SHIPWRECKS OFF THE COAST OF LITHUANIA

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Abstract

The article presents the latest data on ships sunk in Lithuanian territorial waters of the Baltic Sea obtained during archaeological research conducted by the Underwater Archaeology Group of Klaipėda University. The article contains detailed descriptions of the ways these ships were wrecked as found in historical sources from the 14th to the early 20th century, the localisation of newly found remains of wooden ships, data of their study and possibilities for dating them.

Key words: shipwrecks, wooden ships, underwater archaeology, Baltic Sea, Lithuania

Introduction

Between 1989 and 2010, 11 findspots of wooden ship hulls were registered in Lithuania's coastal area, in the littoral between Būtingė and Klaipėda, as well as at sea (Fig. 1). The conditions of the ships vary considerably. In the case of some ships, only small parts of the hulls have survived. Others have been preserved in their entire length and breadth. There is also a sunken ship with cargo on board. These finds are located in very different places. Pieces of some hulls were cast ashore during storms. Others are located on beaches under the sand. Some lie in the littoral at a depth of only two or three metres. Part of one wooden ship has been used for the reinforcement of a quay. Still others lie sunken at depths of 11 to 37 metres. The hulls of the wooden ships have been found in different ways. Remnants of ships washed ashore by storms have been reported by fishermen, beach lifeguards or visitors to the beaches. Some of the shipwrecks have been detected during surveys of the shoals from a plane, from the surface of the water and under the water. Sunken ships lying at a greater depth have been detected by using side-scan sonar during explorations of the sea bed for various purposes (scientific research, applied scientific research, sea bed sounding or mine-clearing operations). Substantial information on underwater obstacles has been collected by the masters of fishing trawlers. Some of them have even compiled sea charts of underwater obstacles that pose a danger to fishing operations. Larger obstacles that pose a danger to navigation are more or less accurately marked on all sea charts; however, these are the remnants of metal-hulled vessels which sank during the modern era. A large amount of data on sunken ships in the Lithuanian littoral has been collected by the Lithuanian Sea Museum (LSM).

There is no doubt that there are many more remains of sunken and wrecked ships along the short Lithuanian coast than we know of today. As knowledge is accumulated and more sophisticated search methods are applied, more shipwrecks will surely be found. More detailed studies of ancient wooden ship hulls have only just started; therefore, there are no analytical articles yet on the remains of wooden ships in Lithuania's littoral waters. This article presents descriptions of the remains of ten wooden ships, and discusses issues pertaining to their dating and identification.

All the ships described in the article have been inspected, provisionally measured, photographed, video-recorded and registered by archaeologists from Klaipėda University's Institute of Baltic Sea Region History and Archaeology Underwater Exploration Centre (KU BRIAI PTC). Data on the ships can be found in the PTC's working Register of Shipwrecks (compiled by Vladas Žulkus).

Historical data on wrecked and sunken ships

Relations between the inhabitants of the Lithuanian coastal area and the inhabitants of the Baltic Sea islands and its western coastal areas from the sixth century AD serve as indirect albeit unquestionable evidence of navigation along the eastern shores of the Baltic Sea. Between the years 900 and 1000, there were several distant Curonian trade centres on the eastern shores of the Baltic Sea. In the 12th and 13th centuries, navigation along the east Baltic shore was already quite busy: the ships of the Scandinavian Vikings would sail across the Curonian Lagoon and up the River Nemunas, whereas Curonian pirates controlled the eastern part of the Baltic Sea and engaged in looting on the Danish and Swedish coasts (Žulkus 2004; Žulkus, Bertašius 2009). No ships that sank during the Viking period or the Middle Ages in Lithuanian waters have yet been found; therefore, much to our regret, we do not know yet what Curonian ships of the 12th and 13th centuries looked like.

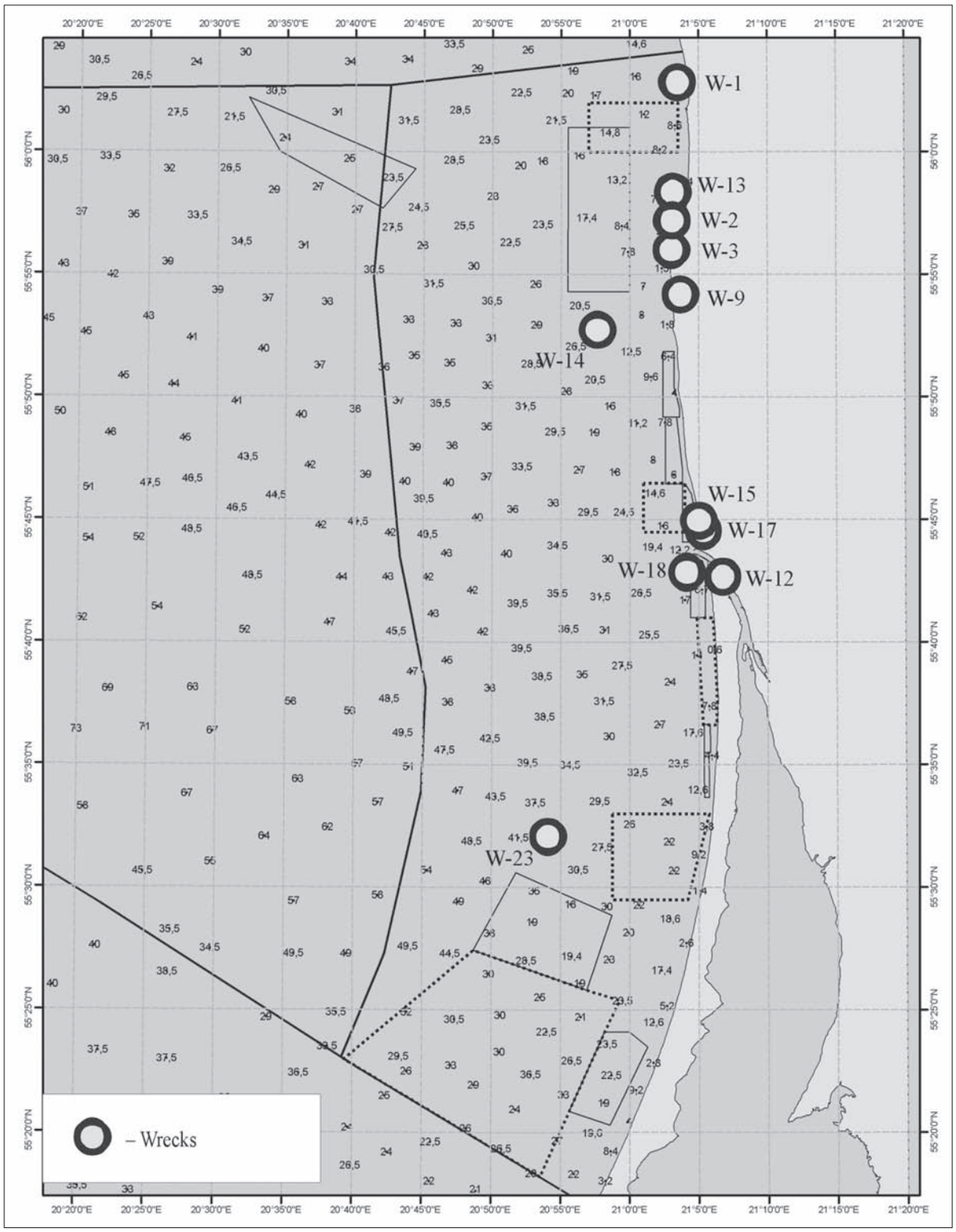

Fig. 1. The locations of ships wrecked and sunk off the Lithuanian coast (compiled by V. Žulkus).

In the times of the Vikings, the sandbanks of Lithuanian littoral waters could easily be overcome; small-draught boats would even reach the mouths of rivulets and shallow coastal lagoons. In the Late Middle Ages and in modern times, as the tonnage and draught of ships increased, shallow coastal waters became a trap for ships sailing to the ports of Klaipėda (founded by the Livonian Order in 1252) and Šventoji (Heiligen Aa); the latter reached the peak of its prosperity in the 17th century (Žulkus, Springmann 2002). The mouths of both ports were narrow and highly dangerous in westerly winds, and it is exactly these winds that prevail on the east Baltic shore. The greatest danger was posed by the storms of the autumn and winter months, and by regular hurricanes (in the coastal area, hurricanes with a wind speed of up to 35 metres per second

strike once every 20 years, on average) (Dorfman, Buzas 1966, p.68). Ships could not avoid sudden storms, because weather forecasts and storm warnings did not exist until the late 19th century; skippers had to rely exclusively on their knowledge of meteorology, experience and instincts. Only as late as 1906 was a semaphore erected at the Southern Cape in Klaipėda, and a service was set up which used mast signals to warn fishermen in the area of approaching storms (Willoweit 1969, p.311).

Although the information contained in written sources is inconsistent, there are many facts about hurricanes that devastated the Lithuanian coastal areas, as well as about ships that sank, were wrecked on coastal shoals, or which ran aground. The earliest information dates from the early 14th century.

In 1313, a mighty spring storm destroyed a flotilla of the Crusaders, which was on its way to Klaipėda (Długokęcki 1996, p.148). Another strong hurricane swept across Prussia in the winter of 1317 (Petras Dusburgietis 1985, p.269). There is a written mention of a heavy storm in October 1422, during which a ship sailing from Redin was wrecked off Palanga. The crew, 32 horses and part of the cargo were rescued (Codex epistolaris). In 1431, a ship on its way from Westerwik to Gdańsk was wrecked off Šventoji (LEK Abt. 1, Bd. 8, 393). In 1446, a storm damaged a ship from Lübeck at sea; the ship then limped to the port of Klaipėda. It was damaged so badly that its skipper, who was called Hermann Hoppner, sold it and its cargo to a Königsberg merchant (Willoweit 1969, p.144).

The early 16th century was marked by as many as three hurricanes. On 26 July 1518, a ship from Gdańsk ran aground on the Curonian Spit between Karvaičiai (Juodkrantė) and Nida (Regesta. No. 22000, 22218, 22223). Between 8 and 15 December 1518, a hurricane sank 14 ships in the coastal waters between Klaipėda and Liepaja, and two ships ran aground: one of them next to the village of Nagliai on the Curonian Spit, and the other close to Klaipėda. The latter was a Swedish ship and apparently belonged to Sten Sture.[1] A similar hurricane struck at the beginning of 1519, during which two ships ran aground at Šventoji (Regesta. No. 22000, 22218, 22223), and on 18 May another Livonian ship was wrecked at Nagliai (Regesta. No. 22282, 22464).

