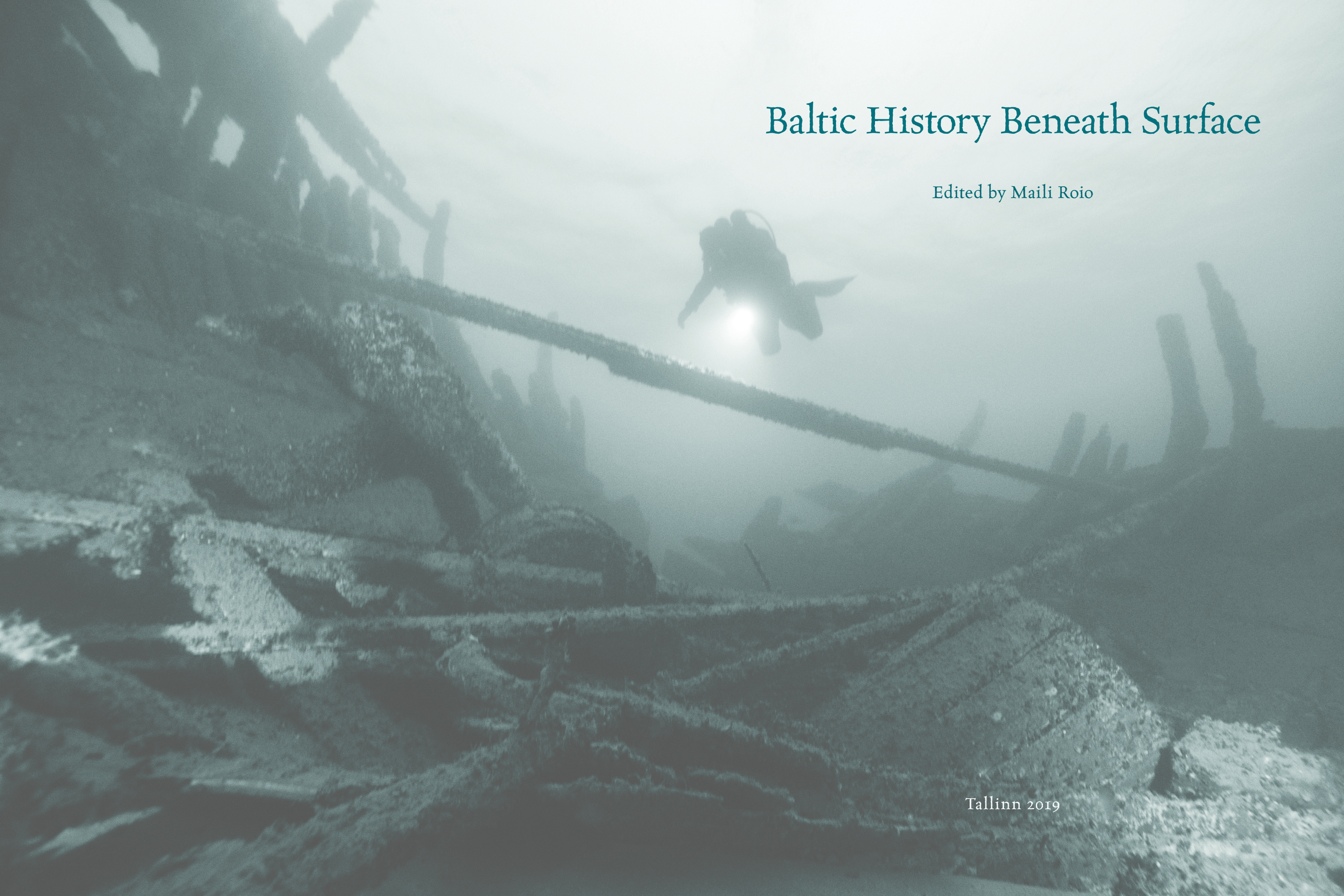
Baltic History Beneath Surface



Baltic History Beneath Surface

Edited by Maili Roio

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Baltic History Beneath Surface
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Going deep into heritage

In his book of essays "The Barbarians" Italian novelist Alessandro Baricco divides people into two groups – surfers and divers. The diver is a vertical man – going deep in looking for meaning. The surfer in his book is the horizontal man, looking for meaning on the surface, in the waves. The diver is more into reading, plunging into the sea of knowledge, the surfer is more about browsing the internet and avoiding falling into the water and going under.

Baricco's metaphors fit well in cultural heritage as well. There is plenitude of people who surf from one heritage site to another enjoying the beauty of accessible and easy to understand human creation over times. And then there are divers – people willing to go beyond what they see on the surface, people who need to understand history and the ways we have lived in depth. We need both – those who look forward, for new horizons and those who look down.

Anyone and anything to do with underwater heritage requires the diver type of thinking and people. There are no fast moves and easy ways of making it available and only patience pays off. For the past three years the Baltacar project has granted an opportunity to research and develop underwater tourism tools for people who are willing to invest into a more difficult and time-consuming interest. Estonia, Finland and Sweden sharing the same *mare nostrum* – the Baltic Sea, share also the history of seafaring and dangers coming from it – the weather, human error and conflict. How ships become wrecks has been the major topic of this project and there is lot to

learn from it. Making the underwater sites and also information about them available tells us stories that cannot be understood only by staying on dry land. Wet vessels, wet merchandise and wet graves make up an often tragic, but nevertheless a more interesting part of history. And as the Baltacar projects shows, there is a lot of it and it is amazing.

I learned from my own diving training and practice (as thin as it is) that going under is easy compared to coming up, so to get meaningful results from the Baltacar project the dissemination of results and follow-up should be taken good care of as well. The Baltic Sea maritime and coastal heritage is rich – we have just only scratched the surface of our common heritage and we need to go deeper!

Siim Raie
National Heritage Board of Estonia

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Introduction to the project

MAILI ROIO

Historical shipwrecks are important elements of the shared past of Baltic Sea countries and non-renewable resources, which are used for scientific research, interpretation of historical events, educational objectives and the development of cultural tourism. Rather little is known about the potential and opportunities offered by the remains of sunken ships at the sites where they perished for the development of tourism. This is why the Baltacar cooperation project of Estonia, Sweden and Finland, which received support from the Central Baltic Programme, has focused on the underwater cultural heritage of the Baltic Sea and cultural tourists who are interested in maritime history, shipwrecks and diving.

The objective of the establishment of underwater wreck parks and trails is to facilitate access to antiquities and ensure their sustainable management at the same time. As diving tourism is still developing, the managers of cultural heritage and the providers of diving services need to start together and follow the same principles. This is the only way to keep the underwater sites, which are sensitive to human impact, open to visitors for a long time.

The regulations for diving to protected wrecks vary from country to country, but we all proceed from the same principles and look for answers to the same questions. What does facilitating access to underwater monuments mean? Depending on the equipment of the diving vessel, localising the wreck at sea and installing the diving rope may take a long time and even end in failure on some occasions. This is why the first step is the installation of anchor buoys near the wrecks, which can be used to fasten the vessels and help divers descend to the wreck. Depending on the wreck, the installed information boards will help divers navigate underwater either alone or with guide ropes. The installation of anchoring systems and information boards supports the protection of the wrecks and safe diving and promotes responsible diving tourism.

The preparation of historical overviews of antiquities and the creation of 3D models are equally as important as the development of activities on sites. The more interesting the story, the more people want to see the site in question. Comprehensive documentation of the wreck site and a 3D model of the wreck are a good start for planning diving and a virtual tour for people who don't want to dive.

The Baltic Sea and diving

The opinion that there is nothing to see in the Baltic Sea, and even if there is something you cannot see it anyway, still prevails. However, this is not always the case. There are regions where you can see further than the diver's hands and even places where visibility is several dozens of metres. Suitable areas must be selected for the development of diving tourism.

The first underwater wreck park in the Baltic Sea was established by the Finnish Heritage Agency in 2000 near the wreck of the Swedish liner Kronprins Gustav Adolf, which perished in the waters of Helsinki, Finland, in 1788. The wreck is located on the Helsinki-Tallinn shipping route and diving would be difficult without an anchor buoy. The cultural path of the site of the wreck was marked with ropes and equipped with information boards that introduce the structure and history of the wreck. For many Finnish divers, this diving park is the place where they celebrate the start of a new season with the first dive. Now, 19 years later, the park of the wreck of the Kronprins Gustav Adolf will also be modernised and several new wreck parks will be established at the sites of the wrecks of sailing ships in the waters of Hanko and Kemiönsaari, which date back to the 17th to the 19th centuries.

In Sweden, the focus is on the development of the Dalarö diving park, which is the first maritime heritage conservation area in Sweden. The park that used to be closed for diving was opened to visitors in 2014. There are many well-preserved wrecks from the 17th and 18th centuries in the waters of Dalarö, which makes it one of the favourite spots of divers. The most famous and visually impressive wreck in the Dalarö diving park is the wreck of Swedish warship Bodekull, which sank in the Stockholm archipelago in 1678. The wreck was only identified as the Bodekull by maritime archaeologist Niklas Eriksson in 2017 and a thorough overview of the events related to the history of the vessel complemented the unique condition of the wreck.

The most suitable regions for the development of diving tourism in Estonia are in the western waters – especially the parts of the Baltic Sea surrounding Hiiumaa and Saaremaa. There is no shortage of interesting wrecks in these waters and many of them are in depths of up to 30 metres, which is suitable for amateur divers. There are well-preserved sailing ships as well as witnesses to the events of World Wars I and II in the waters of Hiiumaa and Saaremaa. In order to balance and diversify the selection of destinations, we selected six wrecks in Estonia that witnessed the events of the Estonian War of Independence and World War I (see register.muinas.ee, reg no. 22265, 27805, 30210, 30392, 30728, 30968).

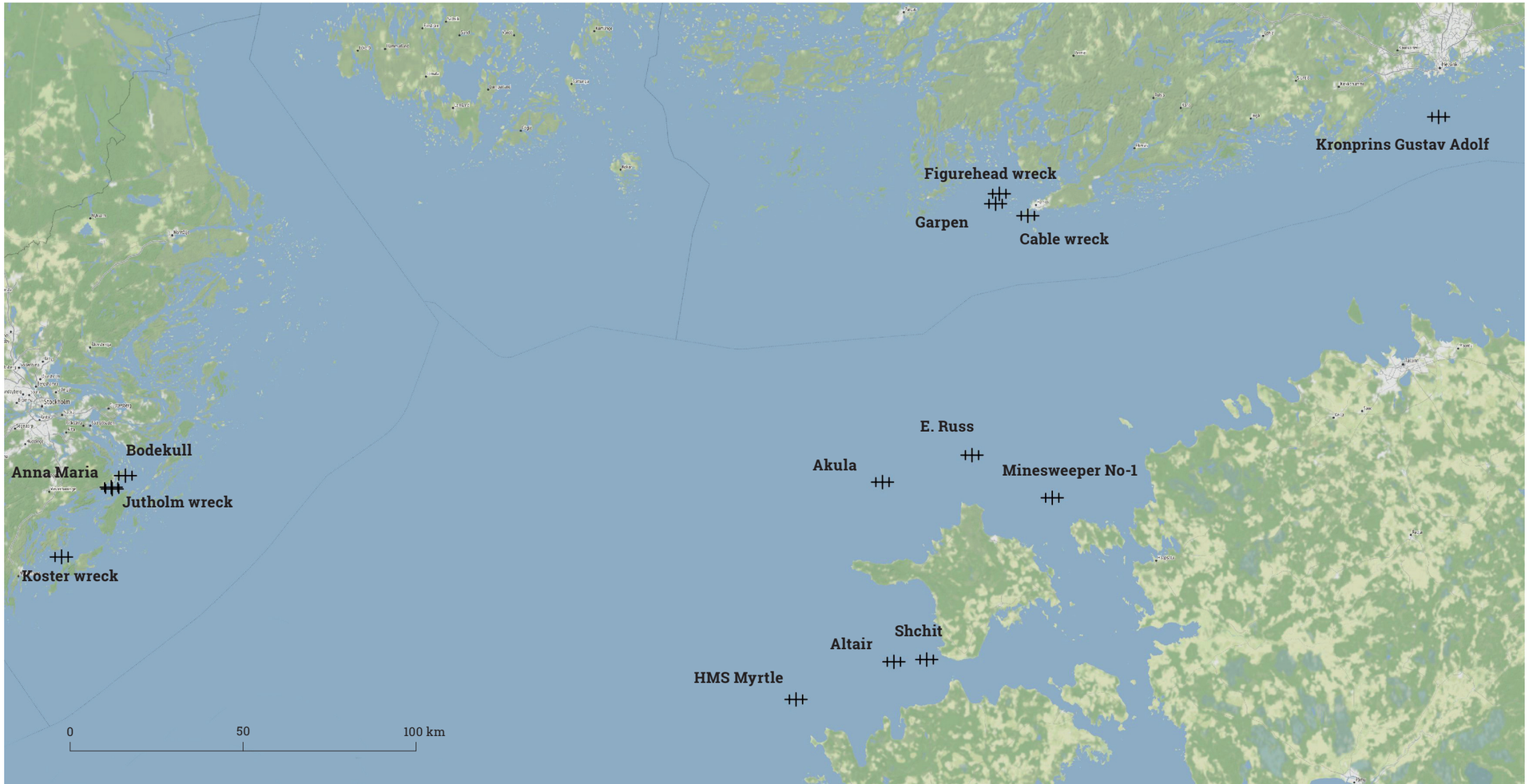


Figure 1. *Destinations developed within the scope of project Baltacar.*

Underwater documentation – is photogrammetry here to stay?

JIM HANSSON

Documenting shipwrecks

Traditionally, shipwrecks have been documented chiefly by photographing, filming, measuring and sketching. These have readily been used as mutually complementary methods in order to ensure good documentation and have been used with success in many underwater archaeological excavations. Other technical tools such as side-scan sonars have been, and still are, relatively clumsy tools for achieving a good image of the status of a wreck. The method is not suitable for documenting and describing the appearance of a wreck and what it was used for but is more a tool for mapping large areas in less time in comparison with the time it would take divers.

Photography is a good method for documenting sections of a wreck site, but above all to achieve more detailed documentation. Photographs are also one of the best means of conveying what a shipwreck really looks like under water. Images have the advantage of being able to show how the real environment looks at a particular moment. The only limitation is that it is almost impossible to get an overall picture of a wreckage site. Often the area is too large to be accommodated in one image, and even if an object is smaller, the often-limited visibility can be a crucial problem. One of the advantages of photography, however, is that it is a relatively simple method to use when documenting.

However, some photo mosaics have been made primarily to get an overview from above. The method has been refined as computers have made it possible to edit in a more satisfactory way. The method places great demands on the photographer and requires knowledge of postproduction techniques.

Today, there are many cameras that require minimal knowledge of photography, and this has facilitated their use. Previously, from a historical point of view, photography has required a greater knowledge of how images should be composed, but above all how they should be exposed. Before digital cameras arrived on the market, there were few underwater photographers who had mastered this. The pictures taken during a dive had to be developed afterwards, which meant that neither the exposure, the right lighting, nor the composition could be secured during the dive. Nowadays, all this can be remedied directly during the dive.

Video footage has the advantage of being able to document a wreck in one go. The method can be used to get a good picture of a wreckage site and its status. Film has also traditionally been used to convey the feeling of a dive but also as the main

medium for creating documentary works. Filming can advantageously be used to produce a sketch. However, references that are visible in the film, such as strategically laid out measuring tape or measurement references on the wreck, are required. The method requires prior knowledge of shipbuilding techniques and certain drawing skills. Filming with a digital camera, which is predominant today, also has an advantage as it is possible to later cut out pictures of different views or objects. It can streamline a documentation because the number of dives can be reduced. The method is also good when establishing a maintenance and protection plan since the wreckage is filmed systematically. It is also possible to cut out pictures that can serve as predetermined photo stations. These can easily be followed up later with the aim of being able to see changes at a wreckage site.

Measurement of a wreck has traditionally been done using simple methods and simple tools. A yardstick can in most cases be used for measuring when documenting detailed objects or smaller areas. In combination with, for example, a grid, greater precision can be obtained. The results in the squares can then be assembled and a larger area is thus measured. The method has long been used and is still used in some cases. However, it is a relatively time-consuming method that requires many dives, depending on the character and size of the wreck and the prevailing depth of the dive.

Documenting a larger wreck area often requires the use of measuring tapes in order to more quickly produce measurements of lengths and widths. The advantage of measuring tape is that combined with predetermined and numbered fixed points, x, y and z values can be obtained, which is the basis of 3-dimensional documentation. The measuring tapes can be drawn between fixed points from different angles and heights, which, combined with triangulation, gives a thorough documentation. However, this requires that the measurement results be supplemented with pictures, video and sketches. The method is time-consuming but can lead to very good sketches. This approach was used in the investigation of the Dalarö wreck/Bodekull between 2007 and 2008. A total of 7–8 weeks of diving and approximately ten divers were required in order to be able to achieve this. The amount of time spent is a crucial factor in underwater investigations. This is one of the reasons why larger and more comprehensive documentation of entire wrecks and wreck sites has rarely been carried out.

The Dalarö wreck/Bodekull

In 2016, we took a course in photogrammetry led by Kari Hyttinen and Immi Wallin at SubZone. The method advocated filming as a method. From the film, images are selected and used as a basis for a 3D model. The method worked well on smaller objects. We found that we could do the work in much less time than if we were applying traditional documentation. However, after several tests in demanding environments, we found it difficult to achieve good results, and switched instead to photographing high-resolution still images.

Within the EU project Baltacar, we were to 3D-document wrecks that are already three-dimensional, namely, with the hull intact:

- the Dalarö wreck/Bodekull – sank in 1678
- the Anna Maria – sank in 1709
- the Jutholm wreck – probably sank around 1700
- the Koster wreck – sank in the second half of the 18th century.

The choice fell on the Dalarö wreck/Bodekull as the first object. The wreck had been previously investigated and documented using traditional methods, so it was a suitable example on which to test the method. Here was an opportunity to observe advantages and disadvantages of the different methods.

The wreck stands upright at a depth of 30 metres and the deck is at a depth of 26–27 metres. This implies a short dive time with regular air. At a depth of 30 metres the diver has 25 minutes from the water surface before having to leave the seabed. A second dive could not be carried out until after at least 4:22 hours, according to the dive table (the Swedish Armed Forces' dive table) and it can then be 14 minutes in duration. The productive time is therefore limited. Good planning and luck regarding visibility conditions was crucial.

This meant careful planning and selection of approaches before starting the documentation. We consulted our colleague Håkan Thorén, who is responsible for 3D-documenting the Vasa, and Ingemar Lundgren (Ocean Discovery) who documented the wreck of the great warship. After discussions, we realised that the Dalarö wreck/Bodekull was probably one of the more difficult wrecks to document. We therefore felt that the documentation should be done by providing the best possible conditions for the program that would process the material, Agisoft PhotoScan Pro (now Agisoft Metashape).

The choice of equipment therefore was a Nikon D810 with two fixed LED lights corresponding to 100 W and a complementary LED lamp corresponding to 300 W, with which diver number two illuminated the wreck. This was a great advantage for the program as the majority of the information gathered by the camera lens is included only when photographing with still images. Certain information disappears if images are cut from a video. The program uses the information from the camera lens to construct the model. We only had one week to perform the dives, so time played a major role in the choice of method. We did not want to risk coming "home" with unusable material.

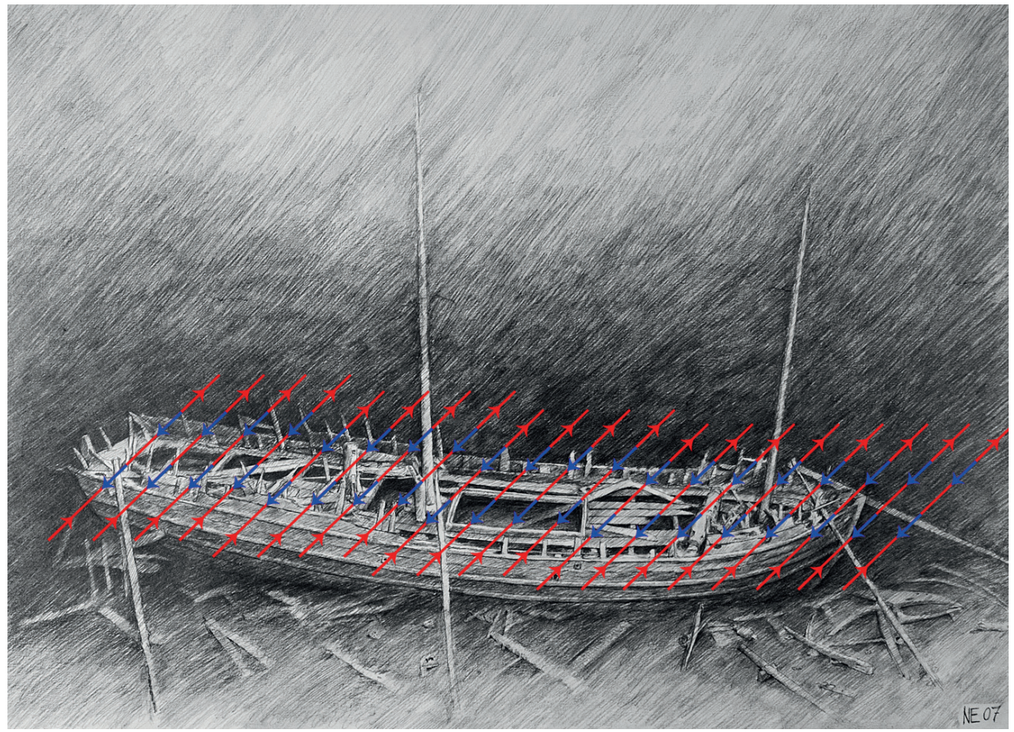


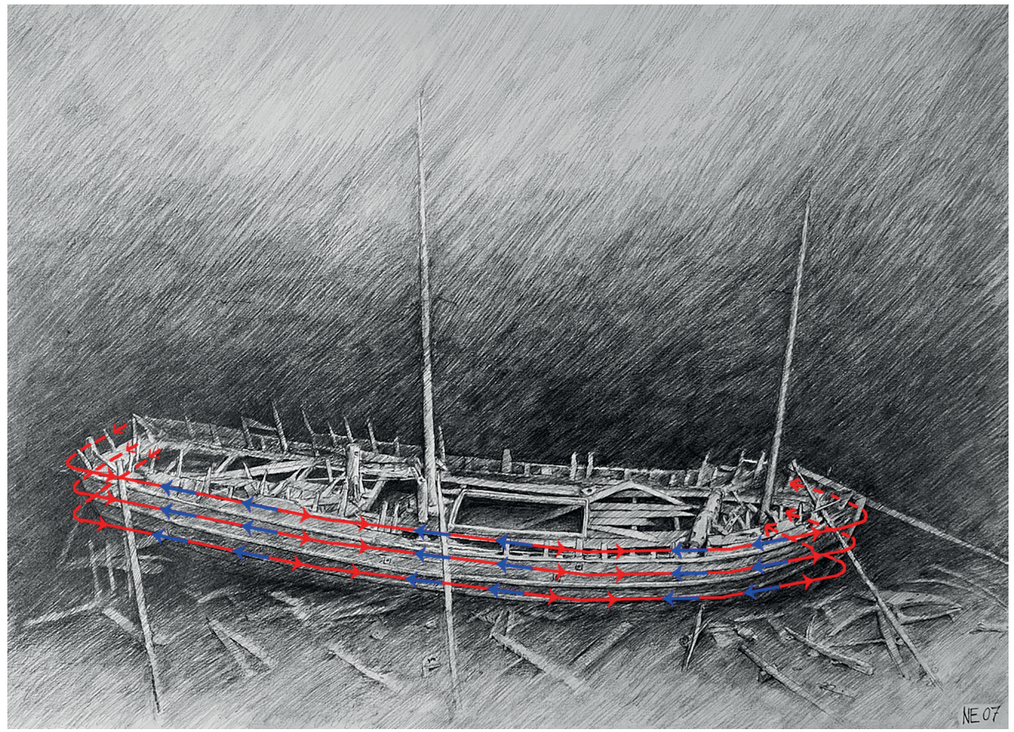
Figure 1. *The image shows how tactical photography was meant to be done in order to secure the overlap. The sketch is one of the results from the investigations in 2007–2008 and is made by Niklas Eriksson. Source: the Swedish National Maritime and Transport Museums (SMTM).*

The tactical setup before the dives was that we would begin by documenting the deck (Fig. 1) and afterwards the hull sides (Fig. 2).

When photographing the deck, we also applied a generous overlap on the hull side. This was done in order to guarantee that in stage two – the documentation of the outside of the hull – we would have sufficient overlap. We did this in order to secure the whole wreck in one go and avoid post-processing the material.

The masts and the projecting yards lying on the seabed were deselected and not documented as these objects would be extremely difficult for the program to assemble. For instance, in the documentation of the Vasa, these ship parts were deselected and modelled afterwards instead.

Figure 2. *The image shows, as in Figure 1, how the tactics were planned before the dives. Sketch: Niklas Eriksson. Source: SMTM.*



Camera settings

Depending on the conditions that would prevail, we planned to set the camera between 2000–3600 iso (light sensitivity), and with manual focus at a distance of 50–70 cm. The images were to be taken at a maximum distance of 1 metre to reduce the risk of particles interfering in the water space in front of the lens. The aperture was set between f stop 8 and 10 and the shutter speed was at least 1/15, but preferably 1/50 or higher. During our dives we landed within all these parameters which was very good. The natural conditions shifted from day to day: varying visibility, current, light conditions, water particles and so on. All of this made the documentation considerably more difficult, which meant that we had to supplement some areas on the deck that the program failed to assemble. Between the dives, images were uploaded and tested immediately in Agisoft to enable quick additions during the "second dive" and to plan the diving in an efficient way. The images were saved in the camera both as raw images and jpeg. This is because jpeg, which is a smaller file format, was ideal for processing on the boat directly after the dives in order to check whether the model came together. The raw images could be used if the model was not successful, but were also collected for preventative purposes so as to be used in other contexts, such as in an exhibition or for VR/AR. The memory cards used were SanDisk Extreme Pro 128 GB. These were highly suitable as the images that were taken were saved quickly. This meant that no unnecessary pauses in the photography were needed while waiting for an image to be downloaded into the camera if the memory card had been slower. This was a great advantage also because it minimized the risk of losing "the common thread".

The tactical method

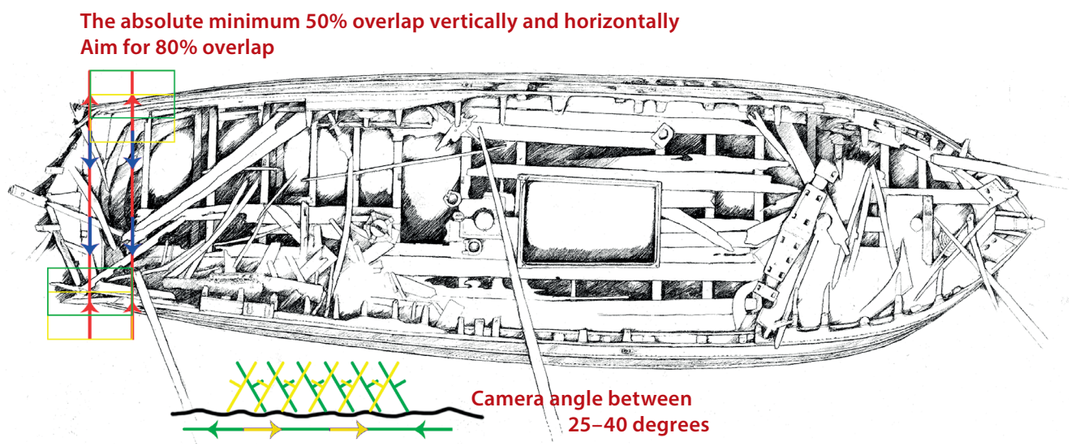
The goal was to shoot straight lines and to never lose the predefined line. In the case of the wreck in question, this led to very complicated photography versus diving technique. The photo series had to be overlapped in many cases by almost 100% to ensure that it would be possible to achieve a complete model. The photography was in principle carried out according to Fig. 3.

