and its roadstead. On the wreck, a load with the total weight of ca. 35 t was identified, including lead ingots and stones undiscovered during the site exploration. This potentially shows that the boat was not loaded to the maximum. However, we need to remember that some part of the cargo could have been recovered after the shipwreck, which occurred near the shore at a shallow depth, or could have been scattered near the site.

The identification of the F53.26 wreck as the remains of a bordyna-type vessel allows us to assume that the cargo in the form of semi-finished quern stones and lead ingots was being transported to the port of Gdańsk after transfer from a seagoing vessel. The microscopic analysis of the stones proved that they were imported from Germany or France. The lead ingots most probably also come from outside the Republic of Poland (most likely from England), since the lightered cargo most likely came from one ship.

[1] Analogous dimensions for the *bordyna from Dead Vistula are as follows: keel length* – 16 m, width 6.3 m, maximum draft 2.2 m.

[2] For the calculations, the dimension of 1 Gdańsk foot (ft) was assumed, which is 28.69 cm.

[3] Estimated dimensions used for calculations: length between staves 58 ft, width 19 ft, height of the hold 11 ft.

Wreck F53.9

Another wreck examined by the archaeologists from the National Maritime Museum is the F53.9 wreck, a flat-bottomed vessel with inland vessel structural elements which could have been used as a lighter to transport goods within the port of Gdańsk. The wreck was discovered by a group of divers from Gdynia in September 2002 and lies at a depth of 16 m, at a distance of ca. 7 nmi north of the entrance to the port of Gdańsk. Underwater investigation of the wreck was performed in 2003, 2006 and 2015.

Fig. 4 Photogrammetric 3D model of the F53.9 wreck in the top view (model: T. Bednarz, K. Treder)

In the plan we can see the wreck as a spindle-shaped flat wooden structure, made of oak planks, 9–11 cm thick and 25 cm wide, carvel-built, with massive pine floor timbers spaced ca. every 50 cm (Fig. 4). We also identified the elbow frames mounted to the floor timbers with metal pegs and fragments of the lower strake of one of the ship's sides. The frame shape indicates that the sloping sides (ca. 120 degrees) were carvel-built, with planks from 6 to 7 cm thick. The strakes of the sides were caulked with laths, mounted in specially carved grooves in planks. The length of the wreck totals 25.6 meters, whereas its width amounts to 6.2 meters. The results of dendrochronological analysis indicated that the earliest date of the ship's construction was 1854. The wood used to build the ship came from the centre or upper Vistula River basin (Ossowski 2010: 147; Bednarz 2016: 9, Fig. 4).

Wreck F53.12

Another investigated vessel is the F53.12 wreck, the remains of a flat-bottomed vessel made of pine wood (bottom planking) and oak wood (floor timbers, ship's sides), operating most probably as a reloading ship or used in local freight shipping between the ports of the Gulf of Gdańsk. The materials used to build the ship were similar to the F53.26 wreck. The wreck was discovered in 2008 by the employees of the Maritime Office. The exploratory works of the wreck were conducted by the archaeologists of the NMM in 2009. In 2018, the museum research team performed a thorough inventory of the site.

The ship's flat bottom was made of pine planks, whereas the floor timbers and ship's sides were of oak wood. The object lies at a depth of 4 meters near Brzeźno, ca. 300 m from the shore. The longitudinal axis of the wreck is oriented along the north – south direction. The end of the wreck on the north side is buried in the sandy seabed. The ship's total length totalled ca. 24–25 m and its width ca. 7 m. The ship's structure comprises carvel-built bottom planking, 32–41 cm wide and 6–7 cm thick; 17 oak floor timbers, 11–20 cm wide and 11–15 cm high, mounted to the planking with 3 cm diameter pegs; and partially preserved fragments of oak staves, up to 18 cm wide, mounted with iron nails. The bottom planks along the length were joint on nibbed scarf. The ship was built after 1869, of wood from the north-eastern part of Poland (Bednarz 2018: 9, 22, Fig. 5).

Fig. 5 Photogrammetric 3D model of the F53.12 wreck in top view (model: T. Bednarz, K. Treder)

Wreck F32.9

Another ship within the analysed group is the F32.9 wreck, which constitutes the remains of a flat-bottomed vessel, 20–22 m long and 5 m wide, most probably used in local transport within the ports of the Gulf of Gdańsk. The wreck was discovered in 2015 by the employees of the Maritime Office. The investigation of the wreck was conducted by the archaeologists of the NMM in 2015. The underwater inventory of the wreck was performed in 2018.

The site lies at a depth of 3 m near Mechelinki, ca. 200 m from the shore. The ship was most probably built and used in the second half of the 18th century. In the absence of dendrochronological dating, the chronology was defined based on radiocarbon survey. The ship's structure comprises carvel-built oak planking, 22–8 cm wide and 7 cm thick; oak floor timbers, 26–30 cm wide and 16–20 cm high were spaced 24–32 cm apart and mounted to the bottom with 3 cm diameter pegs; and fragments of ship's sides, 25 cm high, in the form of oak staves, 3–5 cm thick. The preserved end of the bottom part on the south-east side is shaped as a wide, massive floor timber reinforcing the ship's structure and shaping the ship's sides at the stem or sternpost. The preserved fragments allowed us to identify the length of ship's bottom at 19.5 m. Several bricks which could constitute a part of the ship's cargo were discovered in the wreck and in its immediate vicinity (Bednarz 2018: 9, 22, Fig. 6).