There are mentions of ships that were wrecked off Klaipėda or close to the port of Šventoji from the 17th century. In the autumn of 1635, a foreign (apparently Swedish) naval ship was wrecked off Palanga; five canons taken from the ship were handed over to the elder of Palanga (Kiaupa 1999, p.121). In the autumn of 1637, a hurricane washed away the church of Šventoji, which had been built in 1520, and also the peninsula on which the church had stood (Balčius 1999, p.207).

In around 1655, two naval vessels, a Swedish frigate and a Lübeck *Schute* (lighter), ran aground on the Curonian Spit. They were towed into the sea and returned to the navy of the Duke of Prussia (MD 1988.05. No. 5, p.67).

In August 1683, five ships ran aground in a storm next to Karklė near Klaipėda. One sailor drowned, but the cargo was taken ashore in boats (Consignation, 4j.143, 1–3). In 1695, a ship owned by an English trading company based in Šventoji became stuck in the shoals off Palanga; later, it was plundered by residents of Palanga (Kiaupa 1999, p.139). According to a report dated 4 November 1699, two Polish ships with passengers on board went to explore the possibilities for reopening a port in Samogitia (the port of Šventoji). One of them was wrecked just off Šventoji when it ran aground on a sandbank. Four people died (Smolarek 1966, pp.331-337). In the 18th century, the merchant port of Šventoji ceased to exist, and later shipwrecks are related mostly to Klaipėda.

On 3 November 1801, such a mighty hurricane blew that a medal was minted in Königsberg 'In commemoration of a hurricane of unseen strength and floods in Šiluva, Königsberg and Memel (Klaipėda) 3.11.1801' (Dovydenko 2004, p.57ff). The waves sank ships and destroyed the coastal defences of the port of Klaipėda at Kopgalis (Elertas 2002, p.16).

A tragic event marked the beginning of 1804 in Klaipėda. In the night of 31 January and 1 February, the English sailing ship *Guardian* ran aground off Klaipėda. During the rescue operations, during the attempt to tow it off the shoal, towards the evening a storm approached suddenly from the southwest; the anchor chains finally broke, and the ship was wrecked in the morning, lost together with the port rescuer (*Hafenmeister*) Peter Schröder and 54 sailors, fishermen and workers (Merseburg, film 5, b. 90–97; Elertas 2010, p.61). Sembritzki erroneously indicates that the ship was the *Freundschaft* (Sembritzki 1926, p.331).

From 5 to 7 April 1807, there was a sudden heavy storm. Two ships from Gdańsk with soldiers and civilians on board were lying in the harbour at Klaipėda ready to set sail for Gdańsk. One of the ships sank, and the fate of the other is unknown. Friedricht August Staegemann wrote about this in a letter from Klaipėda to his wife on 7 April 1807 (Mühlpfordt 1963).

In February 1808, nine ships ran aground in the Klaipėda area during a strong storm. Six of them were destroyed by the waves (Guillaume 1808). On 1 May

[1] Sten Sture the Younger, the Swedish regent in 1512–1520.

1829, as many as four ships ran aground at Klaipėda in strong southwesterly winds. The English sailing ships *Northelms* and *Plouman*, which had arrived from Newcastle, ran aground on a shoal at Kopgalis; the German ship *Flora* ran aground at Melnragė (ten sailors perished), and another ship, the *Henriette Auguste* from Klaipėda, ran aground not far from the *Flora* (Adomavičius 2007).

On 23 January 1849, the brig *Albertine* from Klaipėda, on her way from Liverpool with a cargo of salt on board, ran aground off Melnragė and was wrecked by the westerly wind (Adomavičius, No. 45). On 12 January 1851, at five o'clock in the morning, the barque *Urania* from Klaipėda, on her way from Lisbon to Klaipėda, ran aground off Šventoji (Heiligen Aa) during a storm coming from the west-northwest. The crew and eight rescuers drowned (Adomavičius, No. 47).

At ten o'clock in the morning of 4 November 1854, the French sailing ship *Nouveau Prosper* from Dunkerque ran aground just a few hundred yards from the entrance to the port during a terrible storm. All the crew except for one sailor were rescued.[2]

In 1858, as many as three sailing ships from Klaipėda were lost close to their home port. In the spring, on 29 March, a storm approached from the west-northwest, and the barque *Memphis* (tonnage 183 lasts, or 274.5 BRT) ran aground by the northern breakwater. On 23 November 1858, two more ships perished in another west-northwesterly storm. Both of them were wrecked on the shoals off Melnragė. The ships were the brig *Selma* of 216 lasts (324 BRT), and the schooner *Cito* of 109 lasts (163.5 BRT) (Hartmann 1978).

In the late morning of 10 November 1874, the three-masted barque *Minerva* from Klaipėda (tonnage 433 BRT), on her way from London in ballast, was cast on to a shoal next to the northern breakwater by a southwesterly hurricane. Her crew were rescued. The next day, the waves broke the ship's hull in two (Adomavičius, No. 47).

The Norwegian brig *Aurora* (built in 1808), on her way from Sønderborg (Denmark) to Klaipėda in ballast, ran aground in a storm at Nemirseta on 29 October 1876. The crew of the rescue station rescued eight people (Willoweit 1970).

On 16 October 1881, during a gale-force west-southwesterly wind, the brig *Eleonora* (*Eleonore*), built in Elbing in 1834–1835, ran aground north of Klaipėda, on the 'Russian coast' (at Palanga). This was quite a large ship (333 BRT) belonging to Klaipėda, and was carrying loose coal in baskets from Hartlepool to Klaipėda (more than 2,000 baskets were thrown into the sea). Written sources mention that the ship was built of the best oak wood (Gerdau 1978; Hartmann 1978; INK. NA. P 1.1/14).

On 21 or 22 November 1897, the 253-last (380 BRT) brig *Freundschaft*, built in 1847 in Klaipėda, at the Behrend Pieper shipyard, suffered a disaster. On the Saturday, it appeared off the cliff called Olandų kepurė (Dutchman's Hat); on the Sunday, the steamship *Von Schlieckmann* tried to tow it into the harbour, but the ship was heavily laden, and it was decided to leave her. The wind started blowing, and the ship was damaged: the sails were torn, the railings were torn off, and the hold was flooded with 2.5 feet of water. As the wind became stronger, it carried the ship into the sea, and the ship sank nearly within sight of the port. Four people died (MD 20.01.1961, No. 2; Bruno le Coutre 1969; Hartmann 1978; Adomavičius 2000). On 28 November 1897, the waves smashed up the Danish schooner *Ernst*, which had run aground by the breakwater at Melnragė, apparently during the same storm. On 18 June 1898, the German tjalk *Margaretha*, with a cargo of timber on board, ran aground off Karklė. The ship was destroyed by the waves. On 7 June 1899, the Norwegian galeas *Septime*, which was on its way from Karlshamn with a cargo of herring, was cast on to a shoal next to the southern breakwater. The ship was destroyed by the waves. On 10 May 1900, the Russian gaff schooner *Madda Sophia* capsized and sank at a distance of about two nautical miles west of Karklė. At the beginning of the 20th century, the sailing ship *Esther*, on her way from 'Russia' to Königsberg with a cargo of timber, was struck by a storm and capsized in the open sea. The hull was cast ashore still pointing upwards not far from Gaigalfluss (INK. NA. P 1.1/77). As it was told by a fisherman from Karklė, in the 1920s the hull of the ship was still visible in the water (MD 5.3.1958, No. 15).

On 20 July 1920, at a distance of 50 metres from the southern breakwater, a stormy sea destroyed a small sailing ship, the one-and-a-half-mast (*Besahnewer*) *Heinrich*, on her way from Hamburg to Klaipėda. She was being towed, but the tow rope broke (Bericht 1921, p.77ff).

It seems that the last known sailing ship to be wrecked off Klaipėda was the three-mast schooner *Else* on her way from Copenhagen to Klaipėda in ballast. On 17 January 1921 she deviated from the fairway and ran aground at Melnragė next to the northern breakwater. The hull was destroyed by the waves (INK. NA. P 1.1/77; Jaetzel 1996; MD 10.04.1956, No. 7, p. 81; MD 05.03.1958, No. 15).

[2] Notes made by Karl Dahse, the French vice-consul in Klaipėda in 1854–1855 (MD 05.06.1966. No. 11, p.147ff).

To conclude, there is information on 40 or so sailing ships cast on to the shoals off the Lithuanian coast, and on ten to 20 ships that lie on sand in coastal waters. Normally, attempts would be made to tow grounded ships and even those cast ashore back into the sea when the storm was over. This was work that required much time and effort, and which was sometimes not very successful. After a storm in 1734, ships that ran aground off East Prussia were being dug out of the sand for several years (Dovydenko 2004, p.57ff). There is no more information on the number of ships that were towed off the shoals; however, we can guess that the hulls of at least half of the ships destroyed by the waves and dismantled by people remain buried under the sand in coastal waters or on the coast. For example (as has already been mentioned), as many as six ships of the nine that ran aground off Klaipėda in February 1808 were finally destroyed by the waves (Guillaume 1808).

The possibilities for towing ships back into the sea in different locations were different. The possibilities for preserving the hulls of ancient ships are also not the same. Ten erosive, four accumulated and six stable coastal sectors can be identified on the Lithuanian coast of 99 kilometres (Žilinskas *et al.* 2004). The hulls of ancient ships which are lying in erosive beaches will be washed up more often and inevitably destroyed by the waves and by human activity. Wrecks in accumulative coastal and littoral zones are being covered more and more with sand. This impedes the search and exploration of them, but provides natural protection. Although in shallow waters, these wrecks are more affected by strong winds and swell.

Studies of wooden ships (wrecks)

WRECK 1 (W-1). The hull of an ancient ship was found in 1974 between Šventoji and Būtingė during an expedition organised by the LSM. In the summer of 1999, the ship was found for a second time by archaeologists from Klaipėda University. Later, the wreck was inspected nearly every year: in 2000, 2001, 2003, 2004 and 2005. The structure of the ship was measured, photographed and videotaped. In the summer of 2009, an exploratory search and more detailed measurings of Wreck 1 (W-1) were carried out. The ship's structures in the fore and aft of the ship were cleared under the water to a depth of up to 1.5 metres by using a water ejector. The research on Wreck 1 was part of the work within the framework of the SeaSide[3] project.