We had a camera angle between 25–40 degrees in both directions in the same stretch. On the hull side, a smaller angle could be maintained as it was a much easier and flatter surface to document.

It was very important that the overlap was relatively large around the stern and stem.

Eighteen dives were carried out and a total of about 10,800 photographs were collected. Of these, the program managed to assemble 10,400 on the first attempt, which may be considered something of a success. There were some additions during the course of the trip, due to the fact that some dives did not succeed in being incorporated into the ongoing process. This was due to the extremely large number of particles in the water space. The camera's measuring system focused on these, which meant that Agisoft could not find common points in the images. But after additional photography, the program managed to assemble the whole wreck, together with parts of the seabed, into a single point cloud (Fig. 4).

Figure 3. *The image shows how the lay-out looked before the dives, with the overlap and the angle of the camera towards the deck in particular. The hull sides were to be photographed at a much smaller angle. Sketch: Niklas Eriksson. Source: SMTM.*



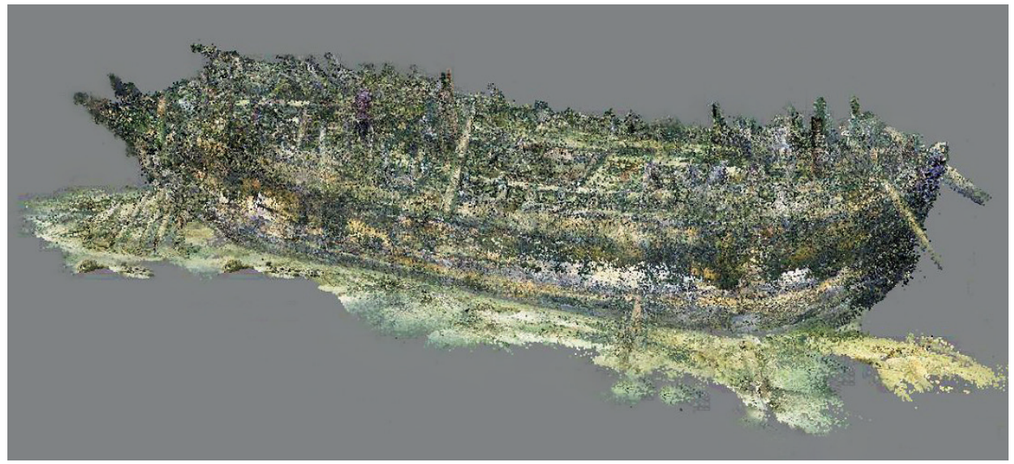


Figure 4. *The point cloud.*
Image: Jim Hansson. Source: SMTM.

In stage 2, Dense Cloud, it became necessary to split the wreck into several chunks (squares). In total, there were 18 chunks that could then be processed. Stage 3 (building the mesh) and 4 (building the texture) could then be done relatively easily and with good results. The result was a high-resolution model that was of very high quality (Fig. 5).

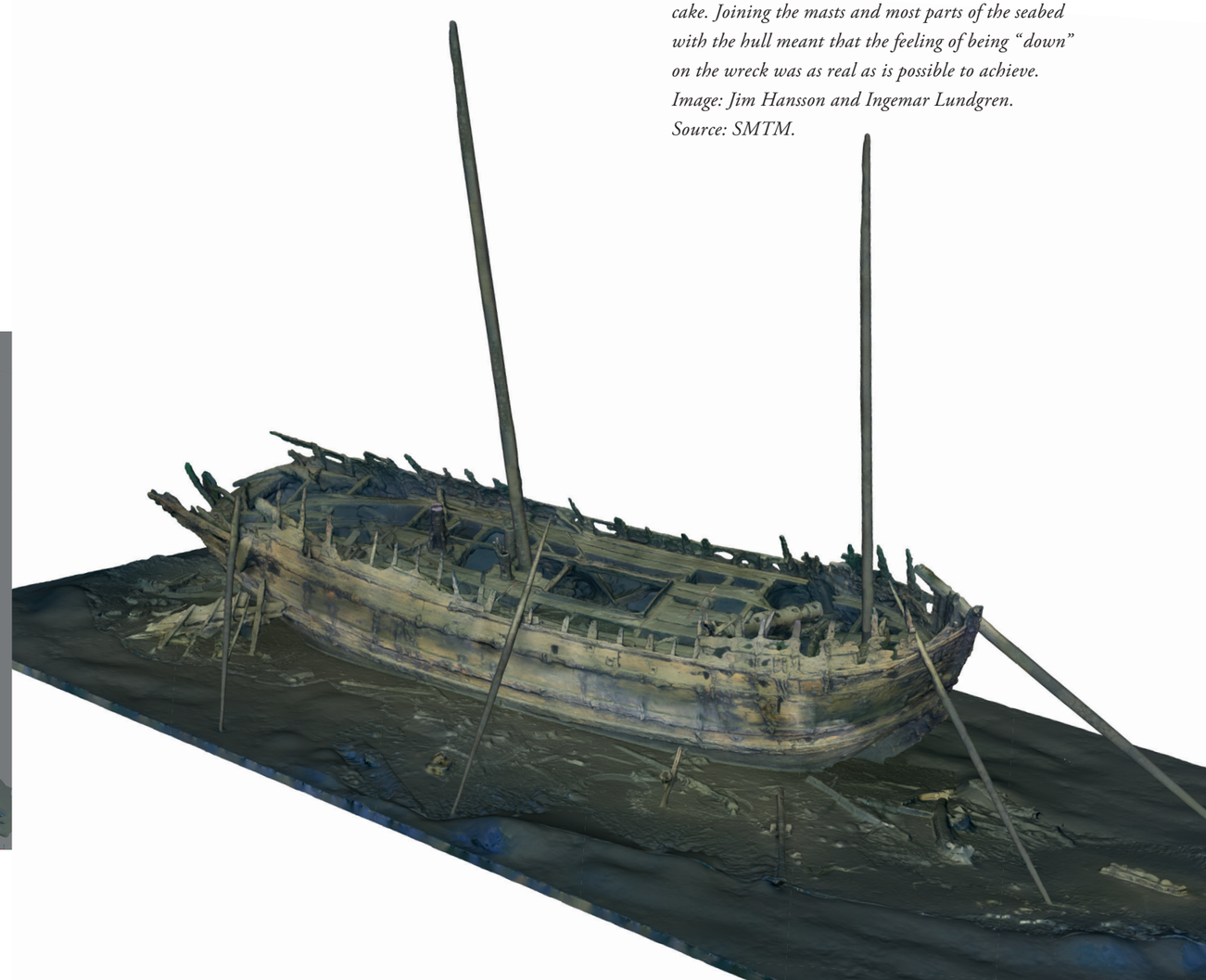
Figure 5. *The result exceeded expectations. The result was highly detailed and mirrored the wreck at a whole new dimension.*
Image: Jim Hansson. Source: SMTM.

In spite of this, the model was not complete, but lacked two masts that are still in place on the ship, as well as large parts of the seabed that there had been insufficient time for during the first week of dives. Additions were therefore made at the end of 2017, where the seabed sections that were missing were photographed. On this occasion, there was a lot of current in the water, mainly on the port side, which made it difficult to photograph with satisfactory results.

During the autumn of 2018, Ingemar Lundgren (Ocean Discovery) was hired to model the masts and incorporate the new images we took of the seabed in the first model. It turned out that the port side could not be constructed, but that side had almost no finds, except for a large anchor. On the starboard side, however, most of the seabed and loose wreck parts were successfully joined with the original model, among other things, the galleon lion. We obtained an almost complete picture of the entire wreck site and a model that truly reflects the experience of being at the seabed.

The result was a top-class model that also ended up on the web-based 3D player Sketchfab's worldwide top 10 list during the week the model was launched. The complete model of the Dalarö wreck/Bodekull shows almost exactly how the wreckage site looks (Fig. 6). The model turned out better than we had hoped and can now be used in a variety of contexts.

Figure 6. *The complete model was the icing on the cake. Joining the masts and most parts of the seabed with the hull meant that the feeling of being "down" on the wreck was as real as is possible to achieve.*
Image: Jim Hansson and Ingemar Lundgren. Source: SMTM.



The Anna Maria

After the dives on the Dalarö wreck/Bodekull, the collection of material on the wreck of the Anna Maria continued. This is also a very well-preserved intact wreck, although considerably larger. The wreck measures about 38 metres in length and 8 metres in width. The highest point of the protruding preserved side of the hull rises almost 8 metres above the sea bed (Fig. 7). The depth at the wreck site is between 14 and 21 metres.

In comparison with the Dalarö wreck/Bodekull, we had to plan the photography using different tactics because of these conditions. During the first dives it turned out that visibility was only between two and three metres, which made photographing more difficult. There were also large particles in the water space. Since the wreck has such large surfaces, mainly on the outside of the hull, it became difficult to determine where we had photographed and therefore also more difficult to ascertain whether the "common thread" was maintained. The photographing continued for four days, four dives a day. A total of more than 23,000 images were collected. During the evenings, the pictures were tested in Agisoft to see if it could merge them. They turned out to be much harder to assemble than the pictures of the Dalarö wreck/Bodekull. Several dives had to be added in order to supplement different areas, partly the hull and partly the ship's parts on the seabed. On the hull side, this was probably due to the contrast of the black oak hull and large numbers of snails, which made it difficult for the program to recognize the same points in different images. On the sea bed, the biggest problem was that a thin layer of sediment partly covered the ship's parts, and partly covered the seabed, which reduced the contrast in the pictures. This meant that there was insufficient contrast in all the images, which caused problems for Agisoft to find similarities in the images.

The number of images was extremely large compared to previous underwater models, which caused major problems for the computer. With a special script, the aligned images could be divided into the desired number of chunks. The advantage of this is that the computer only processes the images in each chunk separately and thereby saves computing power. In total, the Anna Maria was divided into 42 squares in order to cope with stage 2, Dense Cloud. One problem in stage 2 was nevertheless that it took an extremely long time. Some squares took up 5–6 days

Figure 7. *The picture shows the high stern that rises almost 8 metres above the sea bed. Photo: Jim Hansson, SMTM.*

to process and sometimes the computer also crashed, and the process had to be started over. One of the problems may be that too many images had been taken of one and the same surface in order to succeed in aligning the images, which therefore contributed to the extended time used.

When stage 2 was finally finished, it was clear that there were several things that were not entirely satisfactory. The program had difficulty assembling the tops of the frame in some smaller areas. This was probably due to the fact that the images were taken from far too great a distance. This also meant that lots of particles in the water space were caught in the image.

Before beginning stage 3, we began extensive work to clean up the model. The work was time-consuming as it was difficult to clear points without affecting the wreck itself. However, this was facilitated by the fact that the wreck was divided into 42 chunks.

After that, it was time to create a mesh. When the mesh was finished, all chunks were put together, after which the texture was created. The result was surprisingly good considering all the previous attempts (Fig. 9).

Figure 8. *In Stage 1 (aligned photographs) in Agisoft, however, 23,267 images were able to match each other. Image: Jim Hansson. Source: SMTM.*

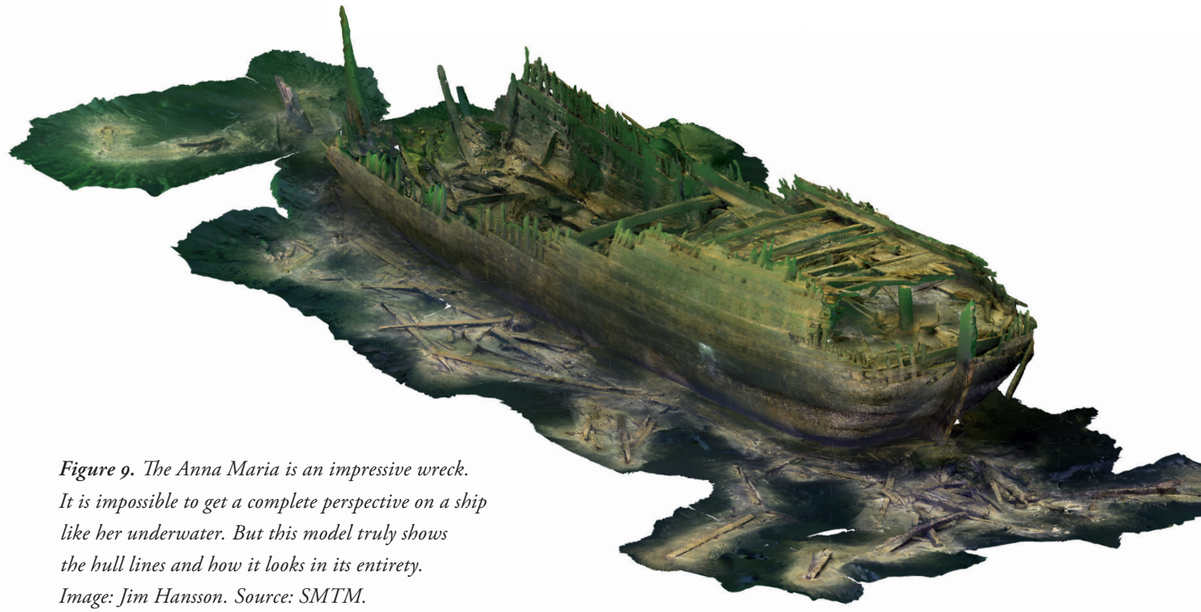


Figure 9. *The Anna Maria is an impressive wreck. It is impossible to get a complete perspective on a ship like her underwater. But this model truly shows the hull lines and how it looks in its entirety. Image: Jim Hansson. Source: SMTM.*

The Jutholm wreck

During the week that was spent collecting material for the 3D model of the Anna Maria, we were granted one extra day which we devoted to photographing the nearby wreck east of Dalarö harbour called the Jutholm wreck. This wreck lies at a maximum depth of 12 metres, which meant that between 4 divers there was an opportunity to collect enough material for a 3D model. The dive times become almost unlimited. The wreck is 25 metres long and about 7 metres wide and the hull is almost intact. The stem is impressive and protrudes about five metres above the sea bed (Fig. 10).

However, the conditions proved to be difficult. There was a relatively strong current at the wreck site, which made it extra difficult to photograph in a satisfactory manner. It also created aggravating circumstances in the water space, plant parts and algae floated with the stream and entered the camera image. In addition, there was a clear blue sky which led to strong natural lighting down onto the wreck site. The fact that there was backlighting in one direction and darker surroundings in the other direction, complicated the situation. The first attempt to render a 3D model of the Jutholm wreck was not satisfactory (Fig. 11).

One day's diving with four different photographers resulted in material that was not able to give an overall image of the ship. In December 2018, we had the opportunity to supplement the material with new pictures of areas on the wreck that had not turned out well. After testing other settings, the program aligned the wreck. This meant that we could get a complete model. In stage 2, Dense Cloud, it turned out that because of the higher settings in stage 1, particles and floating seaweed were also incorporated into the model. We returned to the point cloud where clearing these out was easier. The result was a genuinely nice model of the Jutholm wreck (Fig. 12–14).

Figure 10. *The view towards the Jutholm wreck's stem in the direction of the surface is impressive. Photo: Jim Hansson, SMTM.*

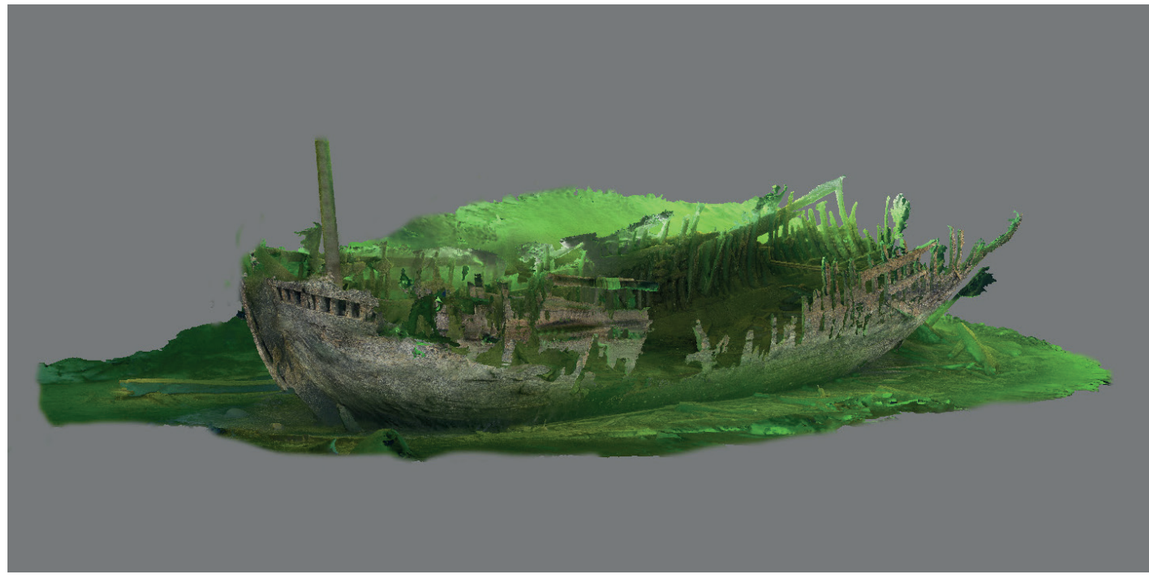


Figure 11. *A lot is missing on the model. Among other things, the stem is not included, and large parts of the port side are not included. Additions had to be made if it was going to be possible to get a complete model. Image: Jim Hansson and Håkan Thorén, SMTM.*

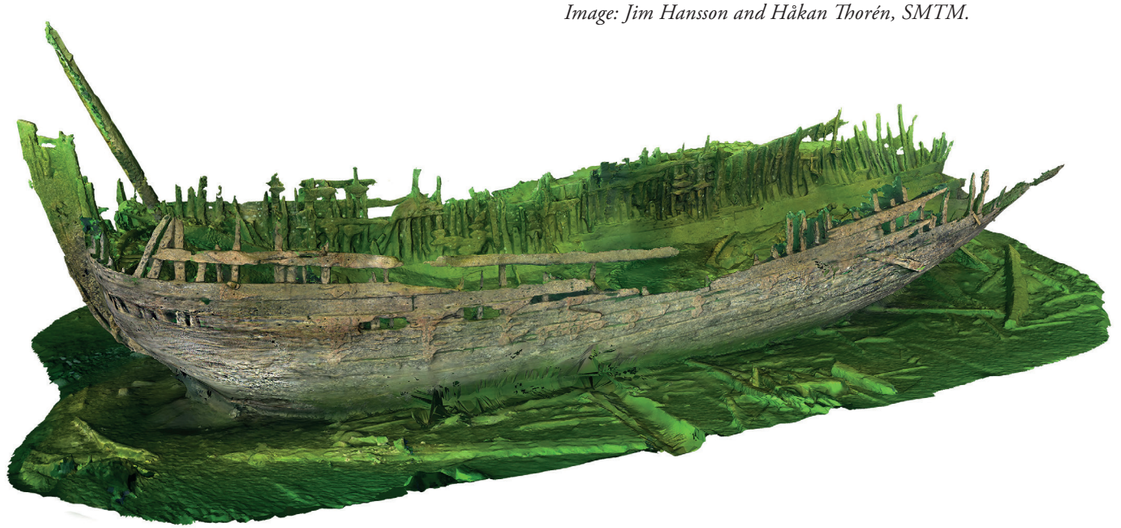


Figure 12. *Ultimately, the model of the Jutholm wreck turned out really good. Here is an excellent image of the excavated wreck and its remains. Image: Jim Hansson and Håkan Thorén, SMTM.*

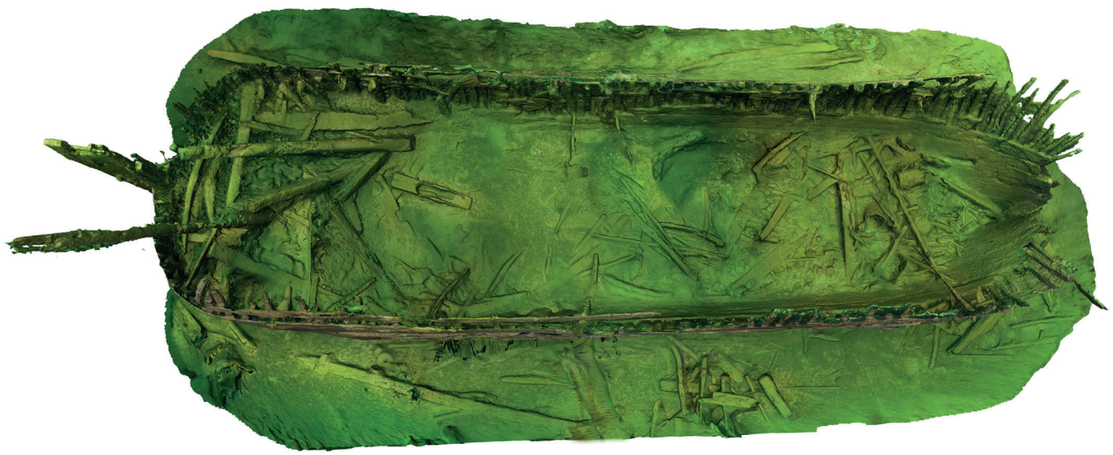


Figure 13. *The wreck is almost totally empty after the big excavation in the 1970's.*
Image: Jim Hansson and Håkan Thorén, SMTM.

Figure 14. *Here is a view of the stern.*
Image: Jim Hansson and Håkan Thorén, SMTM.

The Koster wreck

This wreck was not selected for 3D documentation because of the considerable depth of the dive, 36 metres. In addition, the wreck is located in such a position as to be extremely exposed to weather conditions and the allowed field time was limited. All of this together meant that we felt that the chance of getting together a model was minimal.

Summary and evaluation

The development of the 3D models of the Dalarö wreck/Bodekull, Anna Maria and Jutholm wreck has proved to be a rather difficult task. The selected wrecks were already previously some of the most complicated objects to photograph for 3D, partly because of the depths with limited time at the seabed as a result, and partly because they are already in 3D; that is, the hulls are intact. The first attempt within the scope of the project, the Dalarö wreck/Bodekull, turned out more than successful, although a lot of consideration was needed regarding the settings in Agisoft because of the large number of high-resolution images (11,000). The result exceeded expectations and received a lot of attention in traditional and social media, not only in Sweden but also internationally.

As far as the photo-technical details of collecting and processing are concerned, it is clear that in the future we can develop a better method for collecting the images. Especially in the case of the Anna Maria, where varying image quality and prevailing seabed conditions ultimately resulted in a huge number of pictures. The amount would have been considerably smaller if we knew then what we know now. Photographing should also be done as uniformly as possible, which can be difficult when there are several photographers involved. Also, the distance between camera and wreck is very important for the end result. It should not exceed about 70 cm. Unfortunately, this shifted, and contributed to the model not achieving the sharpness or composition desired.

It has been found that photogrammetry also works well in exploitation archaeology, as a quick method of documenting wrecks and areas. The method provides a very detailed picture of the wreck and has a high level of precision for retrospective measurements.

The 3D models developed within this project truly reflect the Baltic Sea's fantastic preservation possibilities. A wreck can be presented as close to reality as possible. The models are also excellent as tools for showing non-divers what a wreck site looks like and can thus increase awareness of how special and amazing the Baltic Sea is. The material can also be used in museum exhibitions in the form of AR or VR. To see a model in a large dome is, in my opinion, the closest you can come to a genuine dive.

Some final tips: photograph at a maximum distance of 70 cm, use as few photographers as possible on the same wreck, be sure to stick to the common thread, and shoot at a maximum 45-degree angle to the object. If these tips are observed, there is excellent potential for creating a fantastic model that you can be proud of. Photogrammetry is a documentation method that is here to stay.

Malpractices of the Saaremaa manorial lords in rescuing wrecked ships

KERSTI LUST

Introduction

It was common tradition that if a ship was in distress, the local people had the right to seize the cargo that was washed into the sea or salvaged. In several cases in Estonia, vassals and manorial lords took up the habit of the coastal folk (Liiv 1932; Tarvel 1983, 201–203; Peetsalu 2013, 750; Saar 2015, 568). Over the centuries following the conquest in the early 13th century, territorial lords as well as state authorities tried to repress these practices by orders and prohibitions. In the last quarter of the 18th century, legal changes reversed these ages-old practices. The 1781 maritime law of the Russian empire stated very precisely who must help a ship in distress, who should oversee it, and how their efforts should be rewarded, entitling the "rescuer" (in practice, the manorial lord) to a large salvage reward and the official who oversaw it, to a quarter of it (Lust 2017, 74–75). As a result, both salvaging and shipwrecking were subjected to the interests of the manorial lords. While the Swedish sea law of 1667, which was in force also in the 18th century, limited the salvage reward amount to maximum 60 *dalers*, the Russian maritime laws made its amount dependent on the value of the cargo (Lust 2018, 182). Maritime law also considered the distance from the ship to the shore. A distance of up to one *verst* (approximately a kilometre) entitled the rescuer to one sixth of the cargo's value; a greater distance entitled him to a quarter.

How frequently grounded ships really fell to wrecking cannot be read from archival sources, but they record very few such cases in connection with maritime accidents. Court records about the coastal folk of Saaremaa from the 1780s to the 1870s indicate that they pillaged items of little value (RA, EAA.968.1. 2334; 2371; 2729; 2747, 2749)[1] and in any of these cases, it was the local landlord who first notified the authorities. Land police archive of Saaremaa that might reveal a lot about wrecking practices contains only pieces. When, in addition to receiving a salvage reward, the manorial lords wanted to benefit from the shipwreck, they did not need to seize ship parts and the cargo of shipwrecks illegally, especially considering that, if discovered, they would have lost the salvage reward. Rather, they had other means of manipulation (Lust 2017, 78–82). In contrast to Hiiumaa, Vormsi and some other coastal areas, cases where skippers, merchants

1 By contrast, in the early 20th century there were cases on large thefts. See e.g. *Pernausche Zeitung*, 25 May 1912.

or insurers accused coastal landowners of serious abuse in administrative or law institutions are unknown from Saaremaa. Hence, we lack investigation materials that usually allow insight into carefully hidden practices. However, it might be wrong to conclude that the manorial lords of Saaremaa did not use unfair practices. By relying on very fragmentary archival sources, this article aims to show that manorial lords used opportunistic measures to benefit from wrecks until at least the 1860s. Two earlier works have discussed the legal context of shipwrecking in the Baltics already (Lust 2017, 73–77; Lust 2018, 179–187). This paper illustrates in more detail the means of manipulation that have been briefly mentioned before. The data has been collected by going systematically through the shipwreck-related records at the National Archives of Estonia and the Latvian State Historical Archives.

The sea off the west coast of Saaremaa, near Vilsandi and Sõrve, is rich with reefs and banks (Fig. 1). From 1856–1871, 43 vessels ran ashore near Vilsandi and the Harilaid peninsula on the northwest coast of Saaremaa (Peetsalu 2013, 302). However, in close proximity to dangerous rocks and shallows are natural harbours of refuge where vessels can obtain good anchorage. Not only vessels sailing to Riga ran ashore on the west coast of Saaremaa, but also bigger ships carrying precious and desirable goods from West Europe to St Petersburg stranded here.

Figure 1. *Map of the sea off the west coast of Saaremaa. Map: LVVA.6828.4.342, fol. 1 Charte von der Province Oesel (1823).*

Who salvages and receives a reward for it?