Fig. 6 Photogrammetric 3D model of the F32.9 wreck in the top view (model: T. Bednarz, K. Treder)

Wreck F53.20

The last flat-bottomed object identified at the bottom of the Gulf of Gdańsk is the F53.20 wreck, whose structural features prove that it constitutes the remains of a no-keel inland watercraft, at least 19 m in length and ca. 5 m in width (Fig. 7). The wreck was discovered in 2010 by the employees of the Maritime Office. Underwater research of the wreck was conducted by the archaeologists of the NMM in 2010 and 2011. The underwater inventory of the wreck was performed in 2018.

The wreck is turned upside-down and lies at a depth of 5 m near Westerplatte, at a distance of 440 m from the shore and 420 m north-east of the F53.26 wreck. The wood sample dating indicates that the ship was built after 1547, and it was used most probably in the second half of the 16th century. During the survey we documented seven carvel-built oak planks, from 20 to 50 cm wide, forming the ship's flat bottom. The planks are V-shaped, chamfered for moss caulking. The caulking was clenched with wooden strips, and these were mounted to the planking with iron clamps. Oak floor timbers were made of naturally curved pieces of timber spaced every 60 cm and connected to pine staves with 3 cm diameter pine pegs.

Fig. 7 Photogrammetric 3D model of the F53.20 wreck in the top view (model: T. Bednarz, K. Treder)

Some floor timbers have drain culverts, and in one there is a rectangular opening used to mount the base of the superstructure. The place where the bottom meets the ship's side is formed by the L-shaped chine girders – grooved beams of 20 cm in height. This is proven by the cuts in curved pieces of floor timbers. The L-shaped chine girders, fitted at the same angle as floor timbers, formed the first strake of the ship's sides (Ossowski 2011: 21; Bednarz 2018: 7, 22). Figure 8 is showing 3D model of a flat-bottomed Vistula vessel. The same type like wreck F53.20.

From among 30 wooden wrecks identified and examined at the bottom of the Gulf of Gdańsk, dated to the 15th–19th centuries, the five discussed in this article are flat-bottomed vessels from the 16th–19th centuries, used to reload and transport goods between the ports of the Gulf of Gdańsk or, as in the case of the F53.20 wreck, to operate as inland means of transport to float goods down the Vistula River.

Detailed knowledge about the units discussed in the article was obtained thanks to systematic archaeological and archival research conducted in recent years by the author of this publication. This is the first synthesis of all wrecks of flat-bottomed vessels that were discovered and researched at the bottom of the Bay of Gdańsk.

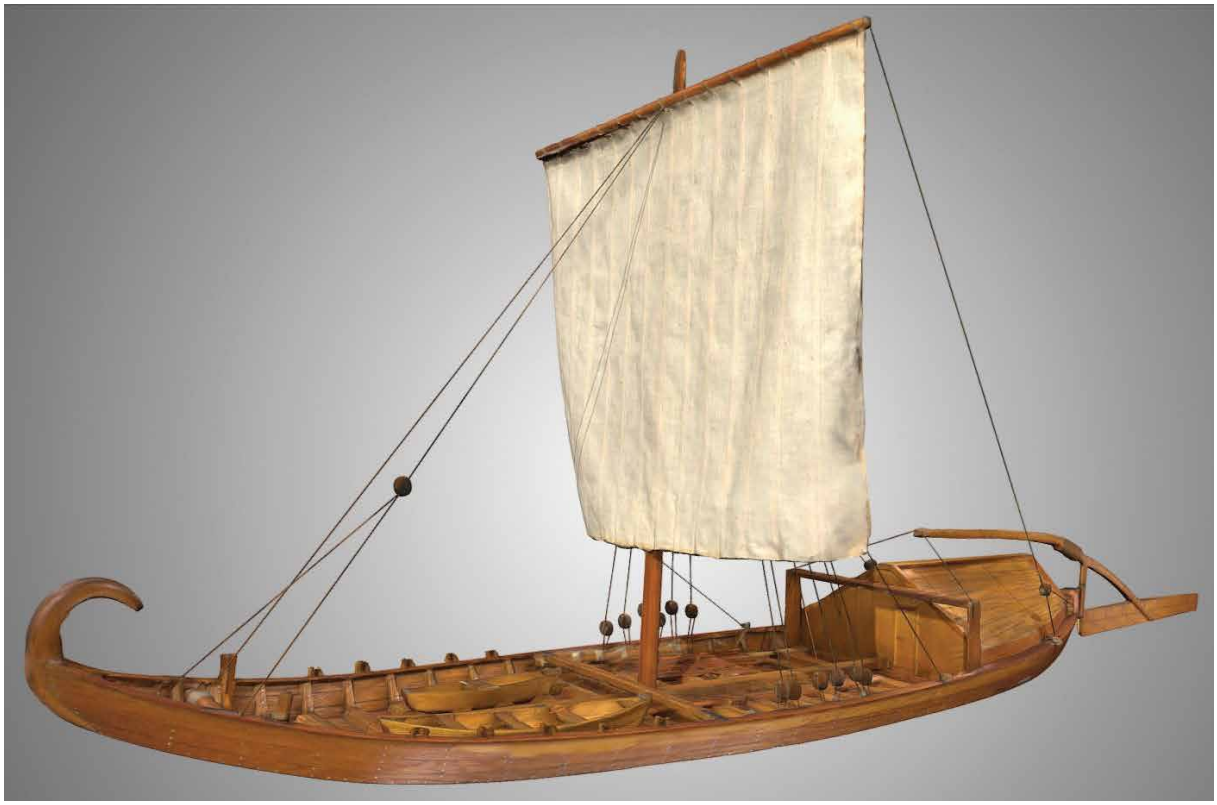

Fig. 8 3D model of a flat-bottomed Vistula vessel (model: T. Bednarz, K. Treder)

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