The hull of wooden Wreck 1 is at a depth of three metres, about 250 metres from the shore. It lies perpendicular to the coast, in precisely an east-west direction, listing to the starboard side. The bow is on the east. The ship is located in a coastal sector subject to erosion (Bitinas *et al.* 2004), and the formation of silt around the wreck depends largely on storms, and especially on winter gales. The monitoring of the ship's wreck in 1999 and 2009 (with some interruptions) also reflects the dynamics of the formation of the sea bed sediments (sands) in this location.

In 1999, the prow of Wreck 1 and the structures above the sea bed next to the prow came to 0.8 metres, the port side frames and the side planks came to 1.3 metres, whereas the starboard frames and the stern frames rose a mere 0.2 to 0.5 metres above the sea bed. After hurricane Anatol in the winter of 1999, the ship's sides rose above the sea bed another 40 centimetres or so. Something similar occurred in the autumn of 2003, when the ship (compared to the autumn of 2001) was cleared by another 70 centimetres. The parts to rise the highest above the sea bed were the prow and the frames and the planks of both sides (up to 1.5m). The starboard side of the wreck rose above the sea bed by up to 1.5 metres too (it came to only about 0.9m in 2001), and five side planks could be seen. In the spring of 2004, some parts of the ship's port side rose above the sea bed by as much as 1.8 metres. A large part of the sand and silt from inside the ship was washed out: the top of the keelson could be seen, the stern structure was cleared, and in the prow of the ship, ballast stones were uncovered. The exterior of the starboard side was covered up with sand, and only a part of about 40 centimetres in height was sticking out. In the summer of 2009, the ship's wreck was rising above the sandy bed by up to 1.3 metres only. The inside of the ship was covered with sand.

That is to say, due to the effect of storms, the thickness of the sandy silt around the ship varied from 0.5 metres to one metre, and differently in different places. During the research in 2009, sand from around some parts of the ship had to be sucked off twice, because even small waves of force 2 to 3 would cover up structures of the ship that had been uncovered earlier. In some parts of the exterior of the hull, there is a hard dark layer of silt about ten centimetres thick. It is believed that this layer is a cultural layer which normally forms around all sunken ships; however, neither in 2009 nor earlier were any finds found in it.

The monitoring and measuring makes it possible to claim that the hull is sunk in the sand to a depth of 1.5 metres, whereas the total height of the hull of Wreck 1

[3] The South Baltic Cross-Border Cooperation Programme 2007–2013. "SeaSide: Developing Excellent Cultural Destinations in the Southern Baltic Area".

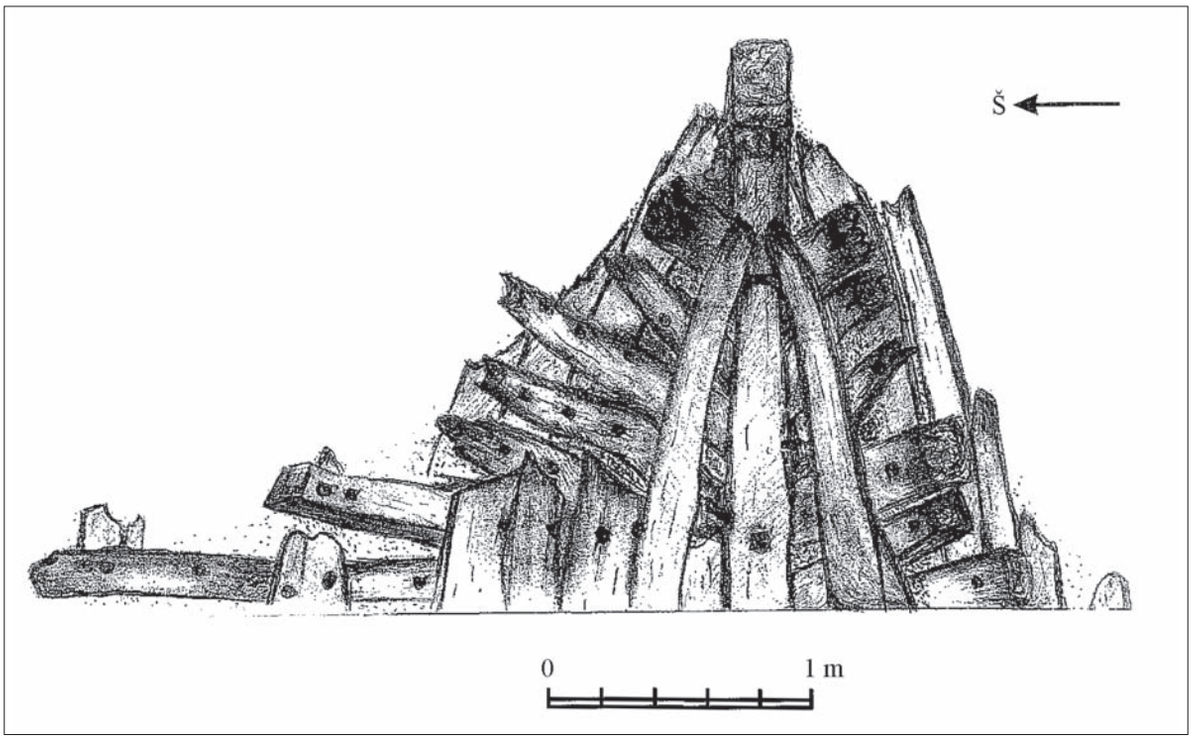

Fig. 2. A drawing of the measured fore structure of W-1 (drawn by R. Kraniauskas, R. Nabažaitė and N. Savickaitė).

may be up to 2.5 metres. The deck, with all its structures, was washed away a long time ago.

The length of the remaining hull of Wreck 1 (W-1) is 23.2 metres, and the beam is seven metres. The largest beam is in the middle part of the ship. The hull is of nearly the same beam in the middle part of the ship, and then gets narrower only at a distance of six metres from the prow and four metres from the stern. The visible round stern gets narrower and tapers downwards. The condition of the remaining structures of the stern of both sides is quite good. Between the frames lies a bowed wooden structure, apparently a beam.

The ship's prow is made from an oak beam 34 by 20 to 24 centimetres in size, with the narrower side directed forward. The prow beam is also reinforced with an iron band 2.5 centimetres wide, above which the prow tapers in the fore part. Inside the ship, there is an 18-centimetre-wide keelson bracket attached to the prow. The keelson is 22 centimetres wide and 21 centimetres high; the keel is 21 centimetres wide and 18 centimetres high. In places where there are frames placed between the keelson and the keel, the keelson is slightly cut: it tapers to 16 centimetres. The first two port and starboard side frames are located about 15 centimetres from the prow (Fig. 2). The frames had been attached to the keelson (and the keel?) with treenails of about four centimetres in diameter. The keelson and the keel had also been joined by using treenails of about four centimetres in diameter. Upon measuring 11 frames in the ship's bow, it was found that the smallest cross-section of a frame was ten by nine centimetres, and the largest 24 by 12 centimetres. The dimensions of the frames in the middle part of the hull vary from 26 by 16 to 16 by 12 centimetres; all the frames are made of oak. The stern frames are 22 by 15 to 18 by 15 centimetres in size. The futtock joins in adjacent frames are not aligned with each other. The joints are reinforced with a wedge-shaped chock. Parts of the frames and the chock had been joined using treenails of about four centimetres in diameter. The side planks are attached to the frames with treenails and iron nails of about one centimetre in diameter (Fig. 3, see Plate I).

The spaces between the frames (frame spacing) are 12 to 40 centimetres; the further from the stem, the wider the frame spacing. In the fore part of the ship, both in the starboard and the port side, adjacent frame spaces are not equal. This fact should be seen as a structural peculiarity of the ship. In the middle part of the ship, there is a unique frame arrangement rhythm: between massive double and triple frame groups there are 40 to 50-centimetre spaces, in which thinner frames, just planks (16x6cm), are placed. The spacing in the frame groups is irregular, and varies from seven to 28 centimetres.

The side planks are joined with each other in the caravel manner.[4] The outer side planks are 24 to 30 centi-

[4] Until as late as the 15th century, in northern Europe (and the Baltic region), a ship's side planks used to be joined in the

metres wide, and up to six centimetres thick; the inner ones are 25 to 30 centimetres wide, and three to four centimetres thick. The side planks are attached to the frames with treenails and iron nails of about one centimetre in diameter. The thickness of the double ship's side is about 34 centimetres.

A small stocked anchor found by fishermen at a distance of about 200 metres to the west of Wreck 1 may be related to it. The anchor shank with shackle is 139 centimetres high, the breadth between the anchor blades is 86 centimetres, and the size of the stock is 144 centimetres. The anchor stock consists of two wooden parts joined with six iron rivets. The rivets are covered with wooden plugs. This anchor is now on display in Šventoji, by the port inn.

The few finds which were found in the ship's bow during the research conducted in 2009 can be used for dating it: these are the upper box of a bilge pump, the bottom board of a wooden cask, plates in the shape of an iron knife blade, an iron ring, a bullet, and forged iron nails. Wooden ship's pumps containing similar parts were used not only in the 17th century, but as late as the end of the 18th century, too (Baines 2008, p.91; Catalogue 299). Among the finds, there is a cast iron grapeshot ball to be fired from a gun. The iron grape found has a distinct cast seam and is 22 to 23 milimetres in diameter. Similar items are dated to the 17th (?) and 18th century (Czerepak 2008, p.160; Catalogue 321). Floor tiles made of stone and ceramics were found in the aft part earlier.

On the basis of the structural parts and finds, the hull of Wreck 1 can be dated to the second half of the 17th century. A dendrochronological analysis of the ship's two oak frame off-cuts and a pine fragment of a cask bottom was carried out. The dating of the analysed wood samples was not successful; however, it was determined that the oak used for the construction of the ship undoubtedly originated from the Baltic region (Brazauskas 2009).

WRECK 2 (W-2) was discovered, researched and measured by the author in 1989. W-2 is about three kilometres north of Palanga. The hull was at a depth of 2.5 metres, 150 metres from the shore. The visible part of the wrecked sailing vessel was 18 metres in length, and about eight metres in beam. The stem rose above the sandy floor by up to 0.7 metres.

The wreck of the hull was marked by frames and occasional side planks. The oak frames were around 20 by 16 centimetres in size, and the outer oak side planks were up to six centimetres thick. The side planks were joined in the caravel manner. The ship's structure is robust, the spaces between the frames (frame spacing) was about 30 centimetres. The ship's bottom was covered with a layer of field stones, that is, ballast.