Russian maritime laws entitled "anyone" who helped with the rescue and provided shelter to the people, cargo, and crew's things to a reward from the ship owners, but, in reality, the reward was usually received by the landowner, i.e. the manorial lord (Lust 2017, 78). The fact that in the parish of Kihelkonna several estates bordering the sea were in state (crown) ownership and on the Sõrve peninsula there were two estates of such type, it made it at the beginning difficult to decide, who actually was "anyone" whose efforts should be rewarded according to the new law. Furthermore, from 1783 to 1796 the Regency Era in Estland and Livland rather favoured the participation of peasants in courts and public spheres of life. On 16 December 1790, Kuressaare district prosecutor Johann Andreas Agthe wrote to the provincial prosecutor that state peasants are entitled to a salvage reward and this article of the maritime law should be read out to them from pulpit every year (LVVA.7465.1.128, ff. 45–46v). In 1791, vice-governor Balthasar von Campenhausen (1783–1797), however, ordered that only manorial lords, among them also renters of state estates, were entitled to rescue rewards. In his words, peasants of Saaremaa who have "misunderstood" the imperial sea law have flocked to wreck sites to help vessels in distress and this has led to thefts of wrecked goods and deceptions (LVVA.7465.1.128, ff. 54–54v). Normally, salvaging peasants were compensated as workers and either paid daily wages or the days spent salvaging were deducted from the workdays they owed the manor.

Livonian manorial lords vehemently defended their "entitlement" to a salvage reward from the ships that stranded in their waters, even in such cases, when they were not involved in salvage operation at all (e.g. LVVA.7465.2.77; EAA.1000.1.3925, ff. 58–59). A specific territory without clearly established borders was between Hiiumaa and Saaremaa. The ship could drift to "other's" waters also because of wind. In their fight for the right to salvage the ship (i.e. receive the salvage reward), local landlords asked both county magistrate and coast guards to go with them to the ship (EAA.625.1.446; EAA.30.1.9183). The coast guards threatened the other party with guns, forcing them to leave the ship and allowing "the rightful landlord" to salvage the cargo. In 1845, the "rightful landlord" demanded that the "unlawful" rescuer of the Pohjantähti would return the salvaged cargo and rigging (EAA.625.1.446). In fact, the law did not limit the right to salvage to the closest landowner. The person whom the captain had authorized to carry out the salvage operation was entitled to a salvage reward.

A particular scheme for sharing the salvage was adopted in the parish of Kihelkonna and on the Sõrve peninsula, where manor borders in the water could not be easily followed and, instead, the salvage reward was divided between several manorial lords (LVVA.4.1.16986; Lust 2017, 78). Such an arrangement caused bad blood, and deals and disputes among the various parties were rife. In 1836, the English brig Brunswick with precious cargo ran ashore here. The lord of Loona manor, county judge Huene, complained to the Governor of Livland that his vessel commanded by an overseer was not allowed to participate in the salvage work (LVVA.4.1.46397, ff. 2–3v). The authorities did not satisfy Huene's request to be nevertheless awarded a reward in goods, although in his opinion it would have been the best way to prevent similar abuses in the future. On 11 December 1836, county magistrate Buxhoeveden explained to the governor that he had sent word to the manors to come to rescue the brig lying 15 versts off the shore (ibid., ff. 5–9v). Manorial lords were required to provide each rescue barge with an official permit which had to be shown to the person in charge of the salvage operations. The barge of Loona manor did not have such a permit and it also did not fit well for salvaging cargo. In 1844, the lord of Pilguse manor, Nolcken, complained to the authorities that he would have liked to be involved in the salvage operation of the Dankbarkeit and receive a reward but the renter of Karala manor, Friedrich Schorning, had driven his rescue barges Sturmjagd and Werpprahm and men away when county judge T. von Buxhoeveden arrived at the site.

The county magistrate had rejected his complaints (EAA.291.1.8810; EAA.291.1.8307).

Withholding information was commonplace (EAA 625.1.499; EAA 625.1.414), since everyone tried to be the first to arrive at the wreck site. On 4 October 1832 clerk Schulz informed Kuressaare merchant Schmidt about a wrecked champagne-ship with a delay in order to avoid quick spread of the information so that their vessels could arrive at the site before the others (Fig. 2). He tried to avoid the participation of other coastal lords like von Dittmar and Huene as well as the watchful eye of the county magistrate[2]. A few days later, when the news had already spread, Schulz insisted that neither country magistrate nor the customs officers "need to come here" (EAA.625.1.399). Similar short notices that have been preserved in a few files of the Schmidt trading house reveal that the manorial lords tried to keep the other neighbours away (EAA.625.1.498) and accused them of playing tricks or making blatant demands (EAA.625.1.414).

The captain or the cargo owners accused the manorial lords of rescue "against the will" when the captain thought that the ship could have made it without the eager "help" sent from shore. On 24 March 1787, the Livonian vice-governor issued an order prohibiting forceful rescuing of ships. In September 1848, the English ship Lamont ran ashore near Karala and the leaseholder of Karala manor, Friedrich Schorning, and the leaseholder of Tagamõisa manor, Friedrich von Buxhoeveden, salvaged part of the cargo. Thereafter the ship got off. The salvors, however, claimed salvage for the ship and the whole cargo (EAA.291.1.13594). Cargo owners sued them to the land court but finally the parties reached an out-of-court agreement: the salvors dropped their claim for a reward of 5142 roubles for rescuing the ship and agreed on a reward of 6856 roubles for salvaging part of the goods. In doing so, Schorning and Buxhoeveden got also into fight with each other. In 1844, Buxhoeveden tried the same trick with the Danish ship Old Peter and the claims adjuster (*Dispacheur*) in St Petersburg, indeed, agreed to pay, besides the salvaged goods, also for the rest of the cargo and the ship (EAA.625.1.90, ff. 107–107v, 114–115). In 1846, the Anne from Liverpool ran aground on the island of Saaremaa, but got off and reached St Petersburg. The consignees agreed to a salvage of 25% in money or kind on the goods detained by T. von Buxhoeveden at Saaremaa and to an additional payment of 1200 roubles for rescuing. In their letter to Schmidt from 9 August 1846, the consignees did not hide their resentment: "Capt. Heppel committed the indiscretion in employing boats from the shore to lighten his ship, of allowing people from the island to assist whereas his own crew was quite sufficient to have got his ship off." (..) The consignees found the above-mentioned salvage for "mere common labour of discharging the goods from a vessel in little or no danger" "anything but equitable" (EAA.625.1.93, ff. 288–289).

In 1836, the seamen from the English brig Brunswick complained "loudly" to British consul Robert Hay in Riga about the plundering of their clothing, provisions, charts, etc. by men who "forcibly entered the vessel under the plea of giving assistance." Robert Hay threatened C. F. Schmidt to lay the list of stolen articles before the governor and to ask him to punish the guilty (EAA.625.1.84, ff. 159–159v). We do not know whether Schmidt asked to change his mind. In the mid-1840s, some unpleasant rumors about the use of "right to wreck" (*Strandrecht*) on the coast of Saaremaa reached the Baltic governor-general. He asked the head of the Livonian governorate for a report. On 29 March 1846, the governor replied that these rumors have no grounds and "aside these two cases (Dankbarkeit and Pohjantähti – author) the authorities of the governorate have not been notified about any violations of the rescue rules on the Island of Saaremaa" (EAA.291.1.8810).

2 County magistrates received one quarter of the salvage reward for overseeing the salvage operations and for organizing the auction of the items salvaged.

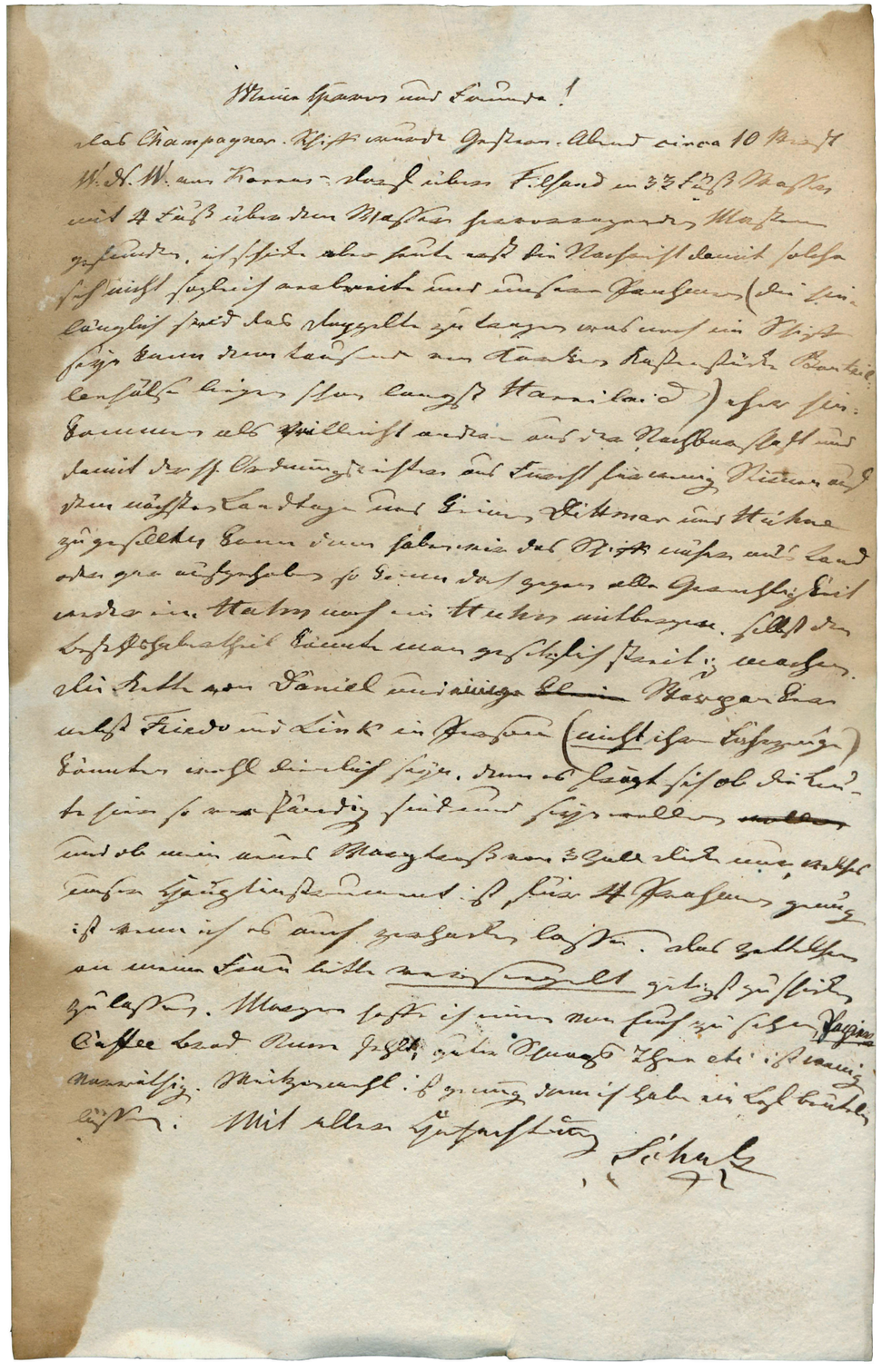
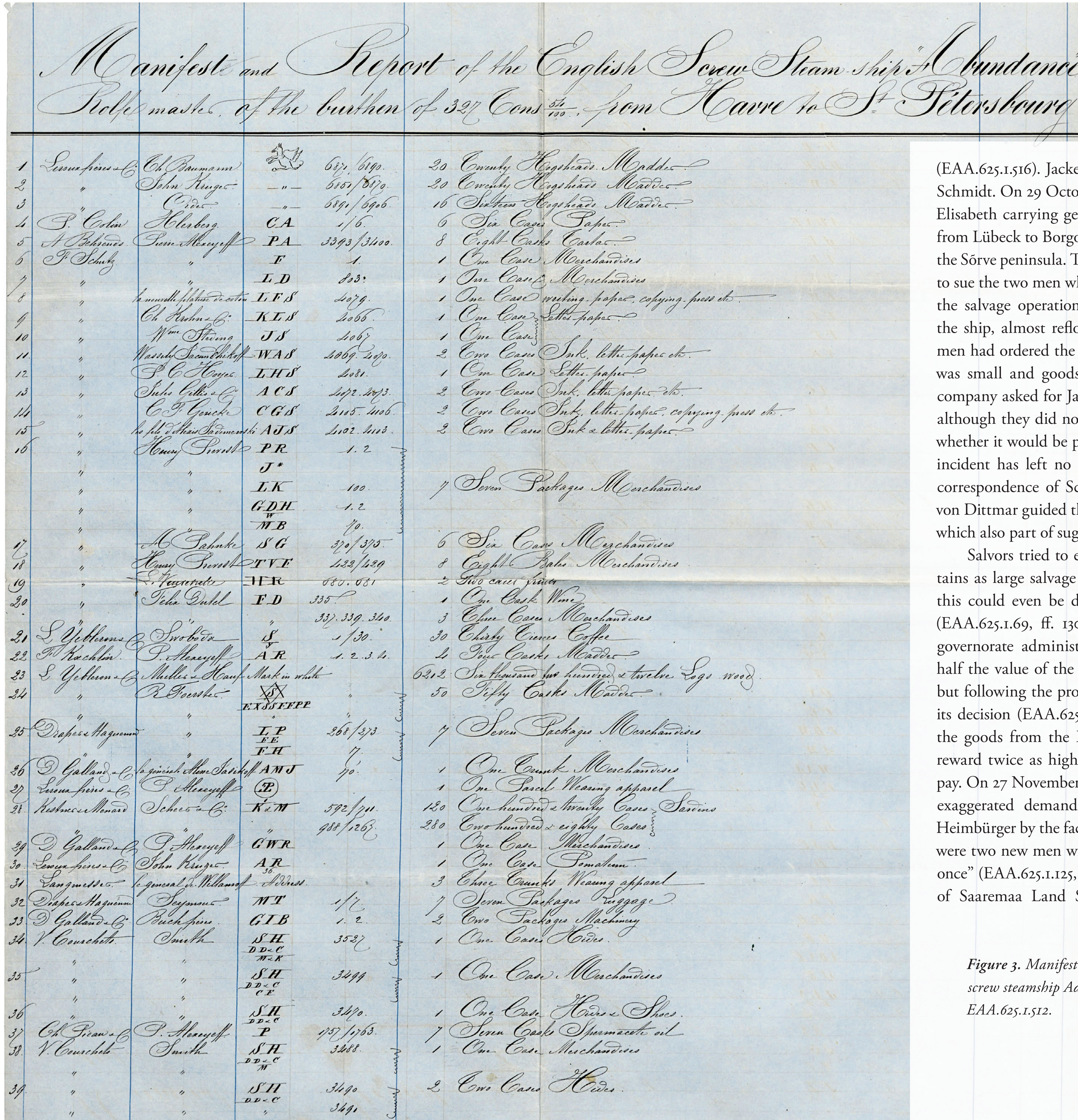


Figure 2. *Letter of Schulz to Schmidt about the wrecked champagne-ship Zufriedenheit, 4 October 1832. EAA.625.1.399.*



Manifest and Report of the English Screw Steam-ship "Abundance" Rolfe master, of the burthen of 327 Tons 64/100, from Havre to St Petersbourg

1	Lemaire frères & Co	Ch. Baumann		6871/6890	20 Twenty Hogsheads Madder
2	"	John Kruger	— " —	6851/6879	20 Twenty Hogsheads Madder
3		Order	— " —	6891/6906	16 Sixteen Hogsheads Madder
4	P. Colin	Helsberg	CA	1/6	6 Six Cases Paper
5	A. Behrend	Prem Alexeyeff	PA	3393/3400	8 Eight Casks Tartar
6	F. Schultz	"	F	1	1 One Case Merchandises
7	"	"	LD	803	1 One Case Merchandises
8	"		LFS	4079	1 One Case writing paper, copying press etc.
9	"	Ch. Roehm & Co	KLS	4066	1 One Case Letter paper
10	"	Wm Stirling	JS	4067	1 One Case
11	"		WAS	4069. 4070	2 Two Cases Ink, letter paper etc.
12	"	P. C. Hoyer	LHS	4081	1 One Case Letter paper
13	"	Julius Gillis & Co	ACS	4072. 4073	2 Two Cases Ink, letter paper etc.
14	"	C. F. Gouche	CGS	4105. 4106	2 Two Cases Ink, letter paper, copying press etc.
15	"		AJS	4102. 4103	2 Two Cases Ink & letter paper
16	"	Henry Prevost	PR	1. 2	
	"	"	J*		
	"	"	LK	100	7 Seven Packages Merchandises
	"	"	GDH	1. 2	
	"	"	MB	70	
17	"	A. Pahnke	SG	370/375	6 Six Cases Merchandises
18	"	Henry Prevost	TVE	422/429	8 Eight Bales Merchandises
19	"		HR		2 Two cases
20	"		FD	335	1 One Cask Wine
				337. 339. 340	3 Three Cases Merchandises
21	L. Yeltheim & Co	Swoboda	S	1/30	30 Thirty Tierces Coffee
22	F. Kochlin	P. Alexeyeff	AR	1. 2. 3. 4	4 Four Casks Madder
23	L. Yeltheim & Co	Miller & Hauf	Mark in white	6212	Six thousand two hundred & twelve Logs wood
24	"	R. Forster			50 Fifty Casks Madder
25	Drapes & Hagueme	"	LP	268/273	7 Seven Packages Merchandises
26	D. Galland & Co		AMJ	70	1 One Trunk Merchandises
27	Lemaire frères & Co	P. Alexeyeff	(P)		1 One Parcel Wearing apparel
28	Kestner & Menard	Scheer & Co	K&M	592/711	120 One hundred & twenty Cases Sardines
				988/1267	280 Two hundred & eighty Cases
29	D. Galland & Co	P. Alexeyeff	GWR		1 One Case Merchandises
30	Lemaire frères & Co	John Kruger	AR		1 One Case Pomatum
31	Langmesser		Address		3 Three Trunks Wearing apparel
32	Drapes & Hagueme	Seymour	MT	1/7	7 Seven Packages Luggage
33	D. Galland & Co		GTB	1. 2	2 Two Packages Machinery
34	V. Courcheté	Smith	SH	3527	1 One Case Hides
35	"	"	SH	3499	1 One Case Merchandises
36	"	"	SH	3470	1 One Case Hides & Shoes
37	Ch. Piran & Co	P. Alexeyeff	P	757/1763	7 Seven Casks Spermaceti oil
38	V. Courcheté	Smith	SH	3488	1 One Case Merchandises
39	"	"	SH	3490	2 Two Cases Hides
				3491	

Figure 3. Manifest and report of the English screw steamship Adundance stranded near Atla. EAA.625.1.512.

The archives of the Schmidt trading house in Kuressaare holds an interesting letter from a Finnish insurance company to Pärnu merchant J. Jacke, 7 December 1859 (EAA.625.1.516). Jacke has probably forwarded it to Schmidt. On 29 October 1859, the Finnish schooner Elisabeth carrying general goods, coffee and sugar from Lübeck to Borgo ran aground near Lõmala off the Sõrve peninsula. The insurance company wanted to sue the two men who came from shore, took over the salvage operation and under whose guidance the ship, almost refloating, ran ashore again. The men had ordered the removal of rigging, too. Leak was small and goods undamaged. The insurance company asked for Jacke's opinion how to proceed, although they did not know any names and asked whether it would be possible to find witnesses. This incident has left no trace in official records. The correspondence of Schmidt, however, reveals that von Dittmar guided this "salvage operation", during which also part of sugar went "missing".

Salvors tried to extort from consignees or captains as large salvage as possible. In extreme cases, this could even be double the price of the cargo (EAA.625.1.69, ff. 130–131). In 1819, the Livonian governorate administration consented the salvors half the value of the goods salvaged from the Aid but following the protest of the insurer, it reversed its decision (EAA.625.1.357). In 1861, the salvors of the goods from the Elisabeth & Mary claimed a reward twice as high as the consignees wanted to pay. On 27 November 1861, Schmidt explained such exaggerated demand to claims adjuster Nikolai Heimbürger by the fact that among the salvors there were two new men who wanted "to become rich at once" (EAA.625.1.125, ff. 133–133v). In 1824, the head of Saaremaa Land Settlement Commission and manor renter at Torgu(?), Carl von Sehrwald, was annoyed to hear a talk as if he is a "wrecker" and "corsair" while he had extorted from a captain higher reward than the latter had offered (EAA.968.1.2050).

Salvage rewards could amount to tens of thousands of roubles, either in goods or money (EAA.625.1.512; EAA.625.1.399). In the 1840s, the coastal lords of manor on Saaremaa received from consignees in St Petersburg in total 173,057 roubles for salvaging 13 ships (EAA.291.1.13594).

Manorial lords' large profits from salvage operations and opportunistic activities are confirmed by the fact that estates where maritime accidents were common were actually very stable, as the manors did not change hands, but rather stayed in one family. It was so on Hiiumaa, Vormsi, and Dundaga. On Saaremaa, the Ekesparre family owned the noble manor of Sääre from 1801 to 1919. State estates were donated or rented for shorter or longer terms and these possessions were less stable. State estates in "key locations" regarding wrecking, however, attracted renters interested in salvage business. In 1819, Kuressaare merchant C. F. Schmidt became a bailiff (*Disponent*) of the Tagamõisa manor in 1819 and in 1828 he took over for ten years the rental contract of the same manor from Count Watpolsky (EAA.625.1.15; EAA.625.1.20). Riga merchant Friedrich Schorning rented the manor of Karala from the 1820s to the 1850s. Atla manor was long in the hands of R. von Dittmar and Tagamõisa in those of von Toll and von Buxhoeveden. The rent prices set by auctions could be sometimes relatively high. For example, from 1866 to 1878 Theodor von Buxhoeveden paid annual rent of 625 roubles for Atla manor, although its estimated net revenue was 144 roubles (LVVA.183.22.295). Earlier the rent had been even 905 roubles. In the auction in 1879, Buxhoeveden refused to bid for it more than 305 roubles (LVVA.183.20.290). Evidently, his profit from salvage business had decreased by that time. In the early 1880s, August Thom, a successful rescuer and entrepreneur of peasant origin (Truuväärt 1997, 94–115), became the renter of Atla manor. The rent of Tagamõisa manor, however, never reached such heights as that of Atla and in the 1870s it

was even lower than the estimated net revenue (LVVA.185.14.52; LVVA.185.16.185; LVVA.183.23.113). The rent of Karala manor surged six times from 1860 to 1861 (LVVA.185.16.185)

The border customs guard, established in 1782, was one of the main threats to the arbitrariness of manorial lords (Lust 2017, 80–82). In 1802, when a herring ship ran ashore off the Sõrve Peninsula, the landlords Ekesparre and von Dittmar yelled at the coastguards and told them to leave, since only manorial lords give orders and on their land they order as they wish (LVVA.4.14.859, f. 15). The limits of power were tested on several other occasions as well. After 1824, the role of the customs authorities in salvage operations grew. Initially, only dutiable goods were placed in the care of customs; from 1836, customs were expected to oversee the whole operation, alongside the police (county magistrates), and be entitled to a reward for doing so.

Fraudulent activities

For the success of salvage business, manorial lords needed reliable and stable partners. If the quantities of goods, either received as a salvage reward in kind or pillaged, exceeded the needs of manorial households, these had to be sold or exchanged for other products. Secondly, as the commission agent was in charge of the wrecked ships and their cargo, and therefore represented the interests of consignees, it was feasible to treat him as a partner not as an adversary. Manorial lords in western Saaremaa developed ties with the Schmidts, who built their fortune by acting as commission agents of foreign insurance companies. Christoph Friedrich Schmidt (1772–1831) founded his trading business at the end of the 18th century. In 1805, the Livonian provincial authorities entitled Schmidt as an agent of the insurance company in Hamburg to deal with foreign ships and cargo wrecked on the coast of Saaremaa. After Christoph Friedrich Schmidt's death, his sons Constantin and August took over the family business. In 1808, as a burgomaster of Kuressaare, Christoph Friedrich Schmidt started with ship repairing and building. Obtaining materials for shipbuilding was possibly part of his business plan (Vunk 2016, 30–31).

Manorial lords informed Schmidt about the progress of salvage, asked him to come to the manor and see the salvaged goods. Schmidt organized for the goods to be received in Kuressaare, their sale and, if requested by the skipper or merchants, their transport onward to the destination. Contrary to the interests of merchants, Schmidt justified the claims of the salvors to a reward higher than the rate set by law. The insurers, however, not always gave in to pressure (e.g. EAA.625.1.126, ff. 2, 12, 27, 53). In 1853–54, in regard to salvaging the Anna both the consignees and salvors preferred a salvage agreement among themselves to the time-consuming procedure of evaluating the goods, rigging and dividing them in kind or selling at auction as the law required. The consignees in St Petersburg were not well informed about Schmidt's relationships with manorial lords, leaseholders and bailiffs, and hoped that Schmidt stood for their interests while mediating their agreement with the salvors. Also assistant county magistrate Buxhoeveden and the salvors acted in collusion contrary to the interests of consignees. Schmidt forwarded to the claims adjuster the salvors' ultimatum, in which the minimum of the reward was set to 8000 roubles, although they had counted on "a substantially higher sum". Claims adjuster N. Heimbürger in St Petersburg offered no more than 7000 roubles. In order to extort the desired amount, someone called Friedmann, allegedly the "real renter" of Atla manor, provided with a corresponding "certificate" by the bailiff of Atla, Schulz, talked with N. Heimbürger in St Petersburg. Friedmann was actually a lawyer notorious for dealing with "dirty stuff". Finally, the amount of salvage was "reduced" to 7800 roubles. (EAA.625.1.105, ff. 12–13, 29–30v, 33–34, 56–57v; EAA.625.1.498). The correspondence of the Schmidts reveals that from the mid-1820s to the early 1850s, Schulz was actively engaged with the salvaging business as a clerk, settling affairs with the manorial lords on ashore and skippers on the ships, while reporting everything to his superior. In his letter from 18 April 1828 regarding a salvage operation, Schulz claimed to Schmidt that, if necessary, he fights for his (i.e. their) interests "by both word and fist" (EAA.625.1.69, ff. 107–108).

The commission agent was entitled to a fee (*Provision*), normally a small percentage of the value of the cargo salvaged or auctioned. The Schmidt trading house tried to charge as high a fee as possible. In 1832, claims adjuster N. Heimbürger wrote that Schmidt charged 7 per cent, while in Finland this rate was 2–2.5 and in Tallinn 4 per cent (EAA.625.1.78, ff. 297, 299).

If a large amount of goods was said to have been destroyed, washed away, and gone missing it could be classified as direct fraud or theft. In a notice, preserved in the file concerning the wrecking of the Bertha on her way from Bordeaux to St Petersburg in 1826, Schulz tells Schmidt, in which private cellars to place 166 casks of wine. He adds that "some leftovers must remain to be taken away to the customs house". From his notice, it appears that altogether ten manorial lords, Schmidt and treasurer Römling had their share in this wine delivery. The casks of Atla and Tagamõisa manors as well of merchant Schmidt definitely had to go into private cellars (EAA.625.1.383). On 6 October 1827, Schmidt(?), in a draft letter to August Scheer & Co in St Petersburg, regrets that insurers concern about the wine and confirms that by far more than three-quarters of the cargo went lost. He had to sell in Saaremaa the little quantity of wine salvaged, as there were no ships available for dispatching it to St Petersburg and the wine could perish on its way.