Two finds found ashore provided more information on Wreck 2. In January 1990, after a storm, two ship's oak planks more than ten metres in length were washed on to the beach 260 metres north of the wreck of the ship. They were lying next to each other, and they were about 70 centimetres in beam and five to six centimetres thick. Clear traces attested to the fact that the planks had been attached with treenails and iron rivets to beams 20 centimetres wide, which were arranged every 30 centimetres. It is evident that these were planks of the outer side planking. Furthermore, in around 1980, a storm washed parts of the ship's deck, beams with remnants of deck boards, on to the beach at nearly the same point. These pieces are currently kept at the LSM.

In 2000, 2002 and 2005, the remains of the ship could not be traced any longer: they had been covered with sand (observation by the author).

WRECK 3 (W-3). In 1989, a search was carried out for the remains of a wooden ship between Palanga central rescue station and the pier.[5] According to fishermen's stories, this small ship is like a ghost: she appears and then disappears again, that is, she is uncovered and then covered up again with sand. During the search, a large wooden part, possibly the ship's prow, was found protruding from the sand among stones at a depth of three to four metres in a section of washed-out moraine.

Finds of wooden ship structures serve as proof of more than a single ship wrecked off the coast at Palanga. During a survey of the sea bed in the vicinity of Palanga rescue station (conducted by V. Žulkus in 1989), individual pieces of ancient ships were found next to stones at a depth of five or six metres. The items found were a piece of a frame (?) and an oak jib mast (a wooden beam) intended for heaving in the anchor. Its length is 1.54 metres, and the cross-section is 10.5 by eight centimetres. The beam was reinforced with iron bands; there are six holes in it made by iron nails. At the end of the piece there are two elongated holes, next to each other, for hooking in blocks. Judging by the size of the structure, the wrecked ship was a small-tonnage one.

clinker manner. The first ship with a caravel-construction hull was built in 1459 in the Netherlands. In Baltic towns, the mass construction of ships with a clinker construction hull started as late as the 16th century (Dudszus *et al.* 1987, pp.158, 165).

[5] Information provided by Jonas Vigelis, the manager of Palanga rescue station at the time.

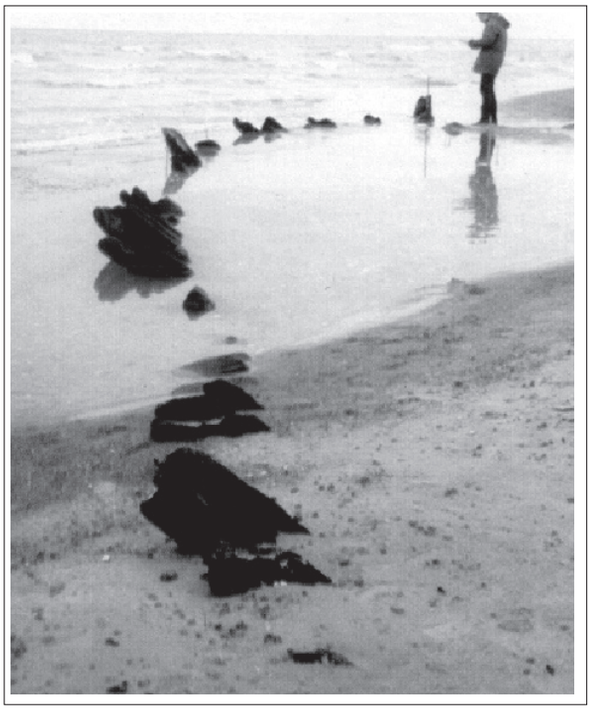

Fig. 4. The remains of W-9 (photograph by V. Žulkus).

Structures found between Palanga central rescue station and the pier, north of W-3, are attributed to another ship, Wreck 4 (W-4). North of the structures, there is an ancient stocked anchor lying at the same depth.

WRECK 9 (W-9). A fisherman from Palanga reported that he had found the remains of a wooden ship's hull cast ashore after a spring storm in 2002 south of Palanga, at Nemirseta. KU BRIAI PTC carried out the initial measuring and photographing of the ship's remains.

The ship was located at the boundary between the water and the sand. The length of the visible part of the hull was more than 20 metres, and the measured beam of the ship was up to seven metres. The ship was lying with her bow pointing to the west, to the waterside, and listing to her starboard side. The only parts to appear above the sand were the prow and the frames; the latter came to 0.7 metres above the sand (Fig. 4). It seems that the prow of the ship might have been blunter than the stern. A total of 41 port side and 13 starboard side oak frames were found. The ship's prow is composite and consists of three oak beams. The fore stem beam is 20 centimetres thick (front view) and 19 centimetres wide. Behind it there is a beam 22 centimetres thick and as much as 43 centimetres wide with lateral rabbets for side planks. The third (inner) stem beam is 22 by 23 centimetres in size. All of them are joined with iron nails. The side planks were joined to the stem with treenails. Some of the visible port side frames have sophisticated rabbets for joining the frames to the futtock (Fig. 5, see Plate I). This method employed for joining frames is considered to be 'ancient' (Dudszus, *et al.* 1987, pp. 27ff). All the visible frames are made of oak; they are 19 by 13.5, 17 by ten, or 15 by 12 centimetres in size, and the frame spacing is six to 19 centimetres. The side construction was apparently of the caravel type. The ends of two frames are cut off; fishermen recall that remains of this ancient ship were washed ashore during a hurricane in 1967 too, and at the time residents of Palanga cut off several beams of black oak wood for their needs. Within two weeks after the survey, the remains of the ship were completely covered with sand again. Until the autumn of 2001, the wreck was concealed.

Based on specific structures, the estimated time of construction of the hull of Wreck 9 is the 16th or the 17th century.

WRECK 12 (W-12). In the port of Klaipėda, in a small bay on the side of the Curonian Spit at Kopgalis, are the remains of an old berth: two rows of piles with a clearance of about 7.5 metres between them. During a survey of the berth structures in 2002, the frames of an ancient wooden ship were noticed. In 2004, KU BRIAI PTC conducted research into these coastal reinforcement works, and the remains of W-12 (Žulkus 2006, p.319). It was determined that the find in question was part of an ancient wooden ship used for the reinforcement of the berth, as was often the case from time immemorial. The larger part of the ship's remains is piled up with stones; therefore, it is not clear how much of the ship has survived, especially when it is not known what the size of the ship might have been.

Five starboard frames are visible among the stones and the sand. At medium sea water level, two of them appear above the surface of the water; others are slightly submerged in the water. A small part of the ship that is not piled up with stones apparently belongs to the starboard side of the sternpost. The sternpost of the ship was apparently rounded. The fore part of the ship is not visible: it is either under the sand, under the 'box' structure of the berth, or it is missing altogether. The ship's beam might have been six to seven metres.

The spacing between the visible frames of the ship is large: the clearance between frames 1 and 2 is 1.9 metres; the clearance between frames 2 and 3 is 2.45 metres; between frames 3 and 4, it is 2.7 metres; and between frames 4 and 5 a mere 0.75 metres. The frames are made of pine, trimmed, and their dimensions are as follows: frame 1 is 26 by 22.5 centimetres; frame 3 is 27 by 26 centimetres. Two planks from the side planking were found next to each other between frames 2 and 3, and five flush side planks had survived between frames 3 and 4. The construction of the ship's hull was of the caravel type. The beam of the side planks is

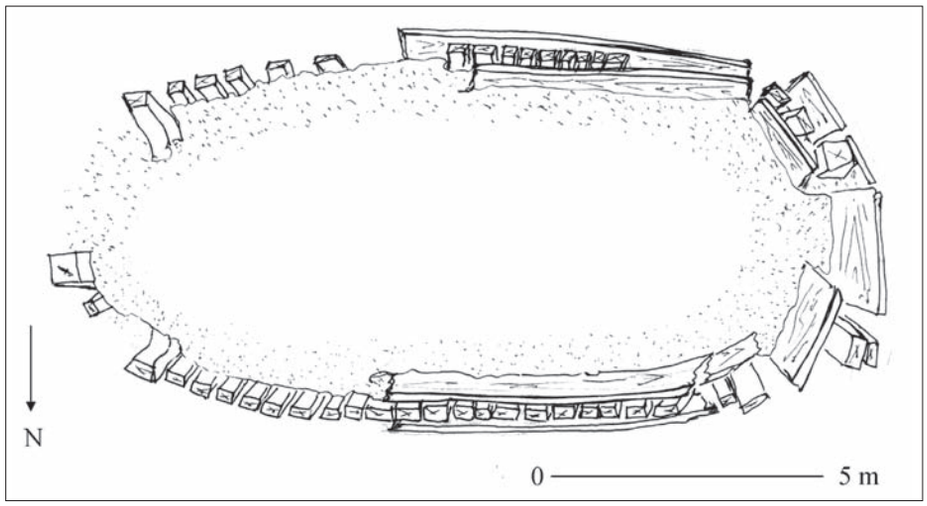

Fig. 6. A technical drawing of the preliminary measuring of W-13 (drawn by K. Perminas).

about 30 centimetres, and the thickness is six to seven centimetres. These are apparently oak planks. In the plank located between frames 2 and 3, a treenail has survived, by which the side plank was attached to the frame. No other structures of the ship were found.

Dendrochronological studies of the wooden reinforcement structures of Kopgalis breakwater and the remains of the ship (frames 1 and 3) were carried out in 2004. The pine wood of the ship's frames was more than 70 years old, and three to ten outer rings had been hand-trimmed. The structures of Wreck 12 (W-12) were dated to the years 1743 to 1748. This means that the ship was built after 1748. The wooden structures of the coastal reinforcement works were dated to the years 1735–1745 (Brazauskas 2009).

WRECK 13 (W-13). In the spring of 2004, when the water was especially clear, the coastal waters were surveyed from a boat. A wooden ship's hull was found off Kunigiškiai (between Palanga and Šventoji) in a shoal at a distance of about 150 metres from the shore. Local fishermen knew nothing about the circumstances or the time of a ship sinking. According to them, it was a piece of the partly destroyed Palanga pier that had been brought to this location by the current after hurricane Anatol. Nobody had seen anything here before.

The remains of the hull of Wreck 13 lie on the sandy sea bed at a depth of merely two metres. The ship lies in an east-west direction, pointing towards the east, towards the coast. In the fore part, W-13 rose above the sea bed by ten to 30 centimetres, and in the middle part to about 0.5 metres. The stern was exposed to a greater degree: about one metre of it protruded from the sea bed. Upon finding the remains of the ship, some provisional measuring was carried out (by KU BRIAI PTC, surveyed by K. Perminas and M. Bučas).

The length of the visible part of the ship was 15 metres, and the maximum beam was 6.3 metres. Thirty-six starboard side frames and 52 port side frames could be seen. A piece of the stem and small wooden structures measuring about five by six centimetres were sticking up in the fore part of the ship. Also in the fore part, at a distance of about 1.6 metres from the prow, an S-shaped frame could be seen on either side; the frames were possibly made of solid wood. The spacing is about five centimetres until approximately the middle of the ship. Further to the end, the frames are nearly flush with each other. There are outer and inner side planks surviving on the starboard side from frame 8, and on the port side from frame 11 (counting from the prow). The hull planking is apparently of the caravel type. The side planks are attached to the frames with treenails; no metal nails were noticed. The stern of the ship is rounded, and there are double beams and a large number of surviving planks (Fig. 6). In 2005, the ship was largely covered up, her prow was not visible, but the rudder stock could be seen clearly at the stern. In 2006 and 2007, the remains of Wreck 13 could not be found, as they were totally covered over by sand.

The dating of the ship and her type are not clear. Undoubtedly, it was a sailing vessel, and its construction indicates that it should date from the 18th or the 19th century.

WRECK 14 (W-14). On 27 May 2005, during a joint mine-clearing operation undertaken by the Lithuanian Navy and its Swedish counterpart, the side-scan sonar of a Swedish naval vessel detected an unknown sunken ship at a depth of 24 metres. The interpretation of the sonar data led to the conclusion that the ship 'had a mast and was apparently wooden'.

In 2005, the ship was inspected by Lithuanian Navy divers, and the information was handed over to KU

BRIAI PTC. An expedition undertaken by KU in 2005 surveyed, videotaped and photographed the remains of the ship. Later on, W-14 was inspected by KU PTC and amateur divers several times.

The remains of the sunken wooden Wreck 14 (W-14) are located southwest of Palanga; its coordinates are 55º52'763 N, 20º 57'620 E. The distance between W-14 and the shore is 3.7 nautical miles, and between W-14 and Palanga 4.5 nautical miles. The sunken ship lies in a north-south direction, on an even sandy bed, next to a place full of stones of washed-out moraine. The accumulation of stones varying in size begins west of the ship, by its starboard side. Upon an underwater inspection of the ship's remains, it was ascertained that the detected object was the hull of a wooden ship, the visible structures and details of which were scattered across an area about 30 metres long and 12 metres wide.

Research was carried out on this wreck in 2009 and 2010. Students from KU and Nicolaus Copernicus University (Toruń, Poland; tutor Krzysztof Radka) underwent training practice in underwater archaeology there. The diving took place from the *Brabander*, the sailing ship of KU. In order to measure the remains and details of the ship, a basic measuring grid was marked out around it. For this purpose, four reference marks with ropes were driven into the sea bed; the ropes formed a rectangle 27 metres long and 13 metres wide around the remains of the ship. The rectangle was oriented to the four points of the compass.

It was found out that the ship was not broken in two, as had previously been believed (Žulkus 2006a, p.420ff); only its prow and its stern are decayed, and parts of the keel are buried under a layer of sand. Most of the structures of the lower part of the hull are located under the sand, too. The size of this wooden ship was defined more precisely during the research: the length of its hull used to be about 27 metres, and the beam about seven metres (Fig. 7).

At the point where the ship's prow was, four wooden-stocked anchors and a fallen chain were found. Two of the anchors are large, the other two are smaller. One of the large anchors is under the sand, and one of the smaller anchors is among the cargo. At a distance of six metres from the structures of the ship's bow, there is a wooden horizontal windlass (for heaving in the anchor), with a wound anchor chain lying on the sea bed (Fig. 8, see Plate I).

The starboard side of the ship has spread out up to 3.5 metres and lies on the sea bed (Fig. 9). The structures of the port side rise up to one metre above the sea bed. The ship's frames are 12 to 17 centimetres in breadth, the frame spacing is ten to 16 centimetres, and the breadth of the planks of the inner and outer planking is ten to 13 centimetres. The construction of the ship's sides is of the caravel type. The starboard side is broken off at the points where the frames were attached to the futtocks. The tapered ends of the frames and the futtocks are joined with treenails about two centimetres in diameter. The cross-section of the keelson of Wreck 14 is 23 by 24 centimetres.

A deadeye (made from a single piece of wood, with a metal clamp) recovered by amateur divers (its findspot is unknown) indicates that the ship had at least one mast. Regrettably, the spread-out cargo covers the possible locations of the mast (or masts). These locations have not yet been found. The ship might have been a barge-type vessel.

The ship contains a cargo of railway lines and wooden boxes 65 by 30 by 25 centimetres in size, with places for attaching lines to sleepers. The rails are stowed in the shape of a 'well' by criss-crossing tiers of rails. This cargo is 14.8 metres long, 7.5 metres wide, and 3.95 metres high (part of it, like the bottom of the ship's hull, is still buried in the sand).

It is evident that the cause of the ship's sinking was the enormous weight of its cargo. When high waves all of a sudden appeared, the overloaded ship might have taken in water, or the cargo might have slipped forward.

On the basis of historical records, it is believed that the ship sank in 1870 or 1871. It is a known fact that on 2 February 1870 a steamship brought 20,000 centners (1,000t) of railway lines to Klaipėda. They were intended for the Liepaja–Kaunas line, the construction of which had just started in Russia. In Klaipėda, the lines were to be re-loaded and carried to Liepaja by other ships (Willoweit 1969, p.291). By 4 September 1871, the line had already opened as far as Kaišiadorys (LE1940, p.1198). The pieces of anchor chain found next to the ship and on the windlass do not contradict this dating. Anchor chains were widely used on board sailing ships instead of ropes from the mid-19th century (Sorokin, Stepanov 2009, p.65).

A ship carrying railway lines sank not far from Palanga. The lines loaded on W-14 are 6.21 metres long. They are largely disintegrated; therefore, no manufacturer's marks could be found that could help determine the place or the time of their production. An attempt to date a sample of oak by dendrochronological analysis was also unsuccessful. It was determined that the wood originated from the Baltic region (Brazauskas 2009).

WRECK 15 (W-15). In March 2003, the remains of an ancient wooden ship were exposed after a storm in the

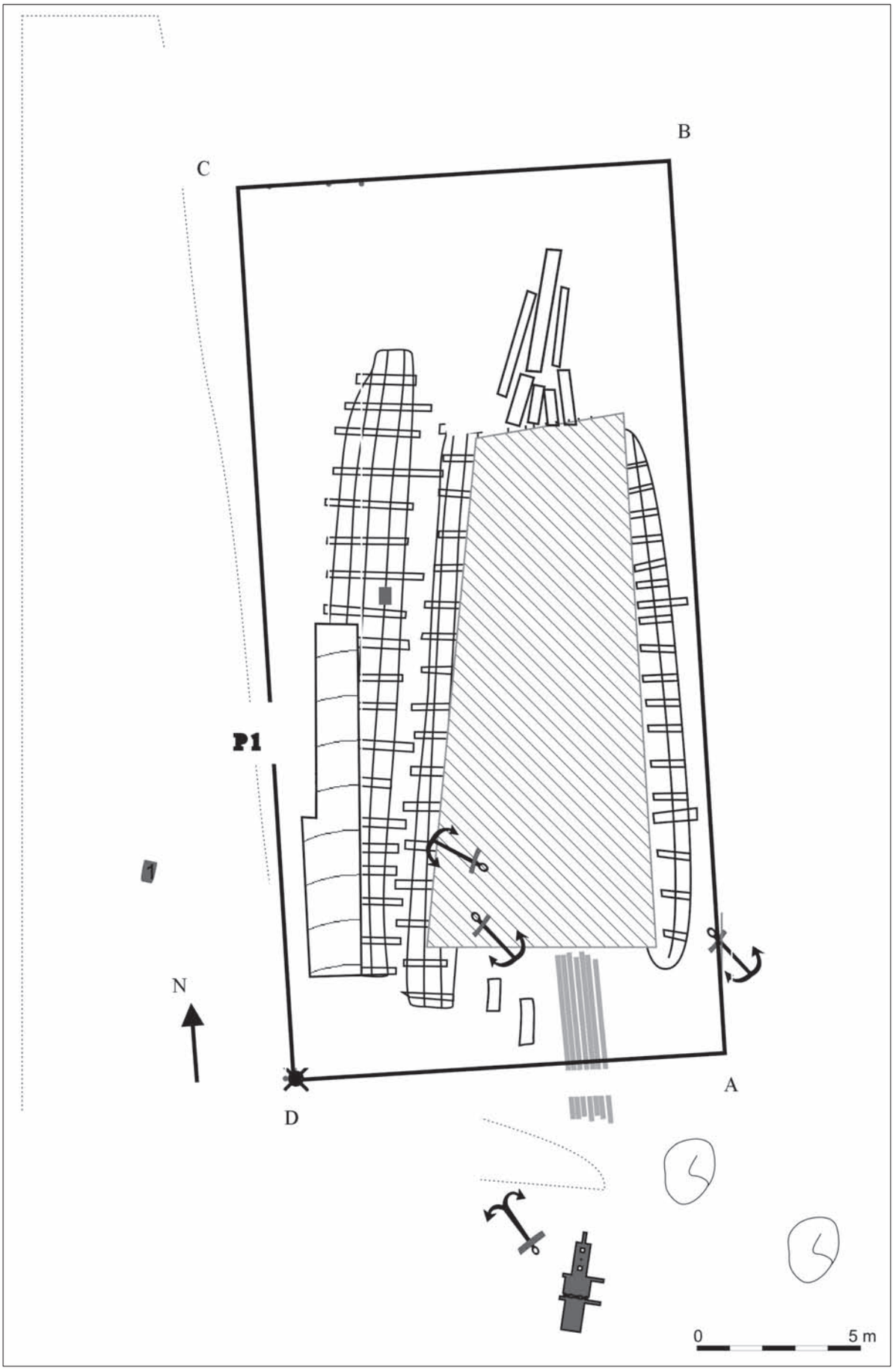

Fig. 7. W-14: a diagram of the ship's remains (drawn by V. Žulkus and K. Radka).