There were other similar cases. Many packages salvaged from the steamer Vulture in 1840 were partly empty. The Lloyd's agent, merchant Johan Bazancourt, confirmed in his official report that, during an "extremely complicated" salvage operation, they were able to save only those goods from the valuable cargo that were listed in the report and that the missing amount was damaged and left on the ship soaked in water (EAA.625.1.418). Captain of L'Occitanie wrecked near Tagamõisa in 1842, also raised concerns about the missing items. Friedrich von Buxhoeveden claimed to the county magistrate that these items have been washed away or stolen by "strangers" (EAA.625.1.428). In 1853, the Anna, en route from Rouen to St Petersburg, stranded near Karala. Out of the 480 cases of champagne, 471 were salvaged (case à 60 or 120 bottles). The salvors were rewarded for salvaging 456 cases while 24 cases were claimed to be empty or have gone lost (EAA.625.1.104, ff. 403–404v; EAA.625.1.498). On 14 December 1842, Schulz wrote to Schmidt about the theft of boards and rum from a ship (its name is not mentioned) by von Toll and Riekhoff, saying the latter was in bigger trouble than the former. Schulz was hatching revenge and, should there be an investigation, he planned to testify about the thefts carried out by von Toll and his accomplices. (EAA.625.1.88, ff. 32–33) (Fig. 5).

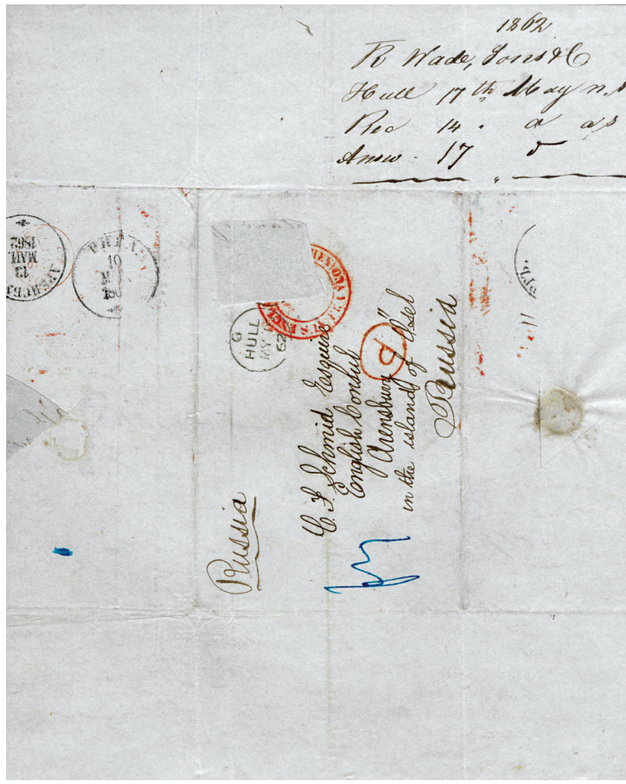


Figure 4. *Envelope of a letter from timber merchants in Hull to the Schmidts in Kuressaare. 17 May 1862. EAA.625.1.536:19.*

Delaying with salvage was also common. It increased the probability that the ship would not get off and also provided an opportunity to demand a higher salvage rate or return later and remove the goods in secret.

Schmidt had a dispute with claims adjuster Asmuss at Riga in regard to the ship Emmeline. On 11 November 1860, the English steamer Emmeline, en route from Hull to Riga, ran aground at Kuivasaare shoal, more than a mile off the tip of Sõrve (LVVA.1736.1.8). It carried diverse cargo: machines, railway parts, engines, agricultural tools and their parts, dyewood, spun yarn, textiles, clothes, mats, guns, alcohol, vinegar, etc. Captain Matthew Brown, the crew and passengers, who received no prompt aid from Sõrve, went on board of a French brig that took them to Courland. During winter and early spring the weather did not allow to salvage. In spring, salvor F. von Buxhoeveden requested that henceforth his salvage should be raised from the standard rate of quarter to one-third and Schmidt supported his request arguing that otherwise the salvaging would be of "little benefit" to Buxhoeveden (EAA.625.1.125, f. 36, 56–56v, 61v). Lloyds agreed to this request. During summer, railway and machine parts, railway wheels, pipes and some other goods were salvaged. In August, Schmidt informed the agent of consignees that the weather seriously disturbed salvaging. In September he forwarded to the agent the request by Buxhoeveden to pay him in spring 1862 for salvaging ironware half the goods or half the value (ibid., ff. 90, 104v). In addition, Schmidt insisted the insurers would let him to decide which goods to sell on auction and which to give the salvors in kind as a reward (ibid.). News about problems with selling the goods and finding out their consignees reached also the insurance company in Hamburg. In his letter from 7 September 1861, Schmidt asserts that it is the first time in half century that the insurance company unfairly reproaches him (ibid., ff. 103v–104).

Asmuss's correspondence reveals that salvaging and selling part of the goods from the Emmeline was delayed. Many goods were saved as loose items without merchant's marks that made it very burden-

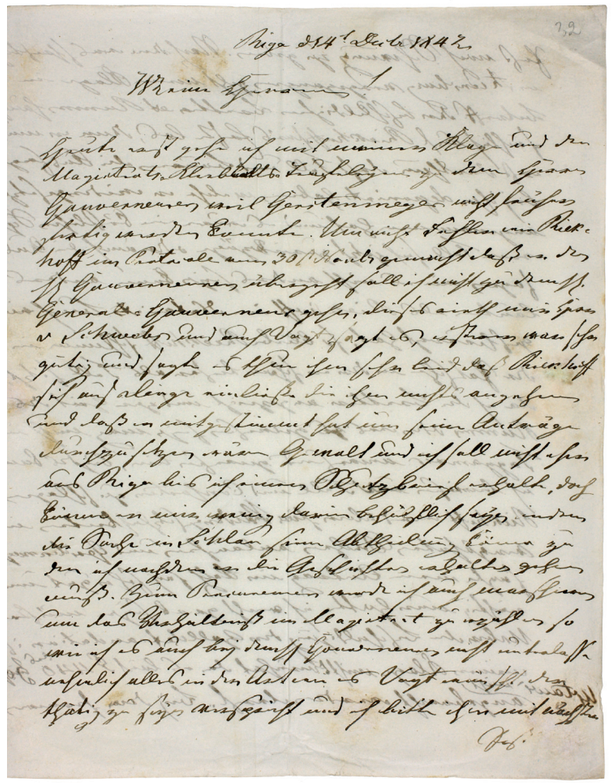


Figure 5. *Letter of Schulz to Schmidt about the thefts by von Toll and Riekhoff, 14 December 1842. EAA.625.1.88, ff. 32-33.*

some to check out their consignees. In some parts the manifest of the ship did not match with the list of goods provided by Schmidt. Solving the discrepancies took long. The calculations concerning the sale of some goods were inaccurate. Non dutiable things like ship's rigging and inventory were charged with customs duty. Asmuss wanted to assess the damages caused to the ship and cargo by salvors, but Schmidt argued that it would be "unimaginable". Asmuss felt that the merchants had suffered too big a loss. He felt that while it was correct to say that insurance would pay for the damages, but that it also meant, that insurance fees would be higher in the future, which would be damaging for commerce in Riga. The claims adjuster also considered Schmidt's fee as a commission agent too high and foreigners named it "plundering" (LVVA.1736.1.8, f. 76v).

Records about Schmidts' activities as a commission agent end in 1862. The Chr. Fr. Schmidt trading house operated until the mid-1870s.

The chances for manorial lords' malpractices significantly decreased in the 1860s and 1870s. Several factors contributed to this. Consuls in Riga actively intervened when the excessive demands of salvage rewards harmed the interests of ship and cargo owners. Schmidt's activities as a commission agent ceased. Manorial lords lost their monopoly on rescuing the ships as the Russian-Baltic Salvage Association, a local branch of which was founded in 1872, started to offer its services. It established rescue stations in some key locations such as Undva, Karala, Vilsandi, Kuivastu, etc. In the mid-1870s, two manned sloops were alternately stationed near the place where the Vulture had sunk to warn of shallow waters (*Rigasche Zeitung*, 24.01.1885; *Rigasche Rundschau*, 17.09.1905). Steam-powered tugboats were operated by salvage associations. Tugboats from Courland, Tallinn and Riga came to the waters of Saaremaa to refloat the vessels. Social and land ownership relations also changed: tenant farmers became increasingly freeholders from the 1870s onwards and the lands of some manors in favourable locations, like Karala and Kotland, were distributed among public institutions and local landless peasants. As a result, the manorial lords were no longer the only landowners on the coast. Sometimes industrious locals managed to become salvors on their own.

Figure 6. Theodor von Buxhoeveden. ERM Fk 888:108.

Summary

Missing records do not suggest the non-existence of fraud, but rather its commonness and smooth running. Although instances of theft by peasants are mentioned in the correspondence of commission agents and the reports of skippers, we can find no traces of corresponding investigative proceedings in law or administrative institutions (EAA.625.1.84; EAA.625.1.398; EAA.625.1.408; EAA.625.1.418; EAA.625.1.445, EAA.625.1.498). Manorial lords preferred their own "on-the-spot" solutions to official investigations and could be rather helpful, like Theodor von Buxhoeveden (1836–1894) (Fig. 6), when the wreckers were caught by the coastguard. According to oral tradition, the baron would go to the coastal chief and say: "Release my men at once!" (Loorits 2002, 304–308). If there was investigation, they did not press charges. The county magistrate, in his turn, did not inform the provincial authorities (e.g. LVVA.4.2.4796).

While the manorial lords did not notify the authorities about wrecking by peasants, the less so we can expect them to denounce their peers and partners. Schulz, for example, threatened, in case of investigation, to turn in von Toll and his associates, but we find no hint of it in the official records. The interests of various parties often conflicted, but they normally solved the disputes without asking for official meddling. Some manorial lords engaged with malpractices also had positions as county judges, county magistrates and their assistants. The business correspondence of consignees, claims adjusters, and insurers gives evidence of their frustration about the claims and activities of landlords, but there are no corresponding official documents. Contextual background should be considered too. If in other coastal areas of Estonia fraudulent activities by landlords were rather common, there is little ground to assume that the Saaremaa lords were different. However, this does not mean that lords of coastal manors were generally frauds. Personal qualities also mattered and there were other kind of manorial lords too.

The situation in the Russian Baltic provinces was advantageous for manorial lords to earn good income from shipping accidents. The judicial and institutional arrangement created with the help of the Russian state and the manorial power relations supported by it guaranteed extensive freedom to act and do business up until the 1860s. The law gave the rescuer, in other words, the local lord on whose shore the accident happened, the right to a lucrative reward. Police and courts were also under the influence of the manorial lords, which helped limit thefts by local peasantry, but allowed for unlawful acts by manorial lords go unpunished.

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Why are there so many shipwrecks in the Dalarö area?

GÖRAN EKBERG

The waters around Dalarö conceal a large number of ship remains that represent different eras, types and materials. Furthermore, the remains are in various states of preservation, some look almost as they did when they sank, while others are more or less fragmented. The ships that have sunk in the waters around Dalarö, and are now lying underwater as shipwrecks that can be visited by divers, are part of the historical stages and phenomena that have been an important and consistently present part of the development of the locality of Dalarö.

Figure 1. *Dalarö Skans from above. Photo: Jim Hansson, the Swedish National Maritime and Transport Museums (SMTM).*

Figure 2. *Jacob Bagge. Unknown artist. Photo: Johan Jonsson, National Maritime Museums of Sweden (SMM).*

Dalernsund

Dalarö was already mentioned in "King Valdemar's Itinerary", a route description recorded in the 13th century. At that time, the site was called Dalernsund (Ahlberg 2005, 9). The itinerary was a route description on the Baltic Sea that described the way from Utlängan in Blekinge to Reval (modern day Tallinn), in Estonia. The route description, which is written in Latin for the Danish king Valdemar Sejr, provides the reader with advice and instructions on the true course for sailing to the destination, as well as information on the choice of route on the basis of different wind conditions. Dalarö, or Dalernsund, is one of 101 places mentioned in the description (Flink 1995) (Fig. 1). Around this time Dalarö was a sheltered, natural anchorage and a place where vessels switched from coastal navigation to archipelago navigation. Dalarö was, in other words, an important junction for shipping at that time.

Military presence

During the centuries thereafter, the waterway passing Dalarö was used by an ever-increasing number of ships on their way to and from the Swedish capital city. On several occasions, even the Swedish navy assembled in Dalarö for further travel to destinations where the navy and its ships were to attend. In May 1564, admiral Jacob Bagge assembled his forces at Dalarö for the journey on to the headland of north Öland, where the Danish-Lübeck navy waited (Fig. 2). After a hard battle, where among other calamities the Swedish flagship Mars was sunk, the Swedish navy withdrew from the battle and retired to Älvsnabben in the south of the Stockholm archipelago.

The navy built a repair yard in 1565 at Stora Rotholmen, a few kilometres south of the community of Dalarö, which even further increased the military presence in the waters surrounding Dalarö (Ahlberg 2005, 11). The objective of the shipyard at Rotholmen was to avoid having to transport damaged vessels all the way into central Stockholm for repair. If the wind was unfavourable, it could take up to several weeks to move the ships to the shipyards at Blasieholmen, Skeppsholmen and Galärvarvet, where the necessary repairs could be carried out. In 1568, 52 people were positioned at the shipyard at Stora Rotholmen. The shipyard was already dismantled after the war in 1570. To call Dalarö Sweden's naval base is, perhaps, slightly exaggerating, but the presence of the navy was notable during many years, even after the shipyard had been dismantled. At the beginning of the 1680s, Dalarö was used as the main location of the Swedish navy, after Stockholm and Karlskrona. At these three locations the Swedish naval fleet could be equipped with cannons, men and supplies. Even the king visited Dalarö to inspect his ships and to transmit his instructions to the admirals before several major sea battles on the Baltic Sea (Ahlbom 1998).

Dalarö Skans

The first military fortification was built at Skansberget in 1623, just north of Lotsberget within the Dalarö community, in order to protect the southern waterway that led into Stockholm. The sconce dilapidated quickly on account of neglect and was replaced in 1656 by Dalarö Skans which was erected on the little island of Stockskäret just south of the community. Dalarö Skans was used on and off until 1856, when the military left the island, and thereby the sconce, to its fate. The cannons that were placed on the sconce were moved to Vaxholm. During this 200-year period several refurbishments and renovations were carried out in step with the military development. The sconce at Stockskäret has never been engaged in battle, not even during the Russian ravages in 1719. The Russian forces attempted instead to enter Stockholm through Baggenstäket, but on the way there, in spite of the proximity to Dalarö Skans, parts of the Dalarö community were burned down. However, in addition to other functions, the sconce played an active part as an emergency port for the ships that had encountered serious problems on their journey to or from the capital city. In 1935 Dalarö Skans became a state-listed historic building and therefore enjoys strong cultural-historical protection (Fig. 3).

Figur 3. *Dalarö Skans. Photo: Bertil Andersson's Collection, SMM.*

Sea customs

In 1632, under the leadership of Axel Oxenstierna, part of the royal chamber of customs was relocated to Dalarö and four years later the maritime chamber of customs also moved to the community. In 1636, there were seven Swedish cities that had permission to engage in trade with foreign countries. Of these staple cities, as they were called, only Kalmar had an open coast, and because of this, an inlet station system was established for customs clearance at the other six locations: Stockholm, Nyköping, Norrköping, Söderköping, Västervik and Gothenburg. Dalarö became the peripheral customs post for Stockholm, but also for Gävle which, however, was not a staple city at the time. This meant that all ships with import goods on their way to Stockholm or ports farther to the north would pass through Dalarö to clear their cargo (Ahlberg 2005, 11).

In connection with the relocation of the maritime chamber of customs to the community, the first customs house was erected. Already thirty years after the construction, the house was deemed to be too small and not imposing enough in appearance, and a proposal for a new customs house was put forth. However, it was only in 1788 that the new customs house was finished (Fig. 4). This customs house was used by the customs service up until 1928, at which time the inlet station system was abolished and the customs station in Dalarö was decommissioned and became a coastal posting.

Figure 4. *Dalarö Tullhus. Photo credits https://commons.wikimedia.org/wiki/File:Dalarö_tullhus_2013a.JPG*

Escorts

At the beginning of the 17th century, a pilot station was set up at Dalarö. The shipping waters around the community were being ever more frequently used by foreign and domestic shipping, and the cargos were important to the inhabitants of Stockholm, among others. To ensure that the ships arrived at their destination undamaged, the state needed to establish a system of navigation aid using escorts, or in more modern terms, pilots. In 1610, there were two maritime pilots residing in Dalarö. One of them, Peter Nilsson, received the entire island of Edesön, just north of the community of Dalarö, from the king as a land grant, in gratitude for his efforts in helping the king's vessels on to a safe journey.

The maritime law of 1667 states that a pilotage requirement shall prevail on all waters where "escorts were needed or habitually used" and in 1674 a pilotage fee was introduced for the stretch from Dalarö to Stockholm for ships with a deeper draught than 12 feet. The cost of the pilotage was 28 öre, multiplied by the ship's length in feet (Ahlberg 2005, 12).

Figure 5. *Dalarö pilot station. Photographer unknown, SMM.*

Figur 6. *View over Jutholmen in winter. Photographer unknown, SMM.*

This means that the piloting of a 25-metre-long ship between Dalarö and Stockholm cost the ship's captain almost 24 kronor. Today, the same stretch for a ship of the same size would cost approximately 10–12,000 kronor.

After the introduction of the maritime law, the need for an organised pilot station increased. Sweden's first pilot station was established in 1675 in Dalarö and the pilotage alderman Per Eriksson was appointed as its manager. At the end of the century, the pilot station was responsible for four pilot posts: in the Stockholm archipelago, in Stockholm, in Dalarö Landsort and in Sandhamn. At the time, there were 18 pilots in Dalarö. In 1676, the pilots in Dalarö were granted their own house on the little island of Jutholmen, not far from the Dalarö community (Fig. 6). The number of buildings in Jutholmen quickly increased as more pilots were needed for the expanding enterprise. In 1751, the number of pilots, pilot apprentices and pilot laborers at the Dalarö pilot station amounted to 48 individuals, of which 27 resided in Jutholmen. The pilotage enterprise continued until 1969, when Stockholm took over responsibility and in 1984 Dalarö discontinued being a pilot post.

Maritime taverns and inns

When the maritime customs were relocated to Dalarö in 1636 the location became important and a more or less organised community grew quickly around the customs enterprise. A church (i.e. a small wooden chapel) was established with its own vicar, as was a tavern. Parts of the present church are from 1652 (Ahlberg 2005, 12). Taverns and inns were, during longer periods, an important part of the communication system that existed in the country, along inland waterways and the coast. Access to food and lodgings was necessary to be able to travel comfortably and the functioning of the inn therefore became a concern of the state.

During the second half of the 17th century and all of the 18th century many taverns and inns were established in the archipelago upon order of the state. Alongside the taverns and inns that were under the control of the authorities, many unauthorized taverns were also opened along the major shipping routes that passed through the archipelago (Virgin 1997).

Dalarö tavern was established in 1638, when a townsman of Stockholm, Johan Ericksson, was given permission to lease a building in the port. Ericksson had received a royal privilege to operate an inn and the privilege also meant that no other tavern was permitted to be established in the community at this time. In 1649, the tavern also became an inn with a shooting station. The building that hosted the tavern was located near the church and was burned down by the Russians in 1719. The tavern was rebuilt and the tavern business continued until 1890 when the building housing the inn burned down with the locality's hotel and approximately 25 other buildings. At the end of the 17th century, there were 150–200 individuals residing in the community and the inn was considered to be the largest tavern in the southern archipelago. Dalarö tavern is the oldest tavern in the archipelago that can be substantiated with historical sources (ibid.).

Tavern operations have also been conducted in Jutholmen, but here the tavern did not exist for as long as in the Dalarö community. The tavern in Jutholmen was probably established during the second half of the 18th century but ceased to exist possibly before 1873. The old tavern building in Jutholmen has not survived. However, in the middle of the island there is an open space that still today is called Krogargården (tavern yard). Furthermore, maritime taverns have existed in the vicinity of Dalarö at several other locations, including Smådalarö and Skinnardal in Ornö (ibid.).

Holiday resort

In 1839, trips to Stockholm with a steamboat several times a week were introduced to the community and from 1865 the trips became daily. By that time, Dalarö had become a popular holiday destination among inhabitants of Stockholm who wished to relax from the hectic life of the city by enjoying swimming and other amusements. Dalarö developed as a bathing and holiday resort.

The important activities that have taken place in Dalarö throughout the centuries have resulted in considerable ship traffic in the area, both with regard to travels to and from the community and ships that have passed by along the waterways leading into Stockholm and further northwards (Fig. 7). As a result of the large number of ships that have passed through the area, many ships and boats have met their fate in the waters around Dalarö. The types of vessels vary from smaller boats used by the residents for daily transport to naval vessels on their way to or from the wars and sea battles they were involved in. Today, the waters around Dalarö are some of the most shipwreck-dense areas in Sweden when it comes to well-preserved ships built from wood.

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Figure 7. *Dalarö old harbor, in the end of the 1880s. Photographer unknown, SMM.*

The Dalarö wreck/ the Bodekull

MIKAEL FREDHOLM

The wreck of the Bodekull or the Dalarö wreck is a well preserved wreck from the 17th century. It has earlier been called Dalarövraket or Edesövraket after the find site, but new research has given us more information about its origin. The wreck Bodekull rests at around 30 metres depth at Edesön, north of Dalarö, southeast of Stockholm, Sweden. It sank during the so-called Scanian war between Sweden and Denmark in October 1678.

Diving to the Bodekull

Since parts of the hull and some details are very fragile, diving across the hull is prohibited. But you can dive around the sides of the wreck at the distance of one metre, if you or the diveboat have permission from Haninge Municipality that manages the Dalarö dive park.

As on several of the wrecks in the Dalarö dive park, the dive boat moors at a buoy. From the buoy at the surface you descend to the bottom and then you follow a line for approximately twenty metres until you´ll approach the wreck from the port side in the aft.

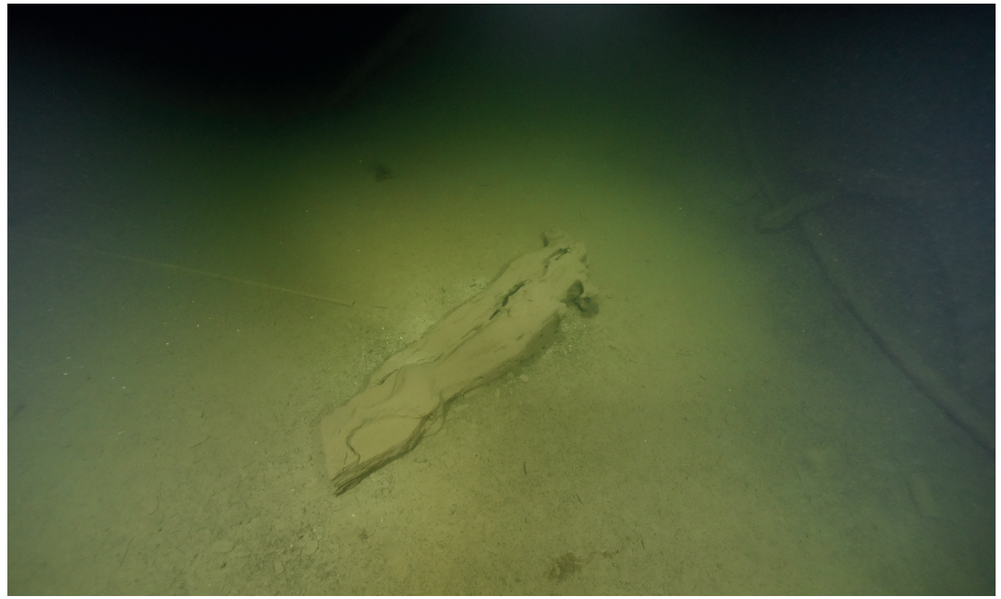
On the wreck you can for example see several Bartmann jugs and a cannon on the starboard side to the aft, the windlass in the bow, pumps, anchors and on the seafloor in front of the wreck lies a figurehead in the form of a lion at the depth of around 31 metres. Two of the masts are still standing in their original place and spread over the deck are ropes, blocks and parts of the rig.

Figure 1. *Lion figurehead. Photo: National Maritime Museums of Sweden (SMM) 2007.*

The wreck is 19 metres long, so you can see it all in one dive. If you, for example, take a tour around the wreck clockwise, you will first swim along the port side of the wreck. On the inside of the hull remains of a cupboard or carpenters store can be found. You will see the capstan, followed by the main mast and the main loading hatch. Towards the bow you can see the windlass and an anchor hanging on the port side of the wreck. If you then follow the bowsprit to the seafloor to the depth of around 31 metres, you will encounter the lion figurehead.

Figure 2. *The lion figurehead at the sea floor in front of Bodekull. Photo: Mikael Fredholm 2018.*

Figure 3. *A diver by the bow at Bodekull. Photo: Jim Hansson 2017.*



Turning back to the bow and along the starboard side there is an anchor standing on the seafloor. On the starboard side part of the rigging is sticking out and on the deck there is a grindstone. In the aft on the starboard side a cannon is easily visible. Just towards the aft of the cannon there are five Bartmann jugs. Continue around the stern and you will reach the small buoy and the line that takes you back to the mooring buoy and the ascending to the surface.

Figure 4. *A diver above the cannon on the starboard side, to the aft. Mikael Fredholm 2018.*

History of the Bodekull

Niklas Eriksson, at CEMAS, the Department of Archaeology, University of Stockholm, has after studying Admiralty manuscripts identified the so-called Dalarö wreck at Edesön as the wreck of the Bodekull. In Admiralty documents he encountered detailed descriptions of the vessel type, the so-called strussar whose dimensions and arrangement proved to compare well with the wrecks quite distinct features (Eriksson 2017 and 2018).

The name of the ship comes from where the ship was built, Karlshamn was called Bodekull until 1664. The Bodekull was one of the two ships launched in October 1660 at the shipyard in Bodekull. It was only two years after the Peace of Roskilde (February 1658) when the south provinces of Skåne (Scania) and Blekinge became Swedish. The king's envoy in 1658 was impressed by the port of Bodekull, the often ice-free waters and the great oak forests around Bodekull. Oak forests that could be used for shipbuilding. Charles X Gustav himself came on a visit to Bodekull in April 1658 and later the king commanded a city and a shipyard to be built in what would become Karlshamn (Lundgren 1999).

The Bodekull is a rather small ship, about 19 metres long, with cargo holds and six gun ports. It was built as a landing ship, a so-called struss. The underlying reason for the building in Bodekull was Karl X Gustav's order, which originally consisted of around fifty ships, specially designed for transporting soldiers and horses in the war against Denmark (Eriksson 2017 and 2018).

The Bodekull was one of several ships in the planned landing fleet, but after the king's death in 1660, the earlier plans to invade Denmark were cancelled. It was decided that the ships would be built as small frigate-like ships to operate in several different contexts. Since the ship's structure changed during the construction time, some specific details that are recognized in the wreck, were discussed by correspondence with the Admiralty in Stockholm (Eriksson 2017 and 2018).

In May 1661 the Bodekull was completed and prepared to sail out for the first time. The first year the Bodekull was in Stockholm and later the same year it was intended to be used to load and transport guns from the sunken warship Svärdet in Landskrona as well as other missions on its way from Stockholm to Landskrona and back (Eriksson 2018, 10).