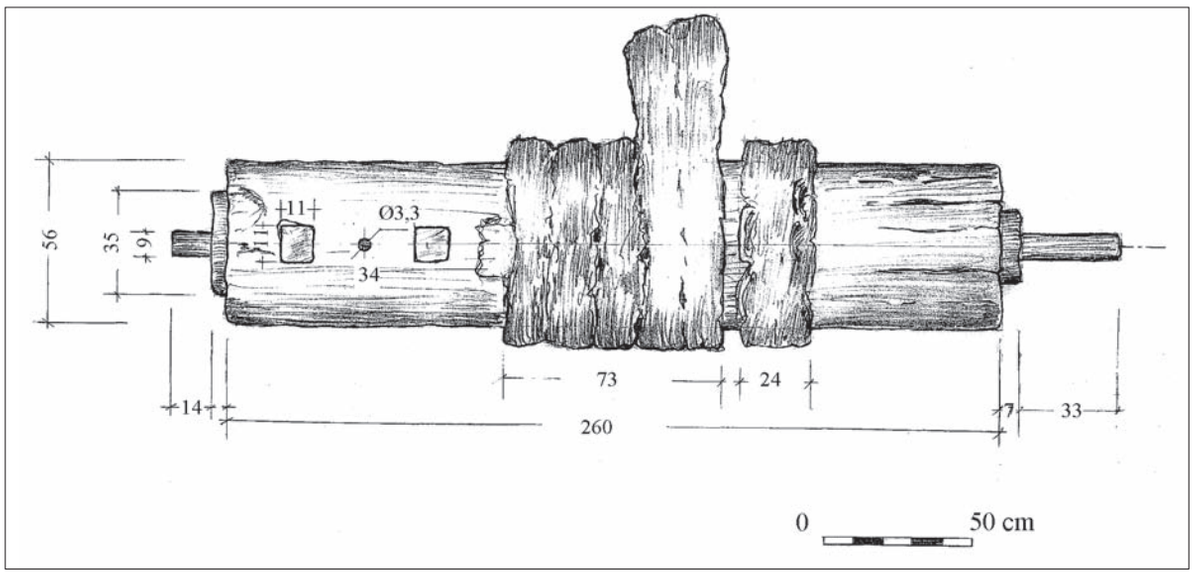

Fig. 9. The measurements of the starboard side structures of W-14 in 2009 (drawing by V. Žulkus).

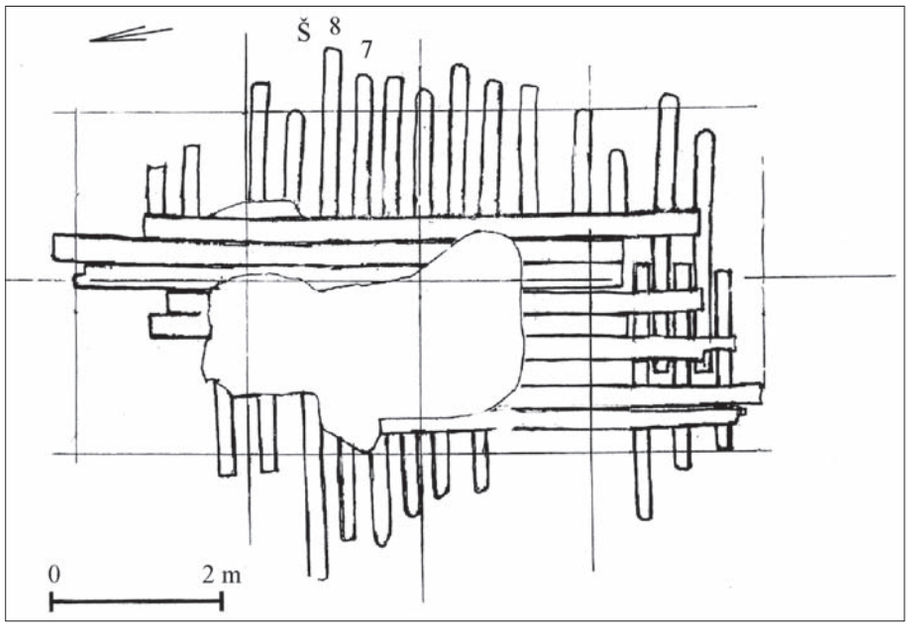

Fig. 10. The remains of W-15 (drawn by V. Žulkus).

northern part of Melnragė beach in Klaipėda. The remains of Wreck 15 (W-15) had been spotted more than once before. In the winter of 1995, a storm exposed part of the ship's hull about nine metres in length. At that time, the remains of the ship were inspected by personnel of the LSM and photographed (R. Adomavičius, D. Elertas). In 2003, a much smaller part of the ship's remains was exposed, and only ten frames appeared above the sand and the water. These were apparently the remains of the starboard side. The wreck was once again photographed and measured (KU BRIAI PTC). Two weeks later, the ship's remains were covered up with sand again.

On the basis of the earlier photographing and measuring carried out in 2003, the ship's structure was partly reconstructed (Fig. 10). It is very robust. Over the densely arranged frames, there is not only a false keel (keelson), but also thick beams about 30 centimetre wide arranged on the bottom next to each other; there were six of them on the port side. The frames of the opposite sides are not joined to each other; they just cross at the bottom. There are remains of the bottom parts of the frames; the extensions (the top parts) are missing. The fact that there had been extensions upwards is attested to by openings found in frame 8. The frames are joined with treenails 2.8 to three centimetres in diameter and iron rods. Oak was used for the frames and the joint pins. The dimensions of the frames were as follows (in centimetres): 22 by 28; 15 by 30; 18 by 30; 15 by 30; 15 by 31.5; 18 by 28; 20 by 26. Frame

6 is composite, and consists of three oak planks. The largest plank (13x25cm) was located in the lower part next to the bottom. Two smaller planks (8x10cm and 8x14cm) were arranged on top of it. The frames are arranged very densely, some spaces between the frames are a mere five to ten centimetres wide. Frame 8, which has been preserved best, shows the original profile of the ship's bottom.

A 16-by-31-centimetre piece of frame 7 was cut off for dendrochronological dating. The sample has been dated to the year 1699 (3±7 years), that is, to the very beginning of the 18th century (Žulkus 2005).

WRECK 17 (W-17). In the southern part of Melnragė, during a storm in January 2007, the waves washed ashore part of a wooden ship's hull (Fig. 11, see Plate II). The ship's remains were not covered with shells, which suggests that the hull had been buried in sand until that time. The part of the ship was found lying in a north-south direction along the shoreline with its keel upwards.

The length of the surviving part of the ship is 18 metres. The part of the surviving side facing the sea was up to 3.5 metres in beam, and the side facing the coast was about three metres in beam; the planks of the planking of this side are disintegrated to a greater degree: 22 frames are exposed. Only a smaller part of the keel 10.8 metres in length has survived. The keel is made of oak, is 31 centimetres high, and 27 centimetres wide. The northern tip of the keel is broken off, whereas the southern tip at the point where the hull gets narrower ends in a lock joint: another part of the keel was joined here. At that point, the frames are arranged more densely, frame to frame. The frames are 28 centimetres in beam, and 32 centimetres in height. The frame spacing is about 30 centimetres. On both sides of the keel, oak planks 27 centimetres wide and eight centimetres wide are pressed to the keel, one plank on either side. Further on, starting with the second plank, the hull is made from pine planks about 25 centimetres wide and eight centimetres thick, which are attached to the frames with treenails and iron nails. The bottom planks are arranged in two layers; the total thickness of the bottom is 16 centimetres. The planks of the sacrificial planking are fastened with nails diagonally to the main bottom planks. The southern tip of the hull is tapered: the third, fourth and fifth planks taper from 25 to 20 centimetres, and eight to 20 centimetres in width respectively.

In the spring of 2007, the remains of the ship were dragged ashore closer to the breakwater, whereas at the end of June they were already nearly completely covered by sand. The hull disintegrated continuously, and by the end of 2009 only a small part of it had survived. This piece has been relocated to the LSM. When the remains of the hull were being relocated to the LSM, the keelson and the longitudinal beams on both sides of it could be seen on the inner side of the bottom. There were three of them on one side, and two on the other side.

We have few indications for dating the remains of Wreck W-17. The reinforcement of the part of the hull located next to the keel with sacrificial planking indicates that the ship should be dated to not earlier than the 18th century (Ossowski 2008, p.135ff).

The piece probably belongs to a ship built in the 19th century or even in the early 20th century, namely the remnants of the motor sailing ship *Grisslan* (*Grissland*, *Grislan*), which sank in 1924 while carrying barrels of cement from Gotland (LCVA, F.386, Ap. 1, B 444, l. 162, 206; Adomavičius 2007). The owner of the ship was Joh. Heinz, a Hamburg-based company. Written sources mention that it was 'an old wooden' (other sources indicate that the ship was built in Sweden in 1919) 350-tonne motor sailing ship, which sank in the very fairway about 400 metres northwest of the northern breakwater at a depth of six to eight metres. On 4 and 5 June a storm completely destroyed its hull and broke its sides into pieces, and parts of the ship were scattered along the coast (*Klaipėdos žinios* 20.4.1924, No. 89; 14.6. 1924, No. 108; 24.6.1924, No. 116; Adomavičius 2007). The hull reinforced with beams along the keelson might serve as proof that it was indeed a motor sailing ship.

WRECK 18 (W-18). The remains of this wooden ship were found in 2007 during sonar scanning of the sea bed south of the entrance to the port of Klaipėda off Smiltynė. The side-scan sonar detected an object about 13.5 metres in length at a depth of 11 metres. During an initial underwater survey, the surviving part, about 16 metres in length, of a wooden ship's hull was found. The hull lies with its bottom up in an east-west direction, and it is partly covered with sand. The beam of the visible part is about three metres. Nineteen frames with planks of a caravel-type hull over them were distinct. Eleven bottom planks are visible. They are 22 to 24 centimetres (another is 18cm) wide, and five to six centimetres thick. The planks taper at the eastern end; it is here that one of the undefined ends of the ship begins. The frames are about 16 to 18 centimetres by 28 to 30 centimetres in size. The spacing of the frames is approximately 16 centimetres, and in other places about eight centimetres; in some places, the frames are double. The side planks are attached to the frames with oak treenails and large iron nails. Two weeks later, after a small storm, the ship's hull was already largely covered up with sand (Žulkus 2008, p.530).

Fig. 12. A photograph of W-23 obtained by side-scan sonar in 2010 (by M. Zakarauskas).