The story of sinking

In 1675, war broke out again, and Denmark tried to regain the provinces lost to Sweden in the Peace of Roskilde in 1658. In the autumn of 1678 the Swedish fleet searched for a winter harbour north of Kalmar, instead of returning to the Stockholm archipelago as usual. The aim was to avoid having to wait for the late ice breaks on the northern Baltic Sea to faster meet the hostile Danish fleet next spring. In order to feed the people on board the ships, Olof Styff was sent with the Bodekull to grind grain in a mill along the Östergötland coast, or possibly northern Småland. Despite these instructions the skipper instead sailed all the way to the mill at Fagerholmen in the Stockholm archipelago. On the way back the ship ran aground and sank in October 1678. 20 barrels of water mixed flour was rescued from the sinking ship and taken to Stockholm. The extensive discussions about how the water soaked flour could be baked into bread was entered in the Admiralty meeting protocols. It is these documents that tell us that the Bodekull sank in the area north of Dalarö (Eriksson 2017).

In Admiralty board protocols from November 1678 one can read that "dough" was salvaged from the wreck and brought to Stockholm in a ship´s boat. The dough could "…only be used for feeding soulless creatures" (Eriksson 2018, 11).

The story of discovery

In 2003 a surveying company was scanning the area north of Dalarö and they found an anomaly that clearly showed a wreck. They gave the position to a group of professional divers that soon realized that this wreck was something special. This group also salvaged a small number of finds that were handed over to the Swedish National Maritime Museum's after the discovery. Because the wreck was fragile the county administrative board put a diving anchoring ban on the site. The Swedish National Maritime Museum's (SMM) first dive to the wreck was in 2007 and the next year the SMM archaeologists in cooperation with the University of Southampton and Södertörn University conducted an archaeological survey of the site. The focus was primarily to create a cultural management plan, to be able to follow possible changes on the wreck (Eriksson 2014, 103–105).

Archaeological investigations, interesting finds

On the Bodekull there are a lot of ceramic bottles of a special type called the Bartmann jug. Such bottles were made during the 1600s in large quantities. In these jugs all sorts of different liquid products, such as wine, oil and chemicals were shipped and stored. The jars are decorated with a bearded face and Bartmann means "bearded man" in German. On the starboard side in the aft there are five Bartmann jugs. In the hold it was possible to discern many more Bartmann jugs. Exactly how many, and what more the holds contain is not known to archaeologists, because the space has not been excavated.

When the wreck was discovered a few items where salvaged, including a glass bottle with a mark in the shape of a noble coat of arms with three crescents. The salvaged glass bottle can, on the basis of its characteristic form, date from the period 1640–70. It is a type known as "shaft and globe" in England, which became common in the middle of the 17th century. Bottles of this kind were often labelled with a seal. A seal is also found on the bottle, which was salvaged from the "Dalarö wreck". According to Henrik Klackenberg, the bottle stamped seal can be identified as an English weapon. Because the colors are not known, it cannot be decided whether it is Boynton in Yorkshire or Ogle in Northumberland. During the 17th century, the Boyntons were known as the Baronets and the Ogles as Lords.

Figure 5. *Bartmann jugs.*
Photo: Jim Hansson, SMM 2008.

SMM fieldwork 2007–2008

During 2007 fieldwork was carried out for five weeks, but no finds were raised from the wreck in 2007. The wreck was recorded and plans and profiles of the hull were established. In 2008 the lion figurehead was raised, optically scanned and put back after documentation (Eriksson 2014, 104).

Ten wood samples have also been taken from the wreck. The samples have been analysed by studying the yearly growth rings in the wood (dendrochronology). Only one of the wood samples was dated. The result shows that the sampled timber is probably from northeast England, the outermost tree rings were dated to after 1613 (Eriksson 2014, 112).

On the dated plank from the starboard side, the outer tree rings were not present and it is believed that the tree was felled after 1628, most likely after 1643. The reason why the other nine samples were not dated could be that some of the samples had too few tree rings. Three of the undated samples had a hundred rings and maybe the unsuccessful dating on these could depend on different provenance of the wood (Linderson 2008).

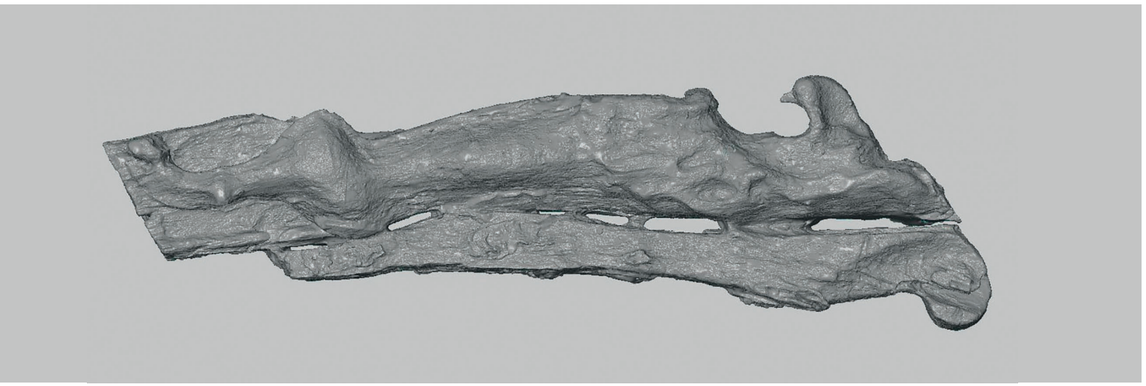


Figure 6. *Scanning of the Lion figure head. Image: SMM 2007.*

During SMM investigations the archaeologists noted that there was some cargo of coal in the hold. Based on the analysis and the age of the ship the coal is likely to originate from Wales, England, northern Germany or Siberia. The coal is of high quality and was likely to be used for combustion (Vajda 2008).

Written sources from the end of 1659 show that coal and sulphur was bought from England to make gun powder (Eriksson 2018, 5).

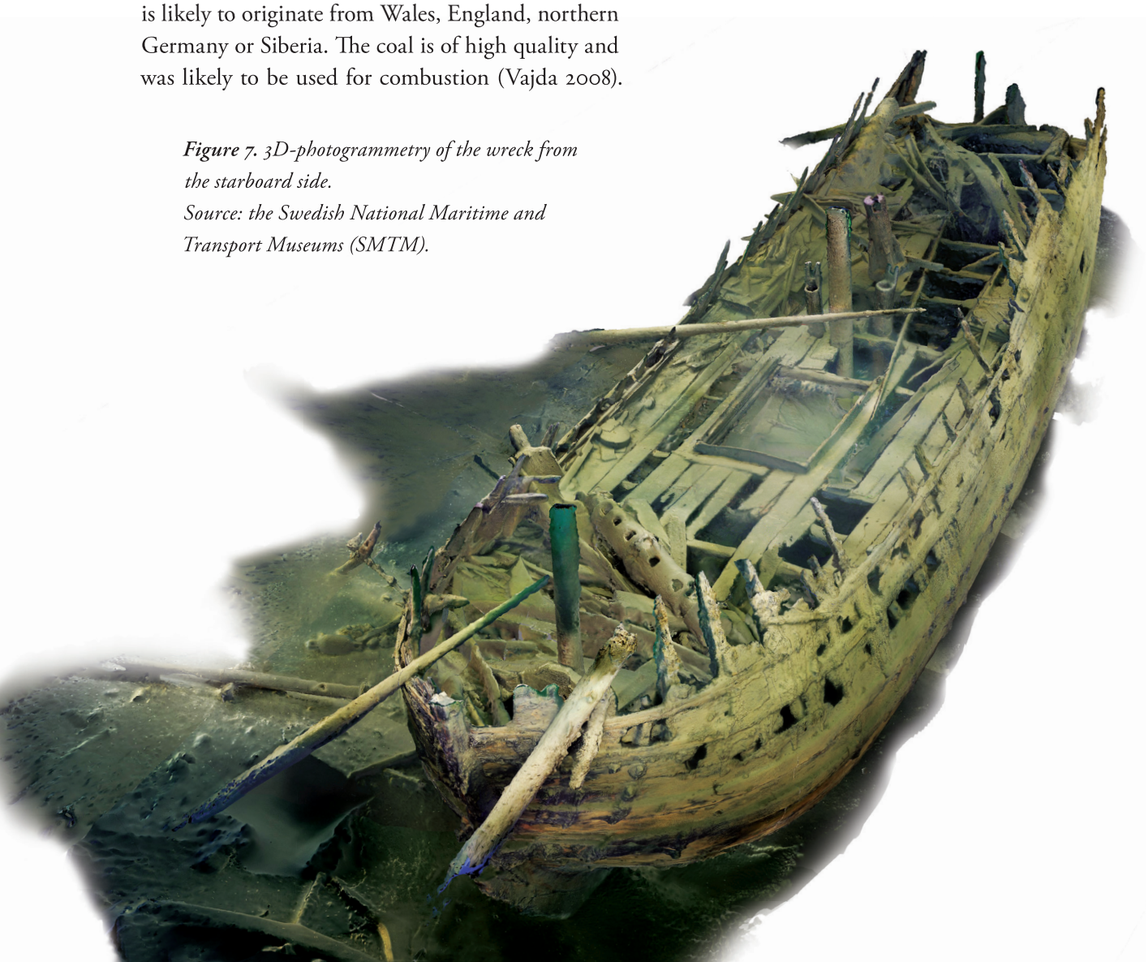


Figure 7. *3D-photogrammetry of the wreck from the starboard side. Source: the Swedish National Maritime and Transport Museums (SMTM).*

Together with the dendrochronological analysis and the earlier mentioned glass bottle, possibly from Northumberland, a lot pointed towards Great Britain or north-eastern England.

Therefore, archaeologists first believed that the ship could have been built in England. How this should be interpreted with the Niklas Eriksson's identification of the Bodekull, built in Blekinge, is interesting. Some written sources indicate that large parts of the ship timber to the shipyard in Bodekull was intended to come from Blekinge, so complementary wood samples might be able to answer more clearly the questions about the ship´s timber origin.

When the Bodekull became Swedish the Danes had left around a thousand planks and oak trees in the surrounding woods. But according to written sources that was not enough, so inspector Simonsson at the Bodekull shipyard was ordered to buy as much timber as possible from the local merchants. But because the master shipwright and at least one of the Bodekull carpenters were from England, they may have purchased some timber from England, as was common (Eriksson 2018, 5–6).

So it is also possible that some of the ship's timber was imported from England and other places, although the Bodekull was built in Blekinge.

There is great archaeological potential in this wreck, with only few ships from this time being excavated in Sweden. The one exception in Dalarö is the so-called "Jutholmsvraket" in Dalarö Dive Park. The Jutholmen wreck, which in size is comparable to the "Dalarövraket", was examined by the Maritime Museum in the early 1970s and because of the excavation, possible earlier salvage attempts and the lesser water depth it is far more degraded than the well preserved Bodekull.

Further archaeological investigations could include taking more wood samples for dendrochronology as well as small excavations in the cargo, to examine if there are traces of the "dough" and other cargo.

Between the investigations 2007/8 and today SMTM has dived regularly to the wreck, to monitor any possible changes on it. In 2017 SMTM dived on the wreck and made a 3D-photogrammetry, as part of the Baltacar project. As well as to show divers and non-divers how the wreck looks like, it is a good archaeological documentation method (read more in Jim Hansson's article in this publication).

So for me as an archaeologist and a diver the wreck of the Bodekull is a unique dive experience (as well as an archaeological experience) and easily qualifies to my top ten list of wrecks after more than twenty years of diving.

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The Jutholmen wreck – a forgotten Hollander

JIM HANSSON

Historical account

The Jutholmen wreck is one of the best-known dive sites in the central Stockholm archipelago. It has frequently been visited by sports divers and marine archaeologists. The wreck has been investigated on several occasions and is, in fact, one of the first remains of a ship to be investigated underwater by professional marine archaeologists. The wreck is located just below the lighthouse on the island of Jutholmen, which has also given the shipwreck its name (Fig. 1).

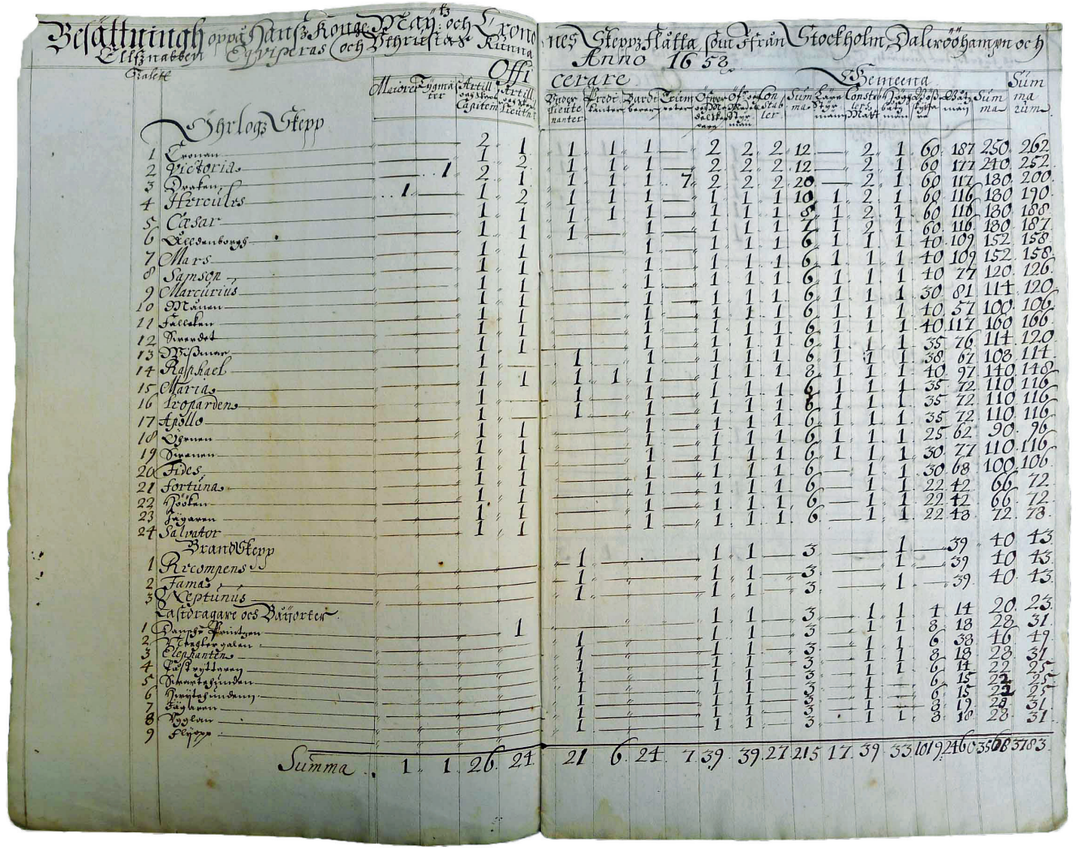
Figure 1. *The image shows Jutholmen towards the east. The wreck lies parallel to the island below the lighthouse. The yellow buoy is an anchor buoy that is intended to protect the wreck from anchoring damage. The wreck is part of Dalarö Dive Park. Photo: Niklas Ekström, Stockholm aerial photograph.*

Jutholmen is a small island located near Dalarö. Dalarö's harbour area was once much larger than can be imagined today and included a number of smaller islands. The ships required adequate room for manoeuvring. Since many large cargo ships would anchor and be customs-cleared in Dalarö, it was also necessary to have a sheltered harbour with a good sea bottom for anchoring. Dalarö was a natural junction with its proximity to Stockholm and the fairway leading south (Fig. 2).

Figure 2. *The map from 1690 shows the sailing route from Landsort to Stockholm, with Dalarö strategically located right next to it. Dalarö harbour/roadstead is indicated by two anchors. Image: Lantmäteriet (the Swedish mapping, cadastral and land registration authority).*

However, cargo ships were not the only vessels that passed by and anchored at Dalarö roadstead. This was also a meeting port for the naval fleet. An exciting example of Dalarö's importance can be seen in a document from the Military Archives of Sweden, dated to 1658. It says: "The crew on his royal majesty's and the Crown's fleet of ships, that can be equipped and armed in Stockholm, Dalarö harbour and Elfsnabben" (Fig. 3).

Figure 3. *The document shows all the ships that could be armed and equipped in one of the three ports mentioned. This clearly shows the importance of Dalarö harbour. Photo: Bengt Gullbing. Krigsarkivet (the Military Archives of Sweden).*



What a sight it must have been to see these great warships lying at anchor in the Dalarö roadstead and being loaded with different equipment, men and other necessities in preparation for various sea journeys! A forest of masts! Large powerful ships have anchored there, such as Carl Gustav Wrangel's flagship Victoria (built at Skeppsholmen in 1658), which had up to 80 cannons.

Due to Dalarö's strategic location in relation to the southern sailing route and Stockholm, a pilot station was established at Dalarö at the beginning of the 17th century. During this period, Sweden was growing, and the Swedish Empire was beginning to take shape. This meant that shipping around Dalarö gradually increased and it became clear that pilot assistance was needed for safe navigation through

the tricky archipelago. In 1667, a new sea law was adopted which stated that using the services of a pilot in all waters where it was needed was a duty (Ahlberg 2016, 12).

Shipping at Dalarö became increasingly frequent and after the new sea law was adopted it became clear that an organised pilot facility was essential. Therefore, Sweden's first pilot station was established in 1675 (Ahlberg 2016, 14). Already the following year, the pilots were awarded their own house on the island of Jutholmen. This was the same year that the great catastrophic sea battle at Öland took place during which, among other calamities, the Kronan (the Crown) and the Svärdet (the Sword) both sank. Not long after, approximately ten ships arrived that had "slipped away" from the battle, among them, the Riksäpplet (the State Apple) and the Gröne jägaren (the Green Hunter) which shortly afterwards sank in the vicinity of Dalarö. The Riksäpplet broke free of its anchor during a storm, crashed against the cliffs and sank, while the Gröne jägaren, having also broken free of its anchor, caught fire and exploded, causing many casualties. According to Anders Franzén (the discoverer of the Vasa), the commander of the Gröne Jägaren was responsible for causing the accident by obviously having mismanaged his duties. He was accused of instead having "banqueted with whores, sea refugees and vagrants at the tavern in Dalarö" (Järbe 1987, 12). It was a seemingly eventful year for the pilots and the population of Dalarö. It can be assumed that life in the harbour was probably quite arduous from time to time.

The pilot operation expanded, and more pilots were needed at Dalarö. By 1751, there were 48 pilots, pilot apprentices and pilot attendants in service, 27 of whom lived on the island of Jutholmen. Construction increased for natural reasons and the island became quite densely populated. Pilot lodgings and a sea tavern on the small island would certainly have left traces both on land and in the water (Ahlberg 2016, 14).

Dalarö's position as a pilot station continued until 1984. This period constitutes many years of activities that have left multiple traces in the Dalarö roadstead and there must also be countless tales of shipping to be told.Shortly after the pilot station was established, Dalarö's importance grew. This meant that the sea customs authority was also moved to Dalarö in 1636. From this point onwards, the Dalarö community seriously began to take shape. A church was built, and inns and taverns were established in order to get a small, functioning community underway (Fig. 4).

Sea taverns are a very old phenomenon and used to be a natural feature along sailing routes. If the winds were unfavourable, one had to wait for them to turn before being able to head off towards the envisaged destination. In the worst case, this could mean a wait of several weeks. Therefore, places that served food and drink during the stay were welcome. A tavern was established in 1638 on the Dalarö mainland

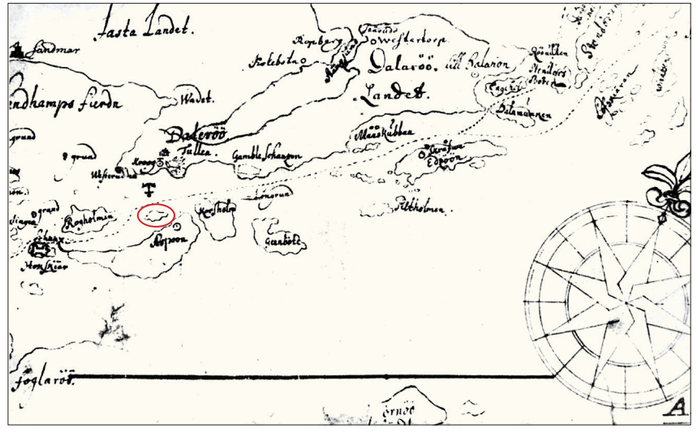


Figure 4. *The map from 1672 shows Dalarö harbour/roadstead indicated by anchors. The customs, the tavern and the location of the old sconce are also shown. Jutholmen is not named but it is the small island marked with a red circle. The new sconce that is still there today is seen to the left on the map, west of Rågholmen.*
Image: Lantmäteriet.

and another on the island of Jutholmen, probably a little later. At the end of the 17th century, approximately 200 people lived in the community, and the tavern was considered to be the largest in the entire southern archipelago (Ahlberg 2016, 14). Based on the size of the population, it is exciting to compare with, for example, Sundsvall, which at that time had its own city privileges. In 1690, Sundsvall had 346 inhabitants. This provides some perspective on how important Dalarö was.

All these events, of course, have left many traces on the sea bottom. That is exactly what we archaeologists are searching for. The wreck is an essential part of this impressive and exciting environment.

The discovery

On 1 June 1965, the shipwreck that was called the Jutholmen wreck (Jutholmsvraket) was discovered for the first time by the divers Sven Olof Johansson and Erkki Tillman (Cederlund & Kaijser 1982, 13). The wreck was found just below the lighthouse on the island of Jutholmen along the Dalarö shipping lane. This sea route had already been one of the most important routes for many centuries leading from the south through the Stockholm archipelago towards Stockholm, the same route which is described in King Valdemar's Itinerary from the 13th century. The divers had received a tip from the chauffeur Sven Wahlström in Dalarö, who in turn had obtained information from the 95-year-old deep-sea mariner Oskar Ekblom, who in his childhood had heard about a ship collision at Jutholmen a long time ago. According to Anders Franzén, the location had also been known among Dalarö fishermen as a place where fishing nets frequently got caught. The fishermen called the shipwreck "Lyrvraket". "Lyr" could be interpreted as pollack or lythe. However, this fish species does not or did not exist in this area, suggesting that the word "lyr" might have had a different meaning and was used by the fishermen around Dalarö as a reference to another species of fish.

Wahlström and the divers quickly obtained boats and diving equipment and set out to look for the Lyr wreck, which was said to have sunk as a result of the collision. The group started their search outside the small lighthouse on Jutholmen island and after only three soundings they found traces of black oak in the plummet when it was pulled to the surface. In other words, the oral traditions turned out to have been very accurate.

Johansson and Tillman eagerly got into their diving equipment and slid down into the dark green water. It did not take long before they returned to the surface and were happy to recount that they had found the wreck approximately ten metres from the lighthouse. The divers recovered some wooden parts and two bottles. A large number of dives were carried out on the wreck and many objects of different types and materials were salvaged. Among other things, coins were found that could be dated to 1660–1685. Quite soon, the discoverers noticed that other divers had got wind of the recent wreckage site and had carried out their own dives on the wreck. Wahlström and his two comrades found that a number of objects had disappeared from the site and had probably been recovered by other divers. The wreckage site was partially vandalized and some of the objects that had been left at the site were damaged.

The discoverers, Wahlström, Johansson and Tillman reported the find to the authorities in order to, among other things, ensure that no other divers would salvage objects from the wreck. The Swedish Maritime Museum received a report on the find and in July 1966 made an on-site inspection. It was found that this was a well-preserved carvel-built vessel with a bulging stern that was about 25 metres long and 5 metres wide. The museum's examination consisted mainly of detailed photographing of the wreck in order to obtain a good basis for planning a methodical archaeological investigation. One could also note that the hull was fragile, especially in the stern section, and in 1969, in order to prevent it from collapsing, the Navy's divers mounted three reinforcements in the form of tension rods. Two of these were placed in the aft and one in the fore of the ship. In addition, the stern was stabilized by stretching a chain around it from both ends of the aft-most tension bar. It was seen as extremely important to secure one of the finest shipwreck discoveries so far.

Archaeological investigations

When the shipwreck was discovered in 1965, it was considered one of the most valuable wrecks since the discovery of the Vasa. It was full of exciting finds and was completely untouched. Judging from the salvaged finds it was determined that this was a ship from the 17th or early 18th century.

The Swedish Maritime Museum started its investigation of the site in 1970, which continued until 1974. The idea was not only to document the wreck but also to test new archaeological methods. During this time, the ship's remains were very carefully measured, and a large number of finds were identified, salvaged and eventually preserved.

When the investigations began, it was revealed that a lot had happened at the wreck site since the wreck was found, especially in the stern sections (see Fig. 5 and Fig. 6).

During the archaeological investigations, virtually the entire inner hull was exposed, and several finds and loose structural components were salvaged and documented. After the investigations were finished, the ship parts that had only been documented, but not preserved were deposited in the vicinity of the wreck. A depository was also established a few hundred metres south of the Jutholmen wreck, which is what the shipwreck had begun to be called: the Jutholmen wreck.

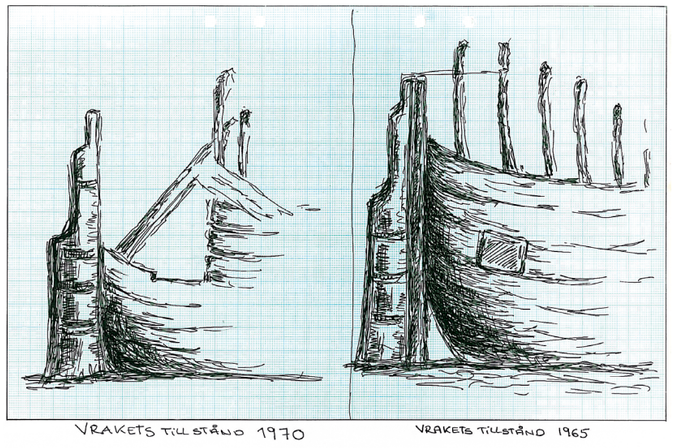


Figure 5. *The hull's stern section in 1965 and in 1970. Sketch: Sven Olof Johansson, the Swedish Marine Archaeological Archive (SMA), the National Maritime Museums of Sweden (SMM), No 861:65.*

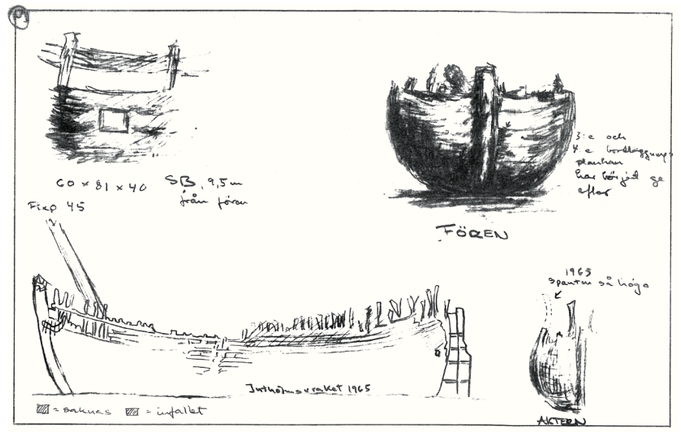


Figure 6. *Sven Olov Johansson's sketch of the wreck, which was later supplemented with information from the archaeological investigation in 1970–74. Down to the right there is a view from the stern, which reveals that the top-timbers in the ship's quarters were in place when the remains were found in 1965. Image: SMA, SMM, No 861:65.*

The wreck site

The Jutholmen wreck lies parallel to land, just below the lighthouse on the island and rests on a slightly sloping sea bottom. At the stern of the wreck the water depth is approximately 8 metres and at the bow about 13 metres. The sea bottom is otherwise relatively flat and consists of loose sediments that overlay a firmer sand and clay bottom. Some firmer bottom sections in the form of bedrock can be discerned through the sediments. Visibility at the wreckage site can vary between 1 and 10 metres. Occasionally, there can be a strong current at the site of the wreck.

Analyses and dates

Back at the museum, the immense task of analysing all the archaeological material began. After summing up all the coins (115 pieces) that had been found in the wreck, it was discovered that the dates on the coins were spread between 1623 and 1700. The majority turned out to be from the 1670s to 1680s. Only two five öre copper coins were dated to the year 1700, the rest were from the 17th century (Cederlund & Kaijser 1983, 7-8).

The bottles found on board and connected to the wreck were analysed and were assessed to have been manufactured during the last quarter of the 17th century, which aptly fits the dating of the coins (Cederlund & Kaijser 1983, 18–26). Dating bottles, though, is slightly precarious.

Many exciting finds were discovered, everything from domestic objects, cannonballs, sword hilts, game pieces, to small, what I believe might be, pigment jars that possibly belonged to an artist (Fig. 7a, 7b, 7c).

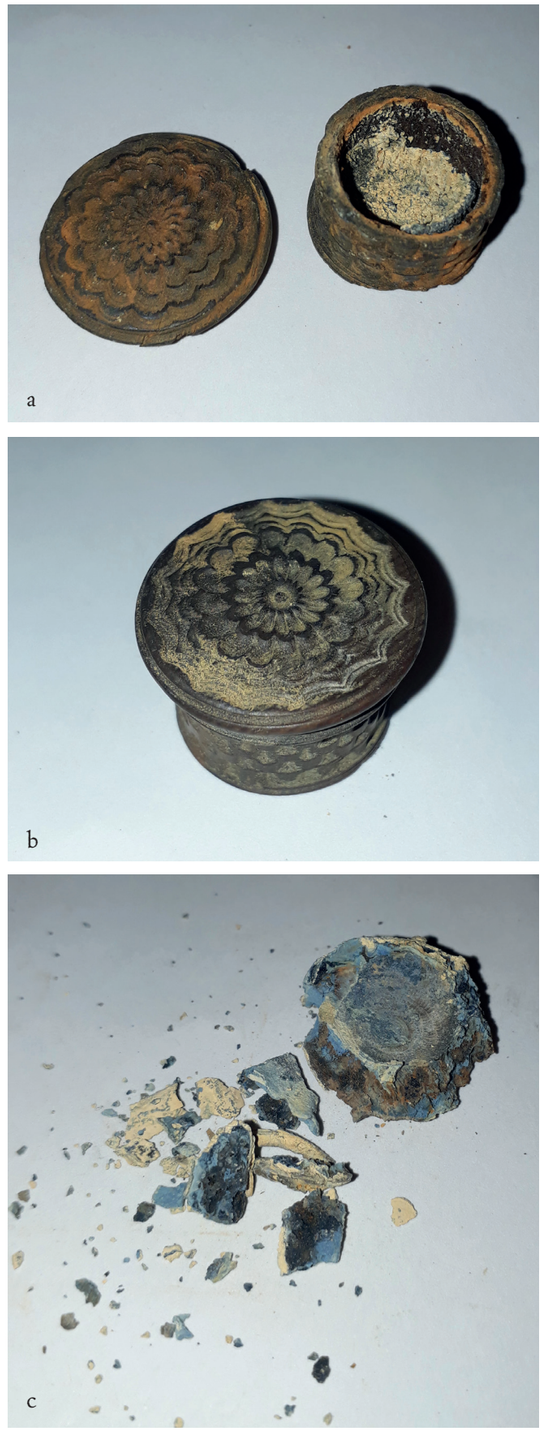


Figure 7. *The image shows what I believe to be pigment jars. The jars are only about 2 x 2 cm. Three of the four jars that were found seemingly still contain the remains of colour pigment. Black, white and blue are visible. Photo: Susanna Alleson Nyberg, SMM.*

A great deal of chalk pipes were also found on board. These are typical finds that are observed almost everywhere in connection with archaeological excavations of remains from the 17th and 18th centuries. Chalk pipes are often very good finds that can provide decent dating. They cannot be dated to the exact year but often have a time-limited period during which they were manufactured. The pipes on the Jutholmen wreck have been dated to the period between 1660–1735 (Cederlund & Kaijser 1983, 39-44). Pipes are also a typical find present in most occupational layers as they were often thrown away when they were broken or worn out. It is therefore not impossible that pipes or piping fragments may have been added after the vessel sunk, especially since we know that numerous pilots lived at the site and that the location had a sea tavern that had been in operation for a long time. There is, however, a homogeneous group of 8 pipes on board which are all dated to 1696–1705 and which can probably be connected to the wreck (Eriksson 2014, 75). This provides dating that syncs well with other dating.

In 1987, samples from firewood and a tar barrel were sent for dendrochronological analysis. Once the test results arrived, it was revealed that the timber from the tar barrel was cut in 1698/99 (Carl Olof Cederlunds arkiv, SMTM). Unfortunately, the firewood failed to date. A tar barrel is probably not a reusable item. There are cases where barrels were re-used but if they had travelled to the continent it is unlikely that they would have returned to Sweden. Therefore, we believe that the barrel was only used for a few years after the felling of the trees. It also means that this dating supports the dating of the coins, the bottles and the chalk pipes.

Together with the ship's technical aspects and the described analyses of the finds, the probability that the Jutholmen wreck sunk around the year 1700 or the years soon after is considerable. The 1970s investigations also revealed that the ship was probably a merchant vessel built in the Dutch fashion. The ship had a bulging hull with room for a large cargo, which was highly typical of Dutch ships of this period. On the other hand, the cargo consisted of, among other things, tar and bar iron, which were typical Swedish export goods in the 17th and 18th centuries. Therefore, we know that the ship was on its way from Sweden, but we do not where it was heading.

Dutch shipbuilding

Between the 16th and 17th centuries, the Dutch economy literally exploded. This was very much based on the fact that shipping expanded enormously and, not least, that the development of the Dutch shipbuilding industry rapidly gathered pace. Dutch shipbuilding during this period was an economic and technical-historical phenomenon. Most of the ship types were standardized and the methods used were rational which led to rapid production. Construction of the ships was carried out with several clever new solutions, including wind power. Many of the finished vessels became important export products. Knowledge of Dutch shipbuilding also spread, which led to more or less Dutch-inspired ships being built across Europe, also in Sweden.

There exist several sources describing Dutch shipbuilding methods. The written sources are few, but Cornelis van Yks and Nicolaes Witzens have written some works that stand out (Fig. 8).

In addition to these, there are some isolated drawings and models available. A major archaeological investigation of ships built in the Dutch fashion has been carried out in Copenhagen harbour and several have been carried out in Holland. In general, only the underwater hulls of these wrecks have been preserved, which has meant that the analysis of these remains has primarily centred around the construction phase. A well-preserved shipwreck in the Baltic Sea can be said to highlight the result of this, while the structural components that form the basis for archaeological discussions about the ship's construction stage are hidden under sediment or inside the still intact hull structure.

Figure 8. *The cover of Cornelis van Yks "Sheeps bouw konst" from 1697. Svenskt skeppsbyggeri 1963.*

Diving prohibition

After completion of the investigations in the 1970s, the Swedish Maritime Museum has continued to inspect the ship. In 1993, the museum received unfortunate reports that there had been damage to the Jutholmen wreck. Upon inspection, it was found that damage had occurred and that several objects and ship components had been moved from their original positions.

Because of this, the County Administrative Board of Stockholm decided in 1995 that the Jutholmen wreck, along with the wreck of the fluyt Anna Maria in Dalarö harbour, would in future be covered by a diving prohibition on account of the damage caused.

From 1995 until 2008, only sporadic dives were made on the Jutholmen wreck by the Maritime Museum. In other words, the shipwreck lay there in the darkness without being visited. The fact that no one was permitted to dive on and witness the unique and exciting shipwrecks in Dalarö was highly regretful. But an idea had surfaced that opened up the possibility of displaying the protected wrecks, and a draft for the development of a dive park was begun. The idea was that it would be allowed to dive on the wreck only in the company of specially trained guides, whereby the dives could be supervised, and the preservation of the shipwreck ensured. Therefore, the Swedish Maritime Museum carried out an investigation on the Jutholmen wreck, among other wrecks, before the launch of the Dalarö Dive Park. The investigation was aimed at documenting the wreck to determine what condition it was in, but also to produce a maintenance and protection plan. An important part of establishing such a plan is to have a system for monitoring future natural deterioration and the possible mechanical impact of diving and shipping. First, photo stations that are easy to revisit were established, and a thorough survey of the hull was carried out in order to monitor the deterioration using simple measures.

Figure 9. *The Bow of the Jutholmen wreck is quite round and bulging, which was typical of Dutch ships. The fluyt (Dutch ship type), which was one of the most common cargo ships during this period, is characterized precisely by such stem sections. Photo: Jim Hansson, SMTM.*

The well-preserved hull structure provides an opportunity for the reconstruction of the various rooms in the ship, which in turn provides a framework for the previously documented finds. The Baltic Sea shipwrecks can be used for more empathetic discussions about the choices involved in organising life on board a merchant vessel during the 17th century.

The ship

Based on the observations made at the wreck site and the finds salvaged during the 1970-74 investigation, the ship at Jutholmen is believed to have sunk at the turn of the 18th century or shortly thereafter. We cannot yet say with certainty why the ship sank. During the investigation in the 1970s, possible fire damage to some loose ship parts was observed, but it is not certain whether these traces come from a fire on board or if they should be interpreted as traces of ship timber having been steam bent over an open fire. However, there is other damage that has clearly been acquired at the actual moment of sinking. At some stage in the sinking, the stem was damaged when the lower part of the fore-foot was broken off. The part that was broken off protrudes beside the bow at the bottom. Whether this damage occurred during a grounding or a collision, or whether it occurred when the vessel hit the bottom, is difficult to say. Depending on how the ship was loaded, if it was top-heavy or if the weight was evenly distributed, it is most likely that the damage occurred on the surface. If this is the case, the ship probably did not go to the bottom stem first. When the Anna Maria, a similar merchant ship, sank, the ship hit the bottom stern first, the rudder loosened and got stuck in the bottom while the ship glided a short distance forward. Compared to this, it may be that the Jutholmen wreck collided or grounded on the surface, which then deformed the bow. However, at this moment, these are only my personal theories.

During the archaeological investigation in the 1970s, it was discovered that the cargo consisted of tar and bar iron. Probably soon after sinking, salvage to the vessel was carried out in order to save

Figure 10. *Several barrels remain in the cargo hold and one of the tension rods is still in place. Photo: Jim Hansson, SMTM.*

the cargo and other equipment. Since salvaging the wreck was carried out shortly after she sank, she may well have had other goods in the cargo that were saved. This type of salvage work was quite common and is described, for example, in Mårten Trievald's book *"Konsten att lefva under Watn"* ("The Art of Living under the Water") from 1734. A large part of the work was probably carried out from the surface. With the help of numerous devices specifically developed for this purpose, including saws, the sunken ship's decks were torn up and deck beams and other supporting structures were severed in order to access the interior of the ship. During the investigations in the 1970s, deck beams were observed that had been sawn away, and during the investigations in 2008 traces of sawing were observed in isolated deck-knees – clear traces of salvage from the beginning of the 18th century (Eriksson 2014, 54). Once the deck had been removed, the hull lost a significant part of its strength transversely. The diver Sven Olov Johansson, who with Erkki Tillman discovered the wreck, made several sketches of the remains in order to illustrate, among other things, the deterioration they themselves had observed (see Fig. 5 and Fig. 6).

Although the sketches are not to scale, they give a lot of valuable information about how the remains looked when the shipwreck was found in the mid-1960s. One of the most noticeable differences in comparison to how the remains look today is that the stern-post and the rudder were positioned in their original places at that time, and that the side planking was preserved to a much higher degree than it is today. Exactly what this is due to is difficult to say. However, a hull that is excavated from its protective sediment and large amounts of removed timber naturally cause the hull to more easily be affected by currents and mechanical impact. Although the construction has been considerably weakened by these events, it still holds together.

One of Sven Olov Johansson's sketches shows that the planking in the stern had begun to loosen. It also shows that a large part of the port side quarter had fallen to the bottom. According to the stern

Figure 11. *Here you can see straight into the stern. However, a few of the frames are still in place on the starboard side.*
Photo: Jim Hansson, SMTM.

view of the sketch, the futtocks seem to have been preserved in their original length at the time the remains were found in 1965. At some point in the early 1970s, the sternposts fell out towards the port side, which meant that the ship's stern lost the last transverse connection above the floor logs. The weakening caused the port side to gradually collapse. This was observed already in the late 1960s and was the reason why three tension rods were mounted on the ship by the navy (Cederlund & Kaijser 1982, 20). In addition, the stern was secured by stretching a chain around it from both ends of the aft-most tension bar. At the same time, the content-rich layers with findings were excavated from the cargo hold in the stern through sheet piles.

The fact that the ship's sternposts fell to the side has sometimes been interpreted as a result of anchoring. There is damage on the port side approximately amidships, which is likely the result of such an accident. During the investigations in 2008, we could see that the stern section was deformed and had eroded the most, while the stem looked virtually intact compared to the documentation of the 1960s–1970s.

New dives were carried out in 2018 in connection with documentation for a 3D model. The shape of the ship has been interpreted as a typically Dutch construction. The stem is quite round and bulging which is typical of Dutch ships, this can be clearly seen on the most recent pictures from 2018 (Fig. 9).

Looking from the inside of the wreck towards the stern, parts of the cargo can still be witnessed in the form of barrels, as well as one of the remaining tension rods (Fig. 10).

Comparing Sven Olof Johansson's sketches (Fig. 5 and Fig. 6) with the pictures from 2018 it is clearly visible how heavily eroded and damaged the stern is, possibly as a result of an anchoring (Fig. 11).

At the front of the ship, the stem is still securely in place. Also, the foremast is visible, still in its position, albeit slightly inclining towards the stem (Fig. 12).

Figure 12. *The powerful stem is virtually intact except for a few hull planks that have loosened. Note the mast that is also in its place.*
Photo: Jim Hansson, SMTM.

What did the Jutholmen wreck look like? Categorizing ship types from the 17th and 18th centuries is a complicated matter, although much indicates that the Jutholmen wreck is a small fluyt, which was one of the most common cargo ships, particularly during the 17th century. The fluyt is characterized by its seaworthiness and vast cargo space. It could also be sailed with relatively few sailors, which was economical. Written sources indicate that only seven men were necessary on a ship like the Jutholmen wreck. Fluytes were built in different sizes. The most common were perhaps those that were built in Holland and were of the larger variant (35–40 metres long), which is represented by the Anna Maria. It was built to sail on the oceans. The Jutholmen wreck, on the other hand, is slightly smaller, 25 metres long, and is more suited for shipping on the Baltic Sea. The collections at the Swedish Maritime Museum contain a model of a fluyt which gives a good picture of what the Jutholmen wreck might have looked like (Fig. 13).

What ship is it?

Identifying a shipwreck is often very difficult. A lot of informative documentation, good dating and a large portion of luck while searching through the archives is necessary in order to possibly identify a shipwreck. Warships are quite well documented in the archives, but when it comes to the merchant fleet, there could often be private operators with their own archives that can be very difficult to trace. In these cases, a great deal of luck is necessary in order to find, for example, court records, customs documents or similar that will make it possible to trace a ship. Despite several investigations, the identity of the Jutholmen wreck has not yet been established. But there is a theory that is exciting and that I believe is credible.

Figure 13. *The model of a fluyt from the 17th century gives a good picture of what the wreck at Jutholmen might have looked like. These were very beautiful ships even if they were "only" cargo ships. Note the small windows in the stern, very similar to the positioning shown in Fig 5. Photo: Karolina Kristersson, SMTM.*

Based on the findings from the investigations, the Finnish historian Christian Ahlström attempted to identify the ship in 1974. Ahlström noted three important facts: that the wreck probably sank in 1700 or shortly thereafter, that the cargo consisted of iron and tar, but that there were also objects of foreign provenance on board, and that the cargo had probably been salvaged relatively soon after the sinking.

After extensively searching the archives, Ahlström found information about a merchant from Stockholm, Johan Lohe, who, in 1700, was involved in a diving company in Dalarö. He was planning to rent a diver by the name of Peter Frisk to salvage on a ship that Lohe was a co-owner of and that had gone under in Dalarö. He was co-owner of 10 vessels at that time. Ahlström mapped Lohe's vessels or those he had chartered in international voyages. He found endorsements for sea expeditions that allowed him to dismiss nine of the ships. The De Vrede van Amsterdam with the skipper Martin Symons, remained. The vessel, which was mainly loaded with bar iron and "iron pieces", had been lost at Dalarö in September 1700 during a trip to Amsterdam. The documents also showed that there were some disputes about the salvaging of the ship. George Liberton and Admiral Cornelis Anckarstierna considered themselves to have royal privilege on diving activities in Stockholm. They were concerned about the fact that a certain Peter Frisk had been hired, who violated their rights. Peter Frisk was ready to start the dives on "the lost ship at Dalaröön" (Sveriges Flotta 1974).

Ahlström's proposed identification has not made an impact, and therefore the ship remains at Jutholmen are still considered unidentified. This seems to me somewhat strange.

I have been in contact with the navy that has mapped the area considered to be Dalarö harbour/roadstead with a side-scan sonar, i.e. the areas within Aspön in the east and Rågholmen in the south (Fig. 14).

Figure 14. *Dalarö community is shown in the picture to the left, Jutholmen is the smaller island just to the right in the centre of the picture. The surrounding areas are Dalarö harbour/roadstead. This view shows the strategic location of Jutholmen in the overall context. Photo: Jim Hansson, SMTM.*

Apart from the shipwrecks already known, namely the Anna Maria and the Jutholmen wreck, only one smaller one was found according to the navy. It should be said that the area has not been 100% charted, but it seems unlikely that a larger ship could lie there without anyone knowing about it and that the navy would have missed it. The fishermen's information regarding the Lyr wreck indicates that they had good knowledge of the area's successful fishing spots. Wrecks attract fish, which in turn makes it natural to seek out such spots for fishing. If another large ship had been in the vicinity, this should have been known to the fishermen. Perhaps they would not necessarily have been aware of a shipwreck lying there, but they would have known that this is a good fishing spot. After all, many shipwrecks have been discovered as a result of interviews with fishermen.

Considering the archaeological results, we know that the ship is of Dutch character. It has been interpreted as a smaller fluyt. We have seen traces of salvaging in the hull. Traces of iron have been found in the cargo. Moreover, we also have the dating. The origin of the coins (115 pieces) is spread over the period 1623–1700. If the ship had continued to sail on trading journeys for another number of years, then it is unlikely that not a single coin representing those years would be on board. We know that these were difficult years, since Charles the XII of Sweden's wars sucked the kingdom's funds dry, but it was probably more during the latter part, after Poltava in 1709, that Sweden became impoverished. Considering this, at least a few coins from after 1701 should have been found in the wreck.

As for the chalk pipes dated between 1660 and 1735, the situation is a bit more complicated. The tricky thing about the pipes is that they represent the period of manufacture, but no exact indication as to the date of manufacture. However, a homogeneous collection of pipes of the same kind was found, which was interpreted to come from the wreck. These are dated between 1696–1705. As for the remaining pipes, it is uncertain whether they come from the wreck, which means that they may well have been added later. The deck of the wreck was sawn away in the 18th century, which exposed the ship's interior. Moreover, the wreck is also located at a cliff near Jutholmen where many pilots lived during this period, and there was a sea tavern that served guests. This means that there must, of course, have been frequent movement on the island, as well as to and from the island. Pipes can easily have landed in the waters around the island, and most probably, also in the wreck.

In addition, we have the dating of the tar barrel that was found on board and salvaged. The dendrochronological (annual ring) dating showed that the timber was cut in 1698/99. Tar was, together with iron, one of the largest export goods. I have reasoned that the barrels filled with tar would have been shipped away, and that when the tar was used up, the barrels would be difficult to reuse, which would otherwise have been a common practice where barrels were concerned. They could be filled with something that would not be ruined by the remains of the tar, such as turpentine. Turpentine, however, is made of pine, which is plentiful in Sweden. Would one sail home bringing empty tar barrels from the continent to Sweden? That is hardly likely. We found chopped up (partitioned) tar barrels during the excavation at Skeppsholmen in 2018, which were used as buckets when tarring vessels. This is a more likely scenario. Therefore, the dating of the barrel is important in this context. I believe the barrel was manufactured and subsequently used within a maximum of two years, which in this case coincides well with the sinking of the De Vrede. The documents of the non-profit association Stockholms sjögård show that timber for shipbuilding was used within a period of a maximum two years after felling, and I doubt that small-sized timber would lie unused for longer.

The glass bottles, which in the 1970s were interpreted as being manufactured during the last fifth of the 17th century are, on the other hand, a little more difficult to date. However, the interpretation coincides well with other dating.

My conclusion is therefore that the information that was found by Ahlström in the 1970s, linking the De Vrede van Amsterdam to the Jutholmen wreck, is highly credible. We know that so far, no major Dutch-type ship with traces of salvage and with iron cargo has been found in Dalarö harbour/roadstead, either by us, the navy, fishermen or sports divers. Could the Vrede van Amsterdam have been completely salvaged? This is highly unlikely, and she should therefore still be lying on the bottom of the sea. The dating of the findings and the tar barrel strongly indicate that the sinking should have occurred in 1700 or shortly thereafter. I believe that what speaks against the wreckage having sunk later is the dating of the barrel and the dating of the coins.

To advance farther in identifying the wreck, a couple of minor archaeological efforts would have to be carried out. We would need to saw off samples of the hull in order to determine when the ship was built, but above all, to determine where the timber came from. It would also be very exciting to take dendro-samples of one of the remaining barrels on board to see if they are made at the same time as the one already dated. Perhaps the content could be analysed to conclude whether they were re-used? With a bit of luck, we could thereby determine whether this really is the De Vrede van Amsterdam, or not.

The Jutholmen wreck, which in the context of diving has unfortunately been slightly forgotten, is a truly impressive wreck. Notwithstanding the fact that it has been excavated, there is still a lot to see and experience. In addition, a fantastic collection of finds has been assembled, including the items that I have interpreted as being pigment jars. The Dutch and art and the 17th century seem like a well-suited combination. We do not know who these jars belonged to, but it is quite compelling to let my imagination run wild when observing such incredibly exciting finds. Whose were they? Was there an artist on board on the way to Amsterdam? Identifying a shipwreck often adds a much greater value to the experience. Clearly, it is more exhilarating to know what you are diving on and to know the history as you quietly hover over the wreck in the green water. On the other hand, diving with the knowledge that you do not know for sure, adds to the feeling of mystery. What ship is it? Why did she end up here? Who was on board? Is she the De Vrede van Amsterdam? I believe the vessel lying there is the De Vrede van Amsterdam, but I cannot, of course, say for sure. Nonetheless, the wreck is an exciting find that lies in a very intriguing environment.

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The Koster wreck

HÅKAN ALTROCK

Slowly, the greyish green sea bed unfolds beneath me and the pleasurable free fall through a greenish black space is transformed into the feeling of control and presence that a sound reference offers. Often, I avoid looking at the descent line during the fall to the bottom, just for the sake of the feeling. It becomes a bit like a passage through a "wormhole" towards another world, the world under the water. First, the struggle of getting into the diving gear and the full-face mask, the jump and the swim from the dive boat to the descent line. Then, the moment when the water closes over my head and I begin to fall to the bottom – the calm and the silence that existence is transformed into during this environmental change is highly enjoyable. The pressure increases and my senses focus on the invisible world beneath me. A large lump of concrete constitutes anchorage for the buoy to which we have moored the dive boat almost 30 metres above us. The distance line extends from the concrete lump towards the shipwreck a few metres above the muddy seabed. My diving partner and I follow the thin white line into the darkness. After several tens of metres a shape emerges, darker than the green environment. A shipwreck with its hull still intact takes shape in front of me and soon fills my entire field of view, an almost surreal sight.

Figure 1. *The Koster wreck in ideal visibility conditions. Photo: Marco Ali 2018.*

I ascend to the height of the bulwark and glide slowly over the deck. An extensive mess is revealed. Blocks and rigging, planks and remains of barrels are scattered on deck. Beneath me lies a windlass, completely preserved, as if ready to hoist up the stock anchor that now rests on the sea bed underneath the cathead. I slowly swim astern over the deck. Beyond the mast hole I see a collection of small boat parts; floor timbers, broken strakes, a stem and a transom.

The Koster wreck was found by the minesweeper Koster in 1995 during the search for a lost training torpedo in the area and has ever since been called exactly that: the Koster wreck. The actual name of the ship and where it once came from is unknown. That it was a galleass, a representative of one of the most common merchant galleys on the Baltic Sea during the 18th century, is quite likely. I say the 18th century because the wreck and its various artefacts quite clearly point towards that century, something that recent dendrochronology samples have also confirmed. The ship was built using timber from northern Germany and/or Denmark sometime during the period 1752–1763. Many divers have theorized about what ship might be lying here. The very recent dating makes me also wonder whether it wouldn't be possible to identify the wreck?

The historian Christian Ahlström was commissioned in the autumn of 1977 to research the archives in order to identify, if possible, a shipwreck outside the Hundudden peninsula at Älvsnabben, the so-called Älvsnabben wreck. He searched the archives for ships that had sunk at Älvsnabben during the period 1724–1766. During the research, information about five shipwrecks was found. The galiot Ulrica Eleonora, wrecked in 1724, the Noaks Ark, which sank in 1744, the galleass/galiot Concordia, which went under in 1754 and the galleass Anna Dorotea which sank in 1766. The fifth wreck he found in his investigations was a small iron-loaded galleass that sank at Älvsnabben in 1766. However, there was no iron cargo found in the Älvsnabben wreck, therefore he excluded this ship (Ahlström 1977, 16). Could any of the data that Ahlström found in the sources fit the profile of the Koster wreck, I wonder hopefully as I hover over it?

In his preliminary report to the Swedish Maritime Museum in 1977, Ahlström found that the Anna Dorotea was the ship that most accurately

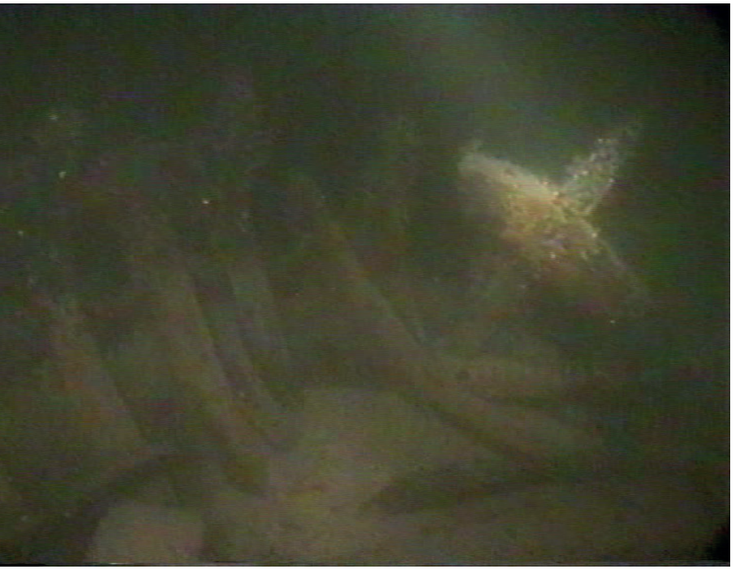


Figure 2. *In film footage taken approximately twenty years ago you can see that the boards once constituted a skiff. The skiff, filmed during the second half of the 1990s. Photographer unknown, Sweden's Marine Archaeological Archive, the Swedish National Maritime and Transport Museums (SMTM).*

matched the profile of the Älvsnabben wreck (Ahlström 1977, 15). This was a view he had changed in 1979 when he published his book "Sjunkna skepp" (Sunken Ships). At that time, it was instead the galiot Ulrica Eleonora that he thought most accurately matched the description of the shipwreck at Hundudden (Ahlström 1979, 88f). Ahlström's book "Spår av hav, yxa och penna" (Traces of Sea, Axe and Pen) was published in 1995, and now it focused instead on the Concordia (Ahlström 1995, 109f). When I try to remember the circumstances of the various shipwrecks that Ahlström presents in his book, none of them seem to fit the Koster wreck, except one.