WRECK 23 (W-23). The remains of a ship were found in the spring of 2010 during a joint expedition by KU PTC and the Hydrographic Service of Lithuania, scanning the sea bed from the vessel *Varūna*. A ship's hull was detected at a depth of 36 to 37 metres, and at a distance of 7.5 nautical miles from the shore off Juodkrantė. A sonar photograph (Fig. 12**)** shows a piece of a ship approximately 38 metres in length and 14 metres in beam. During an initial underwater survey (KU PTC), it was ascertained that this was part of a relatively well-preserved wooden ship's hull. Provisional measurements were taken. The ship is resting on its keel, listing to the port side. There are some surviving parts of the deck. The ship is deep in sand: the structures of its starboard side rise above the sea bed by a mere 30 centimetres, while the edge of its port side is completely invisible at some points. The stern is under the sand, too. The frames of the ship's starboard side are 25 to 26 centimetres wide, and the frame spacing is 16 to 20 centimetres. Two broken wooden masts were found. The main mast is located at a distance of 30 metres from the ship's bow; its diameter is 32 centimetres. The mast is broken at a height of 2.5 metres above the deck, and the broken part leans on one side. On the mast, there is a massive surviving bracket fastened with six rivets; it has an eye for hooking in the sail boom. Part of this mast with the structures of a metal top lies on the sea bed next to the port side of the ship. At a distance of about 6.5 metres from the main mast, towards the stern, are the remains of a thinner mizzen stay. The broken fragment of the mast rises above the deck up to 1.5 metres, and it also has a bracket for hooking in the sail boom. No remains of the foremast were found. There is the metal coamings frame of a quadrangular hatch lying next to the port side at a distance of about 12 metres from the ship's bow (it can be seen in the sonar photograph). There are iron rings intended for fastening the sails to the mast scattered in the ship's fore part. The rings are 25 centimetres in diameter and made from an iron rod 1.6 centimetres in diameter. Passing through these rings are smaller rings 8.2 centimetres in diameter, which used to be fastened to the sail loops. Judging by the size of the rings, the foremast might have been approximately 21 centimetres in diameter.

On the basis of the existing information, we can draw the conclusion that the ship in question was a three-mast barque. Its length might have been approximately 52 metres, and the beam 10.5 to 11 metres. A three-mast barque used to be a very popular type of merchant vessel in the 19th century. The tonnage would be 120 to 300 lasts (240–600t). In the second half of the 19th century, three-mast barks of about 500 BRT tonnage were the most common (Dudszus *et al.* 1987, pp.13, 52).

The dates when the ship was constructed and sank are not clear. According to the information available, the ship could be dated to the 19th century, most likely to the second half of the century. The metal top structures, as well as the sail boom fastening arrangements typical of the Modern Age, support the dating of the ship to this period (cf. Dudszus *et al.* 1987, pp.32, 34). Attempts to link the find to any disaster known from written sources have not yet been successful. Around 1,000 or more ships would call at and depart from the port of Klaipėda annually; in the last decades of the 19th century, most of these ships were still sailing ships (Willoweit 1969, pp.375, 398, 399). Information on sunken vessels, especially those that sank in the open sea, is very fragmentary. In the sea chart of ships that were wrecked and sank off the Prussian coast between 1857 and 1864, there is a sunken ship marked at the same latitude as W-23; however, that ship sank in the open sea, and at a much greater distance from the coast (*Karte der Schiffbrüche*).

Discussion: The possibilities for dating and identifying wooden shipwrecks

Dating wrecked and sunken wooden ship hulls is usually complicated. Wrecks can be approximately dated on the basis of their structural features; however, in most cases, only parts of wrecks found in coastal waters survive; ships found under water are covered with sand, some of them lie with their bottoms up, and thus their structures can only be partly identified. Detailed studies of known wooden wrecks W-1 and W-14,

which rest on their keels, have just commenced; other wrecks, such as W-13 and W-23, have only been surveyed provisionally. Furthermore, in most cases, the structural peculiarities allow for a highly approximate dating only. The reason for this is the wide diversity of shipbuilding traditions. There used to be a large number of shipyards, and the ships built, especially in small yards, did not necessarily reflect the structural trends in shipbuilding that prevailed at the time and were dictated by the shipbuilders of major sea powers.

A more accurate date of a shipwreck can be determined on the basis of the finds that archaeologists usually find inside the vessel, that is, traditional household articles used by the people travelling on board the ship. The set of finds found inside sunken ships is usually quite limited (sometimes sunken ships are called 'time capsules'); therefore, finds can be dated quite precisely, by applying the usual comparative method. This dating method requires the availability of a sufficiently large number of characteristic articles, which can only be recovered during detailed studies. Under water, especially at greater depths, studies like this are carried out comparatively rarely. Lithuanian underwater archaeologists use this possibility for dating only to a limited extent.

Historical data can provide accurate information about the time and circumstances of a shipwreck, the type of ship, its story, cargo and crew; however, this is possible only upon identification of the wreck. More often than not, identification is impossible, especially in cases when the ship is badly damaged or has not been sufficiently studied. A few dozen historical references mention ships wrecked in Lithuania's coastal waters. These include some ten to 20 references indicating the approximate location of a shipwreck, the ship's name, tonnage, origin, cargo and other details; however, not a single one of the 11 wrecks mentioned in this article has been identified. This means that we cannot link any of the known wrecks to an actual ship mentioned in written sources.

Wooden ships provide numerous possibilities for dendrochronological dating; however, positive results are not instantly obtained in all cases. There are several reasons for this:

- The wood used for building ships would undergo intensive treatment; more often than not, the wood samples taken do not contain alburnum, and the sizes of wood samples received for dendrochronological analysis are usually small. Dating is possible only when a group of rings of trees that grew simultaneously is available, because only in that case are the general wood increment trends revealed. Such groups can be formed for the wood of the ship being studied only when a large number of samples are available. Errors in the dendrochronological dating of an individual ship's structures are impermissibly wide (Brazauskas 2009).
- The ships wrecked in Lithuania's coastal waters lie at shallow depths, and, due to this, the wooden structures that have survived on the sea bed have largely been smoothed over by the currents and by the sand. Therefore, even in wood that has hardly been processed, the last rings are missing, and accurate dating is not possible.

Along with dating, dendrochronological analysis allows for the identification of the region where the timber was felled (the 'dendroprovenancing' method) (Brazauskas 2009), and this should allow for the identification of the region where the ship was built. This possibility is also limited, and can be used nearly unconditionally only for the Early Middle Ages. In later times, especially during the Modern Age, when shipbuilding reached a high level of sophistication, shipyards in various countries used more and more imported timber, and any attempt to identify the location of the shipyard on the basis of the place of origin of the wood may result in more confusion than clarity. For several centuries, Klaipėda was an exporter of timber for use in shipbuilding; therefore, the data given below might be of use to underwater archaeologists in other countries.

As the timber suitable for building ships ran short in the major coastal cities of the Baltic Sea and the North Sea, the search for timber began in more remote regions. High-quality processed oak for shipbuilding was carried from east Baltic Sea coastal areas via the ports of Klaipėda and Königsberg to German and other ports as early as the 15th century (Willoweit 1969, pp.146, 147, 357; Groth 1996, p.48). At first, the forests of East Prussia were exploited. Between 1454 and 1466, several kinds of timber felled in Sambian forests were shipped from Klaipėda (Zurkalowski 1906, p.49ff). Later on, timber was searched for in the border areas of Lithuania; this way, eight sorts of timber and wooden articles were brought to Gdańsk from Lithuania in 1473 (Forstreuter 1931, p.90).

In the 16th century, the demand for high-quality timber increased, and shipbuilders looked for it all over Eastern Europe. In 1540 and 1541, timber was carried by ship from Memel (Klaipėda) to Lübeck and Holland (Zurkalowski 1909, p.86). In 1586 and 1587, the Baltic Sea was 'crowded with British ships', searching for hemp, pitch, tar and timber for naval preparations against the coming Spanish attempt at invasion. Klaipėda (Memel) was among the ports visited by ships from Hull, too. Lithuanian timber, as well as tim-

ber from the vicinities of the Daugava, was shipped from this port (Davis 1964, pp.11, 12). In the 16th century, Lithuanian timber would be brought by raft to Königsberg and Klaipėda from the forests in the middle reaches of the River Nemunas, and later on, in the 17th century, from the forests growing upstream from Kaunas and as far as Grodno, Minsk and Vilnius (Forstreuter 1931, p.90).

In the 18th century, the demand for timber used in shipbuilding increased further. Lithuania's wasteland forests became a major source of trees felled for ships' masts. Historical data, albeit fragmentary, indicates the extraordinary scale of the trade in timber intended for shipbuilding. Between 1728 and 1745, 456 masts were shipped from Klaipėda by sea (Sembritzki 1926, p.233). From 1743, Klaipėda merchants were granted the privilege to sell timber directly. Masts would reach France and Spain via Dutch brokers (Roerdansz 1792, p.87ff). Although timber from the vicinity of Klaipėda was more suitable for shipbuilding than timber from Prussian forests, from the 18th century timber felled in more remote areas of Prussia and timber brought from Lithuania had to be processed in Klaipėda. During the War of American Independence (1776–1783), Prussian timber would be carried as far as America (Roerdansz 1792, p.87; Willoweit 1969, pp.112, 114, 253, 358, 360-361). In 1791, large quantities of masts for large and small ships, as well as bowsprits and supports, were shipped from Klaipėda. Oak beams and planks were also shipped; there are mentions of wood for bulkheads, too (Roerdansz 1792, pp.100, 151).

After 1760, British merchants rediscovered Klaipėda. A total of 831 ships departed from Klaipėda in 1788, and as many as 562 of them were from Great Britain (Roerdansz 1792, p. 199). In 1792, even more British ships, as many as 756, mostly in ballast, visited Klaipėda to load up with balks and beams from the forests of the Lithuanian hinterland (Kirby 1990, p.366).

There is also more exact data on ships that carried timber from Klaipėda in the late 18th century. On 14 January 1793, the ship *Bedford* arrived at Kings Lynn with a cargo of timber from Klaipėda. British ships would usually sail to Klaipėda without any commodities on board, in ballast, because their aim was to bring home timber. In the spring of 1793, the sailing ship *Unanimity* sailed in ballast from Kings Lynn to Klaipėda. It came back on 20 May of the same year with timber on board. A week later, on the 28th, this ship sailed in ballast again to Klaipėda. Another piece of information on the *Unanimity*, which again arrived from Klaipėda with a cargo of timber, dates from 8 October 1793. In the summer of 1793, the ship *Jane* brought timber and deal from Klaipėda to the port of Wisbech. Another ship, the *Sally*, also arrived from Klaipėda with a cargo of timber at Boston (The Baltic Trade). In the second half of the 18th century, up to 11 sorts of timber were shipped from Klaipėda (Roerdansz 1792, p.199).

In the 19th century, even larger quantities of timber intended for shipbuilding were shipped, and only war would temporarily disrupt this trade, which was highly profitable for Klaipėda. The annual number of ships calling at and departing from Klaipėda would be close to and sometimes even exceed a thousand. In 1856, for instance, 883 ships from 12 countries called at the port (Hartmann 1978, p.11), and 862 ships departed from it, including 620 ships sailing to Britain. Between 1857 and 1860, between 559 and 590 ships sailed from Klaipėda to Britain every year (Sembritzki 1902, p.86). In 1874, 1,301 ships sailed from Klaipėda; 1,108 of them were carrying timber (Sembritzki 1902, p.85).

Written data indicates that Prussian and Lithuanian timber was widely used in the shipyards of different countries, and for various ship's structures. Therefore, the ascription of wood that has undergone a dendrochronological analysis to the Prussian or Lithuanian region does not imply that the ship was in fact built in Klaipėda (Memel), Königsberg, Gdańsk or other coastal cities of East Prussia or the Duchy of Courland.[6]

Besides, the structures of a ship were not homogenous in terms of the use of wood. Different sorts of wood were used for different parts of a ship. Furthermore, in view of the short supply of high-quality timber, individual parts of a ship's hull would be built of wood of the same sort, but of differing quality. For example, in the middle of the 19th century, oak from the vicinity of Gdańsk was used in ships' bottoms, for decks and for the internal structures of the hull. For a ship's sides, oak shipped from Klaipėda was used, since its quality was higher than that of Gdańsk oak, and as good as timber from Britain or southern Europe (Litwin 2003, p.60).

In the course of searching for, registering and studying sunken and wrecked ancient wooden ships, we cannot avoid the issue of the preservation of their remains. At present, the preservation of the hulls of wooden ships that are classified as being part of the maritime heritage is most adverse. The fate of the remains of Wreck 17 serves as an illustration for this statement. At the end of 2009, only a small piece of the hull that had been washed ashore in 2007 was taken to a museum; most of it was destroyed by human activity and the waves. The conservation and display of wooden hulls is very complicated and costly. I believe that hulls that are located in the shoals, being destroyed by the waves or

[6] In the 17th century, ships were built in three ports in the Duchy of Courland (Pētersons 1995, p.33).

which have been cast ashore, could be preserved and displayed under water, by moving them to a depth of 15 to 18 metres, where they would not be exposed to the stronger currents and waves. The remains of ships protected from destruction and concentrated in a single location could be an object of further study and underwater studies; this would make their protection easier, too.

While discussions are under way as to how to protect underwater finds, first and foremost ships sunk during different historical periods, in line with the requirements of the Unesco Convention on the Underwater Cultural Heritage ratified by Lithuania, sunken ships now and then become the targets of looting. Due to the danger that the underwater heritage is exposed to, we have to avoid mentioning the coordinates of finds and some information on the underwater heritage in documents and publications. It goes without saying that this fact limits the possibilities for the exchange of information and scientific knowledge.

Translated by Vidmantas Štilius

Abbreviations

ATL – Archeologiniai tyrinėjimai Lietuvoje. Vilnius from 1967. (Archaeological investigations in Lithuania).
BRIAI – Institute of Baltic Sea Region History and Archaeology
INK. NA. – Institut Nordostdeutsches Kulturwerk. Nordostdeutsches Archiv. Lüneburg
KU – Klaipėda University
LCVA – Lithuanian Central State Archive
LEK – Liv-, Est- und Kurländishesches Urkundenbuck
LSM – Lithuanian Sea Museum
MD – Memeler Dampfboot
PTC – Underwater Exploration Centre

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Merseburg – Photocopies of documents from the Merseburg Archive, LSM.
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LIETUVOS PAKRANTĖSE SUDUŽĘ LAIVAI

VLADAS ŽULKUS

Santrauka

1989–2010 m. Lietuvos Baltijos pajūryje, priekrantėje tarp Būtingės ir Klaipėdos, bei jūroje buvo registruota vienuolika medinių laivų korpusų radimviečių. Laivai išlikę labai nevienodai – vienų korpusų yra tik nedideli fragmentai, kiti išlikę visu ilgiu ir pločiu, yra ir laivas, nuskendęs su kroviniu. Šie radiniai yra labai skirtingose vietose: vienų korpusų fragmentai buvo audrų išmesti į krantą, kiti rasti paplūdimiuose po smėliu, kai kurie guli priekrantėje vos 2–3 m gylyje, vieno medinio laivo dalis yra panaudota krantinei sutvirtinti, dar kiti nuskendę 11–37 m gylyje. Medinių laivų korpusai buvo rasti įvairiais būdais: apie pakrantėje esančias audrų atplautas laivų liekanas pranešė žvejai, paplūdimiuose dirbantys gelbėtojai, poilsiautojai; kai kurie radiniai aptikti žvalgant seklumas iš lėktuvo, nuo vandens paviršiaus ir po vandeniu. Giliau nuskendę laivai buvo aptikti šoninės apžvalgos sonaru (angl. *side scan sonar*) įvairiais tikslais tyrinėjant jūros dugną (moksli-

nių, mokslinių taikomųjų tyrimų metu, atliekant dugno gylių matavimus, karinių išminavimo operacijų metu).

Datavimo ir identifikavimo problemos

Visus straipsnyje aprašomus laivus apžiūrėjo, provizorinius matavimus atliko, nufotografavo bei vaizdo kamera nufilmavo ir suregistravo Klaipėdos universiteto Baltijos regiono istorijos ir archeologijos instituto Povandeninių tyrimų centro archeologai.

Netiesioginiai, tačiau neabejotini laivybos rytinėse Baltijos pakrantėse įrodymai yra Lietuvos pajūrio gyventojų ryšiai su Baltijos jūros salų ir vakarinių pakrančių gyventojais nuo VI a. po Kr. Tarp 900 ir 1000 metų rytinėje Baltijos pakrantėje yra buvę bent keli kuršių tolimosios prekybos centrai. XII–XIII a. laivyba palei rytines Baltijos pakrantes jau buvo gana aktyvi: skandinavų vikingų laivai per Kuršių lagūną pakildavo aukštyn Nemunu, o kuršių piratai kontroliavo Baltijos jūros rytinę dalį ir plėšikavo Danijos bei Švedijos pakrantėse (Žulkus, 2004; Žulkus, Bertašius, 2009). Lietuvos vandenyse kol kas nerasta nei vikingų laikotarpiu, nei viduramžiais nuskendusių laivų, todėl ir žinių apie tai, kaip atrodė XI–XIII a. kuršių laivai, deja, dar neturime.

Nors rašytinių šaltinių žinios yra nenuoseklios, faktų apie Lietuvos pakrantes nusiaubusius uraganus, nuskendusius, į pakrančių seklumas sudužusius ir pakrantėn išmestus laivus yra kelios dešimtys. Seniausios žinios siekia XIV a. pradžią. Iš viso straipsnyje pateikiami 25 istoriniuose šaltiniuose paminėti laivų sudužimo ir nuskendimo atvejai. Povandeninių archeologinių tyrimų metu nuodugniai iššvalgyta vienuolika nuskendusių laivų, fiksuota jų dabartinė būklė. Datuoti sudužusių ir nuskendusių medinių laivų korpusus dažniausiai yra sudėtinga. Apytikriai mediniai laivai gali būti datuojami pagal konstrukcijos ypatybes, tačiau nemaža dalis sudužusių laivų pakrantėje yra išlikę tik fragmentiškai, po vandeniu esantys laivai yra užnešti smėliu, kai kurie jų guli dugnu aukštyn, todėl laivo konstrukcija yra atpažįstama tik fragmentiškai. Ant kilio stovintys žinomi mediniai nuskendę laivai W-1 ir W-14 dar tik pradėti detaliau tyrinėti, kiti – W-13, W-23 – žvalgyti tik paviršutiniškai. Be to, konstrukcinės ypatybės dažniausiai leidžia datuoti tik labai apytikriai. To priežastis yra didelė laivų statybos tradicijų įvairovė. Laivų statyklų yra buvę labai daug, jose pastatyti laivai, ypač mažose statyklose, nebūtinai atspindėdavo to laikotarpio laivų statybos konstrukcines madas, kurias diktavo didžiųjų jūrinių valstybių laivų statytojai. Mediniai laivai teikia daug galimybių dendrochronologiniam datavimui, tačiau ne visada iš karto gaunami geri rezultatai. Priežastys yra kelios:

Mediena laivų statybai būdavo smarkiai apdorojama, paimti medienos pavyzdžiai dažniausiai neturi balanos, o dendrochronologiniams tyrimams gautų medienos bandinių skalės būna trumpos. Datuoti galima tik turint vienu metu augusių medžių rievių skalių grupę, nes tik tada išryškėja bendros medienos prieaugio tendencijos. Lietuvos pakrantėse sudužę laivai esti nedideliuose gyliuose, dėl to medinės konstrukcijos, kurios išliko virš jūros dugno, yra smarkiai apgludintos bangų ir srovių nešamo smėlio. Todėl net ir mažai apdorotoje medienoje neišlieka paskutinės rievės, todėl neįmanoma datuoti tiksliai.

Dendrochronologinis tyrimų metodas, be datų nustatymo, teikia galimybę nustatyti miško kirtimo regioną. Ši galimybė taip pat yra ribota ir tinka beveik besąlygiškai tik ankstyviesiems viduramžiams. Vėlesniais laikais, ypač naujaisiais amžiais, labai išsivysčius laivų statybai, įvairių kraštų laivų statyklose vis plačiau pradėta naudoti importuota mediena, ir bandymai nustatyti laivo statybos vietą pagal medienos kilmės vietą gali sukelti daugiau painiavos nei aiškumo. Klaipėda kelis šimtmečius buvo miško medžiagos, skirtos laivų statybai, eksportuotoja, todėl straipsnyje pateikti duomenys gali būti aktualūs įvairių šalių povandeniniams archeologams.

Ieškant, registruojant ir tyrinėjant sudužusius ir nuskendusius senovinius medinius laivus negalima apeiti jų liekanų išsaugojimo problemos. Šiuo metu jūriniam kultūros paveldui priskiriami medinių laivų korpusai yra saugomi blogiausiai. Tai iliustruoja laivo 17 (W-17) liekanų likimas. 2009 m. pabaigoje į muziejų buvo nugabentas tik mažas fragmentas 2007 m. pakrantėn išmesto korpuso, didesnė dalis buvo išardyta žmonių ir jūros bangų. Medinių laivų korpusų konservavimas ir eksponavimas yra labai sudėtingas ir brangus. Seklumose esančius ir bangų ardomus bei į krantą išmestus laivų korpusus būtų galima išsaugoti ir eksponuoti po vandeniu, perkėlus juos į 15–18 m gylį, kur nėra didesnių srovių ir bangų poveikio. Nuo suirimo apsaugotos laivų liekanos, sutelktos vienoje vietoje, galėtų būti tolesnių studijų ir povandeninio turizmo objektas, tai palengvintų ir jų apsaugą.