In connection with the discovery in 1995, the navy sent down an ROV that took the first blurred film images of the wreck. Several films and image series have since been made of the ship in various years, which means that it is possible to follow the changes that have taken place. Unfortunately, the changes are often considerable and not always caused by the ravages of time, but more immediately by intrusive divers and buoy weights for descent lines.

In the first films are two large tackle blocks lying inside the ship's boat. Perhaps the crew had tried to launch the boat using the tackle in an effort to save themselves? Although diving requires presence and focus, I cannot avoid letting my thoughts drift away for a while because the lifeboat and the tackle together seem to somehow build a bridge of sentiment across the centuries, a message penetrating the dark waters of forgetfulness. Deep in thought, I hover over a scene that my imagination easily reconstructs in all its tragedy. Maybe the lifting tackle broke, maybe they just didn't have the time to launch the skiff before the ship went under? I shake off my thoughts. The tackle might just as well have belonged to the mainsail, and what really happened we will never know for sure.

Figure 3. *Cluttered deck. Photo: Marco Ali 2018.*

The planks and findings increase while I slowly hover farther astern over the deck. What once was a deckhouse has collapsed, exposing its contents. I remember the old film recordings, the clinker-built wall covering lying disintegrated on the deck next to it. The slender roof beams lying toppled over the contents of the deckhouse. These beams were not left to lie for long, because, as with other objects on the shipwreck, they have either been moved or torn away by failed buoying and anchoring attempts. The remains of a masonry galley with wooden panelling still survive, attached to what was once the front wall of the deckhouse. It has collapsed but the corner posts and remnants of the wooden panelling against the bricks can still be discerned. Doubtless the unfortunate crew prepared their last hot meal here?

Ahlström finally decided that the shipwreck at Hundudden, referred to as the Älvsnabben wreck, is the Concordia. But there is much that does not coincide with that theory; for example, the details concerning the depth. The Älvsnabben wreck is located on a slope at a depth of 12–17 metres, very near the cliffs at the Hundudden peninsula at Älvsnabben. Converted to the measurements of the time, this would mean at a depth of 6.5–9.5 fathoms, which is not at all consistent with the data for the Concordia. The written sources provide the following information about the sinking of the Concordia: "This ship or galiot has, during a strong storm, while sailing, capsized, so that the skipper and 7 men and nine passengers and the pilot unfortunately lost their lives with nothing more salvaged than the pilot's food box and drinking mug. According to the reports of other pilots, the vessel had sunk to a depth of 25, 28 or 30 fathoms" (Ahlström 1977, 8). A depth of 25–30 fathoms corresponds to approximately 44.5–53.5 metres. Consequently, we are in much deeper water than what prevails at the Älvsnabben wreck. Moreover, the masts and/or rigging should also have protruded from or floated above the water surface and thereby pointed out the ship's location. Recent surveys show that salvaging has occurred on the shipwreck at

Figure 4. *A glimpse below the deck. Photograph: Jim Hansson, SMTM.*

Hundudden (Ahlström 1979, 90). Therefore, there should not have been any uncertainty concerning the depth of the Älvsnabben wreck.

As I slowly swim towards the stern, a thought begins to take shape. There is a great deal that does not match with the theory that the Älvsnabben wreck could be the Concordia. In fact, many details fit the profile of the Koster wreck better.

My thoughts are interrupted when a casket catches my eye, the lid has long since disappeared and I look straight into it. A small keg protrudes, but apart from that, only mud hides the contents at the bottom. In the older films, a bottle is visible that juts out from the sediment in the chest. That bottle is now gone, moved or collected by a less fastidious diver. When I hover over the chest, I once more retrieve the memory of the old film. In it, two more caskets are visible right next to this one. I look for them without finding any. But nearby I suddenly glimpse their remains. There they lie, shattered and emptied of their content. With a slight pang of anger and resentment, I reflect on the behaviour of certain divers.

The underwater world is much like the world above, there are good people and there are "bad apples". Perhaps many good divers also think that it doesn't matter if they dig around a little in a shipwreck, picking up a block and dumping it in another spot doesn't destroy anything, does it? But shouldn't an old shipwreck be regarded in the same way as a crime scene? The naval archaeologist is like a forensic scientist, one day he or she might try to find out what happened and what ship lies there? In that case it is important that objects are left to lie, and moreover in the same place. Small, seemingly unimportant things can gain importance in the hands of a future investigator or a leisure diving "private investigator". Moreover, the opportunity for other divers to see this frozen moment in history is ruined. In effect, a proper marine archaeological orientation should be included in each training programme for divers, including compulsory study visits to those who work with marine archaeological research. Because every sports diver should feel the frustration that a marine archaeologist who is in the process of reconstructing a boat or an event feels when parts are missing or have been moved. The frustration felt at divers who cannot keep their fingers under control is also something that the vast majority of sports divers share because why should we tolerate some people ruining a frozen moment of history for those of us who want to experience it, thereby wrecking perhaps the greatest advantage of diving?

I believe many of today's sports divers would be ashamed to exhibit objects stolen from archaeological sites. Yet sometimes one still encounters shipwreck pillagers, often older divers who were active in the 1980s and 1990s, who still boast about all they have at home. Despite the chill of the water, my blood boils at the thought of them!

The after-deck is partly shattered and I can see into the cabin below. Collapsed planks and sediment and suddenly, a single glass bottle. The stern post with its transom still stands upright, but the rudder has fallen off its fittings and is inclined against the starboard side of the transom. The tiller lies next to it. In the first films, the rudder and the tiller were still in place. Whether it is damage from anchoring, divers or the ravages of time that has caused this is impossible to say for sure. The transom stern had already fallen off before the discovery and I look into the cabin from astern. Inside, I glimpse remains of what might be embellished furniture. I swim slowly back toward the bow. What happened to this ship, why is she lying here, what ship is it? Could this really be the Concordia?

According to Norra Bergnings og Dykerikompaniet's (the Northern Salvaging and Diving Company's) quarterly report to the Amiralitetskollegium (Admiralty College) on 8 October 1754, the Concordia came from Stralsund and was destined for Stockholm under the command of the skipper Lempke. She sunk at "Elfsnabbsudden in the Stockholm archipelago". "This ship or galiot has, during a strong storm, while sailing, capsized, so that the skipper and seven men and nine passengers and the pilot unfortunately lost their lives with nothing more salvaged than the pilot's food box and drinking mug. According to the reports of other pilots, the vessel sunk to the depth of 25, 28 or 30 fathoms".

The German customs officials in Stralsund who inspected the Concordia prior to her departure on her last trip call the ship a galleass, which means that she has a transom and thus is a boat type that fits the Koster wreck, but not the Älvsnabben wreck, which has a rounded stern, indicating that this ship is a galiot. "Schiffer Jochim Lemcke aus Stralsund will nach Stockholm mit seine neue Gallease Concordia genannt von Eichen auf Cravell gebaut 54 last gross, fuhret 8 Mann, hat geladen:." There follows in the document a conscientious list of the ship's cargo. The German customs officials had the opportunity to study her carefully because they also measured her length, width and cargo hold depth in connection with the departure. It seems likely to me that they could determine the difference between a galleass and a galiot, especially as they should have been aboard the ship themselves.

Christian Ahlström dismissed the statements of the German customs officials and in his book from 1995, chose instead to believe the information of the Dykerikompaniet, which, after all, according to Ahlström, in its accident report claims that the ship was a galiot. The same source that, according to Ahlström, indicates the wrong depth at the sinking site. So, the previously dismissed source suddenly becomes credible?

Figure. 5. *This is approximately what the Koster wreck might have looked like. Photo: https://www.modelships.de/Galeas-Stettin/Galeas-Stettin.htm*

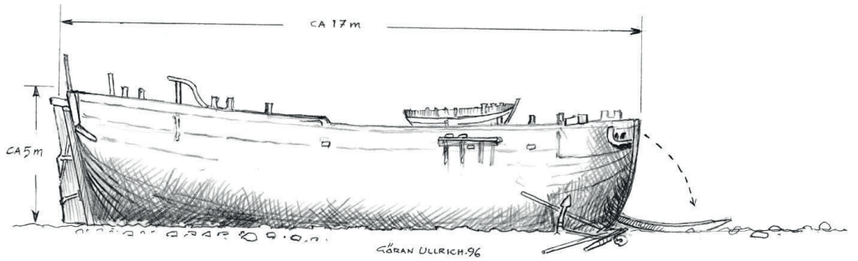


Figure 6. *The Koster wreck, drawing by Göran Ulrich 1996.*

The Dykerikompaniet's informant indicates "other pilots" as informants when it comes to the approximate depth at the accident site, 44–53 metres. One should keep in mind that if someone saw the ship that would become the Koster wreck go under in the middle of the Mysinge fjard during a heavy storm, then they could probably only roughly indicate the location and perhaps they had no other information on the ship type than what they saw from afar on the stormy fjard? Perhaps the informants were not the ones who saw the disaster but other witnesses, unknown to us? If this is the case, then it is no wonder that the ship type was falsely indicated.

Recently, I sat in the Military Archives of Sweden and searched for the original text about the vessel which capsized in a heavy storm at Älvsnabben peninsula in the Stockholm archipelago. I wanted to see whether the ship really was referred to as a galiot or whether there could be some doubt about this. I browsed through the accounts that are arranged in a non-orderly manner in the paper folder. Ship after ship is referred to as "galliothe", occasionally other ship types are mentioned, but "galliothe" is the most common type and it is always spelled in the same way. However, when I find the information about Lempke's ship the Concordia, it does not say "galliothe" but "galiatz" which of course probably means galleass. Both the Dykerikompaniet and the German customs officials thus meant that the Concordia was a galleass, just like the Koster wreck. At the same time, it excludes the Älvsnabben wreck as being the Concordia, because that shipwreck is a galiot.

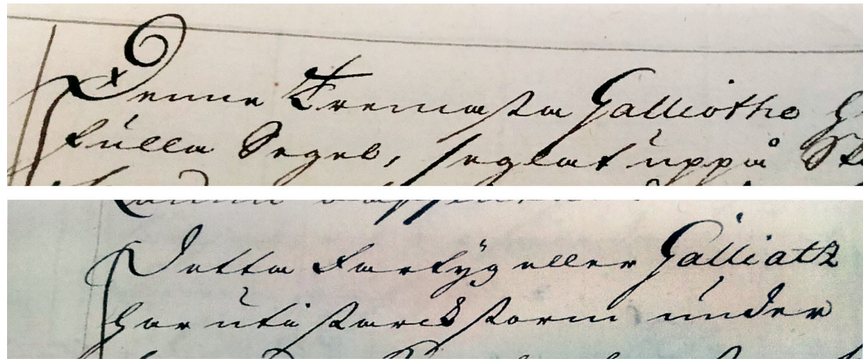
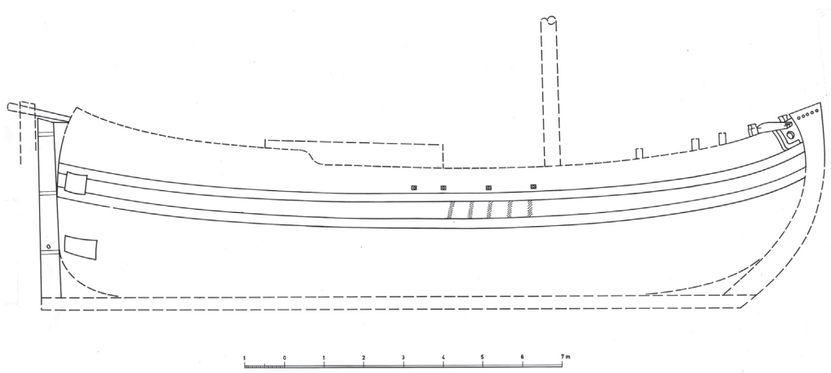


Figure 7. *The upper text shows how the ship type galiot was spelled in the Dykerikompaniet's documents, "Galliothe". The lower one shows the text about the Concordia. Apparently, it seems to say Galliatz (i.e. galleass), which is true for the Koster wreck, but not for the Älvsnabben wreck.*

The fact that the ship sank far out in the fjord can explain the imprecise depth indication. The actual shipwreck was not located, but the approximate depth in the area where it sank was indicated. The actual depth at the site of the Koster wreck is about 35 metres, but there are depths of 40–50 metres in the immediate vicinity. Therefore, the vague depth indication speaks in favour of a sinking in open waters, not near to land, as was the case with the Älvsnabben wreck, where the exact location of the sinking was probably more certain and where any possible protruding rigging revealed the location and depth of the wreck. After all, we know that there has been diving on the Älvsnabben wreck in earlier times, it should not have been difficult to find the wreck at the site where it is located very close to land. In addition, it does not seem very likely that a storm would have caused the ship to topple over and sink into the relatively sheltered position inside the harbour of Älvsnabben, so close to the cliff at Hundudden; a grounding seems to be more likely. It also seems odd that so many would have died in a sinking inside the relatively protected waters of the Hundudden peninsula, although swimming ability might have been limited. The information that the Concordia capsized during a storm fits better with the Koster wreck, which sank right in the middle of open waters a good distance from the shelter of land. If the Älvsnabben wreck were the Concordia then we would also need an explanation as to why she stands upright on the seabed in such shallow water. The fact that the sails and the low-lying centre of gravity can often straighten up ships that capsize in deep water is well known, but if the wreck at Hundudden overturned and sank during a storm at such a shallow depth, shouldn't the wreck have been found on a slope on the seabed?

Figure 8. *The Älvsnabben wreck. Illustration: SMTM.*



The fact that the Koster wreck, as far as I know, does not exhibit any wear and tear, and that its earliest dating has been set to 1752, fits the profile of the Concordia, which the German customs officials suggest was newly built when it wrecked in the fall of 1754. These facts also contradict it being the Älvsnabben wreck, which shows wear judging from the substantial grooves on the lower edge abaft the starboard beam, probably after being used as a hawse for fastening the stern (Cederlund & Kaijser 1981, 43).

The Concordia capsized in October 1754 during a heavy storm near the Älvsnabben peninsula (Älvsnabbenudden). One might assume that "Elfsnabbsudden", which is indicated as the sinking place, would apply better to the Älvsnabben wreck than the Koster wreck because the Hundudden peninsula, near to which the former wreck lies, is the southern headland of the island itself, which is called Älvsnabben. But if one reads Jonas Hahn's "Johan Månssons upplifwade aska" (Johan Månsson's Revived Ashes), published in 1748, which is a revised version of Johan Månsson's pilot guide from 1644, it can be noted that the whole Älvsnabben area with its convex shape bulging towards the Mysingen fjard is called Elvsnabbenudden, and the area within simply Elvsnabben harbour. Hahn writes "until you have passed a cliff with a navigation mark on it/ called Mellsten/ which is high/ and where, situated along the same, a small white and red-speckled steep cliff lies/ called Måseknufwen; which both appear on the starboard side. Then steer northeast to the headland of Elfsnabben/ and then pass a red cliff/ called Röda Kon on the starboard side/ under Nåtarölandet […] When one has passed the Röda Kon on the starboard side/ one has under the Rånö island a cliff at 4 foot depth/ therefore you should go close to the Elfsnabbslandet/ which is a high steep grey rocky promontory off the portside embankment and Muskö island: therein is a good harbour/ and yet a good roadstead on the outside […] After passing Elfsnabb's headland on the portside and Utölandet on the starboard side/ you will sight Dalarö Castle/ and afterwards sail straight ahead:"(Ahlström 1979, 111 f.). This means that the location of the sinking of the Koster wreck in the 18th century may well have been mentioned as "at Elfsnabbsudden in the Stockholm skerries" just as it is in the Dykerikompaniet's report on the sinking of the Concordia.

More and more details come to mind, facts that are more in line with the Koster wreck than the Älvsnabben wreck, including that the latter wreck had oats in the cargo which the Concordia did not have. In his report in 1977, Ahlström also dismisses the Älvsnabben wreck as being the Concordia precisely for this reason, among others (Ahlström 1977, 9). The Concordia's dimensions initially better matched the Älvsnabben wreck because the Koster wreck was previously estimated to be only 17 metres in length. More accurate measurements in recent times, however, show that the length is a little more than 22 metres, which fits at least as well the length of the Concordia as the length of the Älvsnabben wreck.

I hover slowly forward along the starboard bulwark. A change I note since the first dives at this site is that a piece of the bulwark railing is missing.

Shortly after the shipwreck was discovered, further along on the portside, there lay a fallen mast, probably the mainmast, resting on the bulwark with its tip in the seabed. It is no longer visible on the film from 2009 and now probably rests on the bottom next to the ship – probably as a result of damage from anchoring or buoying. Contemplating, I swim on ahead. Next to the main mast hole, at the bulwark on the starboard side, I see three blocks and dead eyes that are some of the objects visible in all the film footage since 1995 when the shipwreck was found. Therefore, they are interesting objects for comparison. In the first films, the cordage around the dead eyes still remains. This has since disappeared, and the objects have been moved around.

Figure 9. *Dead eyes and a block 1990s. Photographer unknown, SMTM.*

A little further on, next to the starboard side bulwark, lies a barrel and a bit of wicker sticking out of the sludge on deck. The barrel has collapsed, and its rods are also located in different places in each film and photo opportunity, a clear indication that someone, or something, has moved them. There are many more items that have disappeared from the deck, things I have not seen myself but which I have been told of by others. At the front of the bow I turn

around and note how the stem itself has loosened from the ship's sides and fallen to the bottom. This was so already on the film from the 1990s, during the first diving on the shipwreck. The portside hawse piece has loosened and fallen toward starboard – whether caused by anchoring or the ravages of time is impossible to say, but on one of the films recorded from previous dives on the wreck, a buoy line is visible, tightly stretched through one of the hawse-holes. It could be that it was due to similar inconsiderate acts that the hawse piece fell out of place sometime between 2004 and 2009.

The ship's deck lies at a depth of about 30 metres and the allowable dive time at such a depth is not long. The time to return to the surface begins to close in. While I slowly follow the thick buoy line back up to the sunny surface of the Mysinge fjard, I cannot avoid reflecting on what ship lies here below. Can the Koster wreck really be the Concordia? None of the other of Ahlström's shipwrecks match the Koster wreck. Either they sank before the Koster wreck was built (Ulrica Eleonora and Noaks Ark) or the sinking is described as a grounding where the ship was torn to pieces (Anna Dorotea). The little galleass that sank at Älvsnabben loaded with pig iron could possibly fit the description, because we know so little about the event and what the Koster wreck has in its hold. However, the Koster wreck points northeast, as if it were heading toward Stockholm, not south toward Döderhultsvik, as the iron-loaded wreck was. The skipper's name, Dufwa, also sounds quite Swedish on board a ship that was probably German. These are uncertain indications but still enough for me to put that ship aside for the time being. There remains the Concordia, which Ahlström thought was the Älvsnabben wreck.

Table 1. *Comparison of data of Concordia, Koster wreck and Älvsnabben wreck.*

	Concordia	Älvsnabben wreck	Koster wreck
Type of ship	Galleass	Galliot	Galleass
Depth at sinking site	Somewhat uncertain, approximately 44.5–55.5 m	12–17 m	35 m
Sinking location	At Elfsnabben-udden in the Stockholm skerries	At Hundudden inside Älvsnabbens harbour	Between Älvsnabben-udden and Rånö in the Stockholm archipelago
Sinking process	Capsized while sailing in a heavy storm	Sank near land, reason unknown	Sank in open waters, reason unknown
Ship length	22.5–23.5 m (70 feet)	21 m	22.2 m
Ship width	6.4–6.9 m (20 feet)	6 m	7.4 m
Ship draft	2.8 m (9.25 feet)	2.6 m	Unknown
Provenance	Stralsund in northern Germany	Possibly northern Germany	Probably northern Germany
Construction year	1752–54? (Newly built at time of sinking)	No dendro- testing. (Worn at time of sinking)	1752–1766 (No signs of wear and tear)
Sinking year	1754	Probably after 1728	Unknown, probably quite soon after construction
Cargo	Malt	Oats, rye	Unknown

Much suggests that the Koster wreck could actually be the Concordia, and that the Älvsnabben wreck, whose dating is uncertain, is a shipwreck that has fallen outside of Ahlströms' "search light" in the archives. Of course, we cannot be completely certain. Perhaps there have also been other shipwrecks on the Mysinge fjard during the mid-18th century that were not noticed by Christian Ahlström or that have not been recorded in written sources. To be able to safely say that the Koster wreck is the Concordia we could possibly analyse the cargo. After all, we do have the cargo list from the customs officers at Stralsund. Maybe there could be other clues if one were permitted to investigate the ship in more detail?

The Koster wreck is a popular wreck among sports divers, because, despite looting, there is still a lot to look at. To put a name to the ship and therefore a history surrounding the wreck makes the adventure of visiting it even more substantial. Because it is, after all, a part of our common history and as such the shipwreck should be able to be visited by as many as possible, with respect to the responsibility that belongs to all of us. However, a dive guide requirement should perhaps be evaluated for diving on the Koster wreck, as is currently required for the Dalarö wreck, whose deck, just like the Koster wreck, is full of exciting objects. Perhaps there are those who think that the Dalarö Dive Park's restrictions on diving on particularly sensitive shipwrecks are unwelcome, but it is a necessary evil as a consequence of negligent divers and a selfish gift to all diligent divers. It is not only today's divers who should have the privilege of visiting these fantastic shipwrecks, but also our children and grandchildren. Remember this when you stand in front of a shelf full of looted goods in the home of a diving friend you used to think well of.

At a depth of five metres, my diving partner and I stop for three minutes to release the elevated nitrogen content in our bodies, while I hold on to the heavy buoy line. Just like the other wrecks in the Dalarö Dive Park, this wreck is provided with a proper mooring buoy which lies at a safe and adequate distance from the wreck, and with a guidance line leading to the wreck. Thanks to this, dive boats do not need to anchor and buoy on their own initiative, considering the risk that entails of getting caught and damaging the shipwreck.

Little did I know that this was the last time we would use this assistance. It wouldn't take long before the Swedish Maritime Administration decided that the buoy must be removed as it was too close to the shipping lane. Equipping it with lights was obviously not at issue. Thanks to this unfortunate decision the buoy weights continue to fall on a hitherto well-preserved historical monument.

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The Swedish Ship of the Line Kronprins Gustav Adolf, the Swedish warship wrecked at 1788

SALLAMARIA TIKKANEN and RIIKKA ALVIK

The shipwreck of the Kronprins Gustav Adolf

"Thursday, 7.8.1788. After sailing for about half an hour (after leaving the Kronprins Gustav Adolf, taken by the enemy, on shoal) we saw the last Russian sloop putting the vessel on fire using a sulphuric wick. Soon the whole stern was on fire. The guns, being all loaded, went off by themselves, causing a beautiful but sad fireworks" (Wahlbom´s diary, SMM).

This was how the Swedish officer Gustav Harald Wahlbom[1] wrote about the fatal last hour of the ship in his diary. The shipwreck of the Kronprins Gustav Adolf is described in other sources, too. The loss of a great warship did not pass without notice, it was discussed both privately and officially.

The chain of events that led to the shipwreck of Kronprins Gustav Adolf already started in July and August of 1788. The vessel escaped the naval battle of Hogland with only light damage, and was sent with the rest of the seaworthy ships to watch over the enemy. The rest of the fleet was being repaired in the fortress Sveaborg, off Helsinki. The squadron, led by Colonel Fahlstedt, included three ships of the line: the Försiktigheten, the Prins Fredrik Adolf and the Kronprins Gustav Adolf; and four frigates: the Minerva, the Sprengtporten, the Hector, and the Thetis. The squadron kept to sea during daytime and anchored at night (Mellin sine anno, 46)[2].

On the night of August 5, the squadron anchored about one and a half Swedish miles off Sveaborg (Wahlbom´s diary, SMM). The next morning at 5.30, the Swedes saw a Russian force closing in. The Russian squadron, coming from Seiskari (Seskär), was within cannon – shots before it was noticed, being helped by darkness and fog. The Swedish ships of the line Fästigheten and Prins Fredrik Adolf, and the frigate Thetis cut their anchor lines and set sail for the Sveaborg fortress, the rest of the squadron having already sailed earlier in the morning.

The only vessel left was the Kronprins Gustav Adolf whose master, Colonel Harald af Christiernin, trusting his ship´s speed, gave order to weigh anchor. But things did not run smoothly and in the end the entangled anchor line had to be cut. The Kronprins Gustav Adolf set full sail and escaped towards

1 Wahlbom was born in Kalmar in 1760, promoted to Lieutenant 1784, Captain at 1795 and died as a Major at 1805. Wollin 1988, 26.

2 Dr. Christian Ahlström´s letter of 19.5.1997. Dr. Ahlströms help was appreciated in this research.

Sveaborg. Just as the ship seemed to be out of harm's way, she struck a previously unknown shoal[3] somewhat north of the Gråsjälsbådan[4] shoal. There were two ground touches, of which the second caused the topmast of the main to fall to the sea[5]. The hull broke, causing leaks to the holds.

There was no way of getting the vessel afloat. The Russians drew nearer and the Kronprins Gustav Adolf opened fire from the upper gun deck. Faced with superior force, af Christiernin had no choice but to strike his flag and surrender. The Russians sent boats to the side of the ship to capture it; two Russian officers went on board and were given the keys to the holds and the powder magazine (Wahlbom´s diary, SMM). At the same time, the Swedish Second Lieutenant Gustaf Klint[6] received orders from Admiral Nordenskiöld to sail for the rescue of the Kronprins Gustav Adolf´s crew.

This is how Klint describes what followed: "I made haste. Near the lighthouse island of Harmaja Second Lieutenant Ekholm passed me in his sloop Esplendianin, warning me against taking action in the middle of the Russian fleet. Nevertheless, I kept my course and stopped at half a cannon-shot from the Kronprins Gustav Adolf, as I was determined to lay alongside the grounded vessel and rescue her crew. Two Russian frigates met me and did not stop before they were half a cannon-shot away, so they both could fire at me. Then I noticed that there were several Russian boats alongside the Kronprins Gustav Adolf, taking on board the crew which was now taken prisoner. At that point I had to change my plans and admit I had failed. After reaching Sveaborg, I was ordered to follow the Duke to the narrow of Gustavssvärd, where he watched the Russians on board the Kronprins Gustav Adolf through his binoculars (Ericsson, sine anno)"[7].

The grounded ship could not be helped from the Sveaborg fortress, as her position was out of reach of the Swedish cannons. All the Swedes could do was to follow the events from ashore (Bonde 1911, 299).

A few hours after the shipwreck, at about 0900 hours, some of the Kronprins Gustav Adolf´s officers, including af Christiernin and Wahlbom, were taken on board the Russian flagship to meet Admiral Greig. The Swedes were received politely and dined with the Admiral. Later in the afternoon, Wahlbom and Second Lieutenant Alm were sent to retrieve their belongings from the Kronprins Gustav Adolf on board a small sloop. The swell, raised by the hard winds, prevented them from boarding the grounded vessel (Wahlbom´s diary, SMM). In the evening the Russians made for open waters. Covered by darkness, Second Lieutenant Klint sailed to the wreck on board the sloop Makrill, salvaging a part of the mainmast rigging, the topyard and topsail (Ericsson, sine anno), and some other equipment he could carry in his small vessel (Mellin sine anno, 47–48; Munthe 1914, 18–19).

The next morning Wahlbom and Alm succeeded in getting on board the Kronprins Gustav Adolf with some Russian troops. Wahlbom describes the event: "…at last we made it to our ship risking our lives at the throng in the midst of the Russian sloops alongside our ship. The Russians were looting everything they got their hands on, ignoring their officers´ commands. I could find none of my belongings nor my comrades, except Captain Pihl and Lieutenant Lyckou, who had spent the night on board. In my cabin I found only my sword which the Russians had overlooked. The ship was to be set on fire in an hour, so we mad haste."

The Kronprins Gustav Adolf was set on fire at about 1400 hours. At about 1900 hours the powder magazine exploded (Wahlbom´s diary, SMM; Mellin sine anno, 47–48; Munthe 1914, 18–19). The vessel was probably burned because it could not get afloat (Munthe 1914, 19). Had it been possible to salvage her, she would probably have been included in the Russian fleet.

Word of the Kronprins Gustav Adolf´s fate spread fast. The news reached the commander of the Finnish Coastal Fleet in Sveaborg, Commander Mikael Anckarsvärd, on the eastern Gulf of Finland at noon on August 7 through Colonel Klerker who reported that a messenger had come to the headquarters with the news of the Kronprins Gustav Adolf´s loss (Anckarsvärd 1892, 30). King Gustav III was also informed the same day, as he was reading a report from Duke Carl about the Russian fleet´s arrival off Sveaborg and the accident that had met af Christiernin´s ship (Anckarsvärd 1892, 30)[8]. The Duke had witnessed the events by the strait of Gustavsvärd. The master of the Kronprins Gustav Adolf, Lieutenant – Colonel af Christiernin, also wrote a report of the events, which the Russians later handed to the Swedes[9].

According to the Commander Anckarsvärd´s diary, the wreck of the Kronprins Gustav Adolf was still visible after the burning of the ship, as he wrote the following on August 8, 1788: "I met Sergeant – Major Nikander…he told that the Russian fleet is active off Sveaborg…Christiernin´s burned ship is not far from the fortress (Anckarsvärd 1892,32)." This is what the archives tell about the wreck[10].

The crew of the Kronprins Gustav Adolf was taken to Russia as prisoners. Those who had not died in Russia returned to Sweden on November 22, 1790 (Arne Myllenbergs arkiv, Karlskrona). Af Christiernin described his captivity with the words "heavy and long" (Hägg, 1941, 191).

The shoal that proved fatal for the Kronprins Gustav Adolf became known as, and is still named, the Gustav Adolf´s shoal.

Gustav Adolf´s shoal and seafaring in the 18th century

The crew on board the Kronprins Gustav Adolf experienced first-hand the state of sea charting of the late 18th century. Even if the ship would have carried the most recent chart of the waters, the chart of the Gulf of Finland printed just before the outbreak of the war, this would not have prevented the shipwreck. Special charts did not exist. The charts printed in the spring of 1788 were small scale general charts, lacking information about details important to the safety of navigation. One Swedish officer said, after the Kronprins Gustav Adolf´s shipwreck: "… the Russians know our waters better than we do ourselves… and the Duke started the war without the first reliable chart whereas the Russians have very good charts." The chart of 1788 was a part of the project to improve the quality of charts, started in 1756. As the result of the project, a series of charts were printed between 1782 and 1797. These charts were named after the leader of the project, Rear Admiral Johan Nordenanckar (Ericsson 1987a, 26 and 1987b, 150; Kokkonen 1995, 170,214; Mattila 1983, 132, 140).

Second Lieutenant of the Swedish Open Sea Fleet Gustav Klint, who led the failed operation to save the crew of the Kronprins Gustav Adolf, was later ordered to chart the waters of the shipwreck. In August 1788, i.e. after the shipwreck, he sounded the approaches to Sveaborg and Mjölö roads, both important for the ships of the line, along with his father Erik Klint (Ericsson 1987b, 144; Ericsson 1973, 71).

The collection "Sjökartverket" of the Military Archives in Stockholm includes a chart from 1790, signed by Klint (Sjökartverket, KrA). The chart bears the text "the shoal on which the ship Gustav Adolph was wrecked, d: 6/8 1788" (Fig. 1). Another shoal in the area is marked with the text: "New Shoal – where the warship Äran grounded on ?/7.1788." This alludes to the Kronprins Gustav Adolf´s sister ship Äran, which struck a previously unknown shoal to the south of Gråskärsbådan on July 9, 1788. The Äran was salvaged, and bearings taken of the shoal which was buoyaged after the war. The shoal was named

3 According to Wahlbom, the depth of the shoal was 15 feet, or about 4,45 m (Wahlbom´s diary, SMM).

4 Nowadays Gråskärbodan or Halliluoto.

5 Wahlbom used the term "storstången", which corresponds to topmast in the rigging diagram of the Svenska flottans historia. If Wahlbom really meant the topmast, then obviously the topgallant mast with the yard and sail must have fallen, too (Wahlbom´s diary, SMM).

6 Gustaf (af) Klint (1771–1840), son of Erik (af) Klint, both were awarded knighthood in 1805 as af Klint for their work in sea charting. Farleder berättar 1997,113.

7 The text is based on Christian Ahlström's Finnish translation of a copy of Gustaf Klint´s diary, owned by Christoffer H. Ericsson, who kindly allowed the Maritime Museum of Finland to take a copy of the diary. Christian Ahlström´s letter 19.5.1997.

8 The report has not been found.

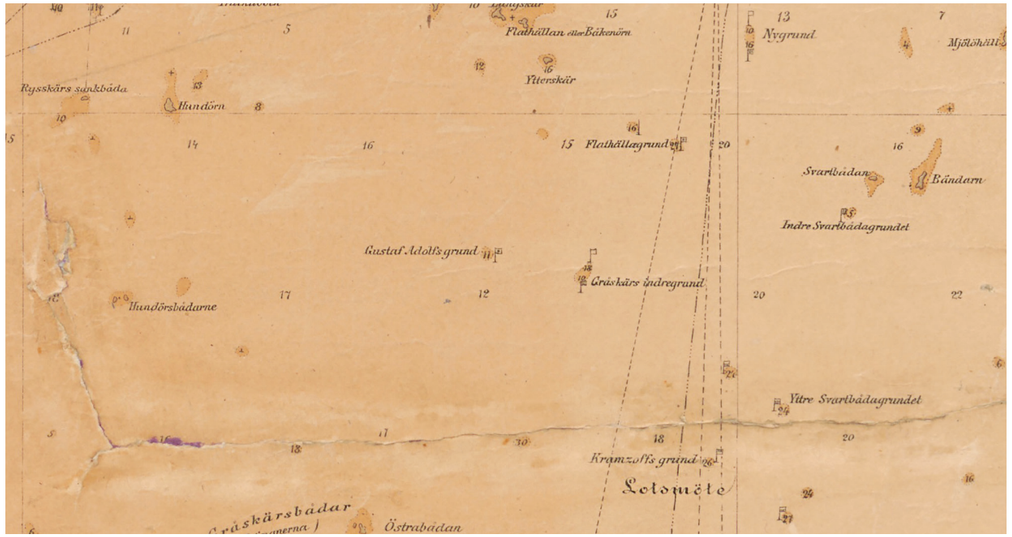
9 The report has not been found. There might be information in Russian archives about the incident, but it has not been researched yet.

10 This is the authors interpretation of the chain of events based on the sources used for this article (see Tikkanen 2000).

Äransgrund (the Äran´s shoal). On the same day, the Kronprins Gustav Adolf also touched ground; the vessel´s guns were moved to the fore and she floated undamaged from the shoal. The ship of the line Ömheten struck the Kalbådagrund shoal, south of Emsalö, on July 16, 1788, even though she had a pilot on board. The Ömheten was salvaged (Mattila 1983, 156; Hornborg 1950, 446; Wahlbom´s diary, SMM, 5).

The above mentioned collection also includes a 1794 copy of a chart signed by Gustav Fredrick Klerck in 1792. This large chart includes a shoal with the text "Here grounded the ship Gustav Adolph in August of the year 1788". The soundings of the shoal are marked in green ink (Sjökartverket, KrA). This chart was drawn by Klerck and Second Lieutenant P.P. Grise during their charting expedition in 1792, which included the harbours of Helsinki and Sveaborg (Dahlgren & Richter 1944, 254).

Figure 1. *The shoal on which the Kronprins Gustav Adolf grounded. The chart from 1880. Map: The Karta öfver Finlands skärgård, Porkala-Helsingfors-Willinge, utgifven år 1880 af K.G.Ekebom. Meri- ja vesistökartat (Vesistökartta A 19/- -), Kansallisarkisto (The National Archives of Finland).*



The wreck of the Kronprins Gustav Adolf today

The wreck of the Kronprins Gustav Adolf is located about 3,5 nautical miles south – south-west of the Harmaja lighthouse off Helsinki. The location is around one mile from the Gustav Adolf´s shoal where the vessel grounded[11]. She has probably drifted off the shoal, having been made lighter by the fire and explosion, during a storm or a higher water level. The remains of the vessel lie 18–20 metres deep on a flat bed of moraine, partly scattered over an area covering about 100 x 100 metres. It seems probable that there has been a final explosion which has sunk the drifting vessel.

The part of the wreck still intact consists of the bottom part of the hull, the sides, which have collapsed, different structural parts, such as the rudder, and 71 guns, gun shots (iron cannon balls etc) and

11 The shoal has been surveyed by diving throughout the years in search for the wreck, but there have been no findings connected to the wreck.

other loose artefacts and ships equipment like ropes (Fig. 2 and 3). There is a large, bent iron anchor in the middle of the wreck (Fig. 4), and another anchor just outside the aft. The cast iron guns are covered by a thick layer of rust. The massive oak structures of the wreck are in good condition. Scattered around the wreck there are some large structural parts of the hull. The length of the wreck is nearly 40 metres and the width approximately 15–16 metres (Tikkanen *et al.* 1997).

The Naval Research Institute discovered the wreck during a side scan sonar survey of the seabed off Helsinki in 1995. Divers from the Coast Guard checked the location and reported the wreck of a large wooden warship. The Maritime Museum of Finland has investigated the wreck in 1997–1999. Financial support for the research has been received from the Finnish Cultural Foundation and the City of Helsinki. The grants by the Finnish Cultural

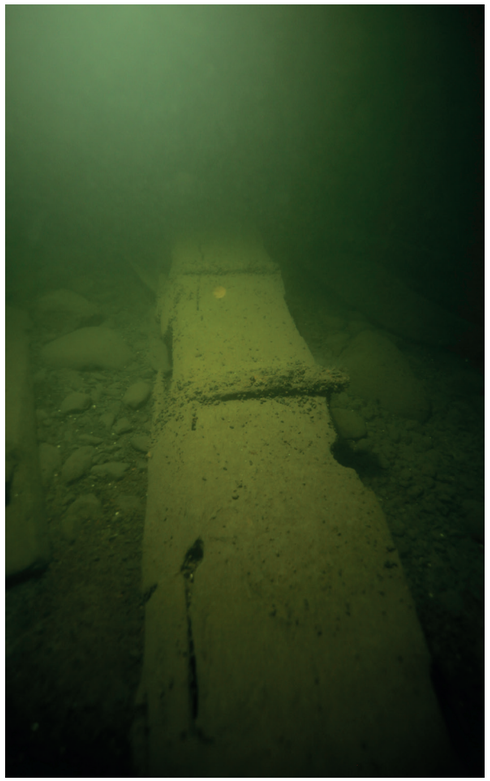


Figure 2. *A rudder of the ship Kronprins Gustav Adolf. Photo: Jesse Jokinen.*

Figure 3. *An ammunition chest. Photo: Jesse Jokinen.*

Foundation made it possible for some students in maritime archaeology of the University of Helsinki to participate in the research and conduct fieldwork. Members of Teredo Navalis association[12], along with other volunteers, have been involved with the investigations. Without the voluntary work, the research would not have been possible.

On the basis of the research conducted 1997–1996, the wreck has been identified as the Kronprins Gustav Adolf. That was the main emphasis of the research at the time. The most important evidence for the identification was the location of the wreck, number and type of guns and their inscriptions (the guns are presented more precisely later), the measurements of the hull, rudder and anchors, the fire marks in the timber, oak as building material, the structural details of the ship and the artefacts found at the wreck (Tikkanen *et al.* 1997; Tikkanen *et al.* 1998, Tikkanen *et al.* 1999). All these correlates with the type of the ship of the line Kronprins Gustav Adolf and are consistent with the facts found in literature and archives. Unfortunately, no name plate, royal insignia or ship´s bell have been found; such proofs of ships identity have probably been looted or destroyed already when ship was captured.

12 An association founded in the 1970´s for helping the Maritime Museum of Finland to conduct maritime archaeological fieldwork.

The Russo – Swedish War of 1788–1790

Sweden had lost parts of south – eastern Finland to Russia as a consequence of the Great Nordic War in 1721. The King of Sweden since 1771, Gustav III, strove to strengthen his position by expanding his kingdom. Russia had entered a war against Turkey in 1787, and King Gustav III now saw an opportunity to claim back the eastern parts of the kingdom in Finland. The constitution of Sweden, however, gave the King only power to proclaim a defensive war, not a war of aggression. The King spread rumours of Russian aggression on the eastern border and after a staged skirmish in Vuolteensalmi, Puumala, the King demanded that the Russian Empress Catherine II cede some territory. Empress Catherine II proclaimed the war on Sweden on the 11th of July 1788.

Figure 4. An anchor in the middle of the wreck Kronprins Gustav Adolf. Photo: Jesse Jokinen.

During the three summers of war, the Swedish and Russian forces engaged in battle on both land and sea. The first naval battle was fought near Hogland in the summer of 1788. Next year, in 1789, the battle of Svensksund (sometimes in literature called "Rochensalm" when translated from Russian into English) off the present city of Kotka ended up in victory for the Russian fleet. In the year 1790, there was the second battle of Svensksund where the Swedish fleet defeated the Russians. As a consequence of this battle, there are more than ten shipwrecks in the battle area still preserved, among them a Russian frigate St. Nicholas. A peace treaty was signed next autumn in Värälä. Against the wishes of King Gustav III, the war did not lead to any changes in the borders.

King Gustav III and the new Swedish navy

Preparing for the war

With the war against Russia in the horizon, the King Gustav the III needed to modernize his navy. The new fleet was to include both older ships and new ones to be built. A committee was appointed in 1780 to decide upon the new types of warships. The plan was to build 15 new ships of the line and 16 frigates; the new ships were to be launched by 1788. In 1781 the King announced his programme for building the new fleet (Cederlöf 1965, 5). The planning of the ships was given to naval architect Fredrik Henrik af Chapman, together with the Commander of the Navy, Henrik af Trolle. Basis for the planning work was the 60-gun ship of the line Wasa, built in 1788 according to af Chapman´s plans. Using the data available from the Wasa´s test sails, af Chapman strove to plan vessels with even better characteristics. The building of the new fleet was the greatest undertaking in Sweden at the time (Halldin 1928, 19–21; Glete 1993, 189, 196–197; Arteus 1992, 128).

The new fleet was the key factor in Gustav III´s policy of war. To keep an eye on the development of his project, the King often visited the shipyard in Karlskrona. The King´s war plans were criticized: his advisors doubted the policy on diplomatic, military and economic grounds. The commanders of the open sea fleet and the coastal fleet expressed the opinion that the fleet was not fit for battle. The greatest problems were the lack of experienced crew, scarce availability of materials, inadequate salaries, bad provisioning, and deficient medical services (Glete 1993, 152; Mattila 1983, 140; Toivanen 1989, 105). The critique was well – founded: it is illustrative of the early stages of the war that only 15 of the 26 ships of the line took part in the war. The rest could not be equipped for sailing (Unger 1929, 164; Glete 1993, 176, 178).

Fredrik Henrik af Chapman

Fredrik Henrik af Chapman was born in Gothenburg in 1721. His father, Thomas Chapman, was a Briton who had served in the Swedish Navy since 1716. His mother, Susanna Colson, was the daughter of a shipbuilder in London (Harris 1998, 20). Chapman had studied shipbuilding and design in Great Britain, France and the Netherlands and he mastered shipbuilding in both theory and practice, being the leading shipbuilding theoretician in Europe. F. H. af Chapman was also an internationally renowned and significant scientist and author. His work dealt with the planning and design of war ships and cargo vessels, shipyard business and the design of anchors and cannons. His main works "Architectura Navalis Mercatoria" (1768) and "Traktat om skeppsbyggeriet" (1775) made him internationally renowned, having being translated into several languages. He was awarded a knighthood in 1772 (Harris 1998, 11; Glete 1993, 191; Arteus 1992, 128).

The Karlskrona Shipyard

Sweden had become a naval power in the Baltic area on the 17th century. She controlled the Baltic with her large and powerful navy which had played a major role in her expansion to the eastern and southern coasts of the Baltic. Russia was not a threat to Sweden´s dominance of the Baltic in the 17th century, and naval warfare focused on Denmark and Germany. Thus the main naval base was moved from Stockholm to southern Sweden, a natural harbour

called Karlskrona, where the navy would not be surrounded by ice during the winters. The town was built on little islands. Erik Dahlberg planned the process of filling, embanking and building bridges, which turned the town into closed fortress. Gradually also shipbuilding, maintenance of ships, and the staff and administration of the navy were concentrated into Karlskrona. There was a civilian population in the town as well as the military one (Nurminen 1995, 110; Ericsson 1987, 124)[13]. Fredrik Henrik af Chapman moved to Karlskrona to supervise the building of the new fleet.

The Karlskrona dockyards were the greatest industrial unit in Sweden in the 18th century, using the most modern technology available at the time. The aim of the dockyards was to build and maintain the Crown´s vessels along economic principles (Glete 1993, 146). During the 1780´s the dockyards and the town experienced a very intensive period when a large number of vessels, as well as different buildings were built (Halldin 1928, 21; Glete 1993, 155)[14].

The open sea fleet and ships of the line

At the end of the 18th century, the Swedish Navy was divided into the navy proper or the open sea fleet (Örlogsflottan) and the coastal or army fleet (Skärgårdsflottan or officially Arméns flotta). The open sea fleet was based in Karlskrona. The Swedish Squadron of the Coastal Fleet was based in Stockholm, and the Finnish Squadron in Sveaborg. Besides the Navy, the cornerstones of the Swedish war policy were the fortresses and the army. The strategy in the war of 1788–1790 was based on joined surprise attacks by the open sea fleet, the coastal fleet and the army (Glete 1993, 148).

The open sea fleet consisted of different types of ships: ships of the line, frigates and smaller vessels. Ship of the line was the largest type of ship in the open sea fleet. The name of the ship type derives from the battle strategy the vessels mainly engaged in: the ships formed a battle line which fired simultaneously at the enemy. Usually the battle lines fought each other without decisive victories. A ship of the line was built to carry heavy armature and to withstand long fire from the enemy. They were capable of operating in the Baltic from spring to autumn without visiting a harbour. Apart from battle lines, the ships of the line were also used in smaller units or even by themselves. They could be used to support the smaller operations of the army and the coastal fleet. The smaller vessels of the open sea fleet were used for reconnaissance, patrolling and chasing the enemy (Glete 1990, 14; Glete 1993, 146–148).

The Kronprins Gustav Adolf and her sister ships

The Kronprins Gustav Adolf´s type drawings and scale models

The "Mariners ritningar" collection of the Swedish Military Archives includes drawings for the series of vessels including the Kronprins Gustav Adolf, dated on July 20, 1780 (Mariners ritningar A1, KrA). The drawings show the lines and frames of the vessel, and the profile of the vessels outer hull. Also the Chapman archives of the National Maritime Museum in Stockholm include some of this series of vessels (Chapman arkivet). These drawings depict the same information as the drawings at the Military Archives. In the Maritime Museum´s collection there are some drawings of the rigging, dated July 18, 1780, and some drawings of the vessel´s accommodation arrangement[15], deck arrangement and some cross section drawings.

In the drawings mentioned above there are no ornaments. The drawings, and to some extent also the scale models, were meant for the whole series of ships. The ornamentation of the individual ship was designed separately for each vessel.

Four different scale models (1:16) were made of the Kronprins Gustav Adolf series of ships in the 1780´s: the frame model, the launching model, the model of the finished ship above the water line, and the diagonal cross section model. All models

13 The town and shipyard of Karlskrona were added to the UNESCO world heritage list in 1998.

14 The intensive building period in the 1780´s was not systematically reported and there is only fragmentary information in the archives (Tikkanen 2000, 40).

15 "inredningsritning", or interior drawing

are exhibited at the Karlskrona Maritime Museum. There is one model of the series in the National Maritime Museum showing a finished vessel, including the hull below the water line (Glete 1990b, 14–43).

The Kronprins Gustav Adolf series of 60-gun ships of the line in numbers (Harris 1998, 111).

Length	49,30 m (166 feet)
Beam	13,59 m (45 ¾ feet)
Draught in full cargo	5,79 m (19 ½ feet)
Height from water line to gun deck	2,18 m (7 1/3 feet)
Displacement[16]	2000 t
Crew	564 men

Names and ornamentation

The allegorical names of the ships were given by a royal edict. The ships of the line were given masculine names, e.g. the first ship of the series was named after the son of King Gustav III and Queen Sofia Magdalena, Gustav Adolf, who later ruled as Gustav IV Adolf[17]. The rest of the vessels were given names reflecting qualities needed in the war. The frigates, designed at the same time as the ships of the line, were seen as feminine and some of them were given names after mythological goddesses (Cederlöf & Olausson 1987, 83; Cederlöf 1965, 5).

The names of the ships of the line were a part of the King's political propaganda. The names follow the order of the following sentence, composed by the King himself:

Kronprins Gustav Adolf styr Fäderneslandet med Ömhet och Rättvisa, Dygd och Ära, välj Försiktighet, Dristighet, Manlighet, Tapperhet (Enighet och Ståndaktighet) till rådgivare (för att uppnå Styrka och Seger till ett Gott Samvete). In English the sentence would read: Prince Gustav Adolf shall reign his Fatherland with Gentleness, Righteousness, Virtue and Honour, employing Cautiousness, Fearlessness, Valour, Bravery (Unanimity and Solidity) as his advisers (in order to achieve Strength, Victory and Clear Conscience).

16 Chapman´s drawings from 18.7.1780 include the text "deplacement 69122 kubikfot" (Chapman arkivet).

17 Gustav IV Adolf (1778–1837), King of Sweden 1792–1809.

Figure 5. *A model of Kronprins Gustav Adolf made by Marko and Anne Torvinen. Picture: Archives of Finnish Heritage Agency.*

The King gave orders to equip each vessel with a figurehead and transom ornament depicting the vessel´s name. This work was given to the sculptor Johan Törnström, whose plans and drawings were to be accepted by the King. The figurehead of the Kronprins Gustav Adolf has not been found at the wreck site. Some of her sister ships´ figureheads are displayed at the Karlskrona Maritime Museum. The figurehead of the ship the line Dygden, for example, is more than four metres tall. The drawings archive of the Swedish National Museum in Stockholm includes a drawing for a figurehead with the text "Ship of the line No 1, Kron Prins Gustav Adolph". The drawing depicts a man with a cloak. The drawing is not signed; the author could be Johan Tobias Sergel or Johan Törnström. There is no documentation as to whether Törnström carved a figurehead for the Kronprins Gustav Adolf on the basis of this drawing. The late 18th century saw the most magnificent figureheads and cutwater constructions on the Swedish warships. The figureheads of the Kronprins Gustav Adolf series of ships were "English red" or white (Webe 1969, 30; Cederlöf 1965, 5; Halldin 1968, 28–32).

Törnström was also responsible for the transom ornamentation of the new fleet. The name of

the vessel was placed in the middle of the transom and the emblem at the upper part of the transom. The emblem of the Kronprins Gustav Adolf depicts a profile of a child´s face, that of Kronprins Gustav Adolf. Törnström´s drawing for the transom and the model for the series of ships differ from each other; there are four portholes in the model and eight in the drawing. This indicates that the final plans for the transom were not completed at the time when Törnström made his drawing (Halldin 1967, 21–23).

The hulls of 18th century warships were painted usually with yellow oil paint or light tar, with black bends and black or blue gunwales. The Karlskrona model of the Kronprins Gustav Adolf corresponds to the traditions except her white hull. The bottoms of the ships were coated with a mixture of tar and pitch (Glete 1993, 193, Svenska flottans historia 1943, 352).

The Kronprins Gustav Adolf ship´s bell has not been found at the wreck site. The frigate Bellona, built at the same time as the Kronprins Gustav Adolf, had her ship´s bell cast by Johan Björkman in 1790. The bell carries the ship´s name and Gustav III´s monogram. The Kronprins Gustav Adolf´s sister ship the Försiktigheten´s bell was cast in 1785 in Karlskrona. The bells of warships did not always carry the ship´s name because the duration of bells was considered longer than that of the ships, and thus a ship´s bell could serve several ships during its lifetime. A ship´s bell was used for announcing the start and finish of a task, the watches and time on board, prayers, and to give the vessel´s position in the fog (Webe 1986, 153–154; Wilstadius 1965, 54; Svenska flottans historia 1943, 443)[18].

A coin was traditionally placed in the vessel´s mast step when the mast was attached. As the mast step of the wreck of the Kronprins Gustav Adolf lies beneath the bottom, it is not possible to confirm the existence of the mast coin without archaeological excavations. A mast coin was discovered in the mast step of her sister ship the Försiktigheten when the vessel was scrapped in 1825 (Webe 1986, 280).

18 The bells of the Försiktigheten and the Bellona are in the National Maritime Museum´s collection.

The sister ships of the Kronprins Gustav Adolf were all lost, scrapped or sold. Two of them sank in the Bay of Vyborg, Russia in 1790, one destroyed by an explosion in her powder magazine, two were sold in the 19th century, and four were scrapped in the 19th century (Svenska flottans historia 1943, 549). The frigate Bellona, built at the same time as the Kronprins Gustav Adolf, was wrecked in 1809 near Öregrund (Webe 1986, 280). The shoal she ran aground was named Bellona´s shoal (Cederlund 1983).

Building the fleet in Karlskrona

Chapman´s idea for serial production

Chapman´s aim in building several ships according to the same plans and drawings was to rationalize, speed up, and lower the costs of building by utilizing the advantages of serial production and standardization. The stem, stern and frames were built according to the model parts to ensure the correct shape of the parts. The different parts of the ships were built at different places and then assembled at the shipyard. Serial production and standardization also made fitting out the ships easier, since all parts of, for example, the rigging fitted all the ships. Jan Glete has described the new mode of production adopted when building the new fleets in the 1780´s as "mass production" (Glete 1990a, 9; Glete 1993, 194–197; Cederlöf 1987, 83–84; Harris 1989, 122).

One fully fitted out ship of the line was a kind of floating standardized store of spare parts, the parts and fittings of which could be used on other ships. The ships carried a double store of many fittings and equipment, such as anchors and anchor lines, mast spars, sails and gun carriages, for repairing damages caused by the enemy or storms (Glete 1993, 157–158, 161).

Chapman aimed at designing the ships of the line stable enough for the lower gun ports to be open under sail, making it possible to use the cannons even in fresh winds. This was something that the ships of the line at the time were normally unable to do. Other desired characteristics for the design were good sailing speed at all points of wind, good manoeuvrability, and predictability of motion (Svenska flottans historia 1943, 341.

Busy timetable and great costs

Building the Kronprins Gustav Adolf and the frigate Bellona started at the same time on July 18, 1782 by laying their keels and frames. Both vessels were launched on November 11, 1782 at 0800 hours. The same day at 1300 hours started the building of the next two ships. It took the shipyard 111 days to build the Kronprins Gustav Adolf and frigate Bellona. When launched, the vessels were not yet completed; the hull was only built up to the bends. The rest of the work was done afloat. The last part of the work was fitting out and arming the vessels. The Kronprins Gustav Adolf was ready to sail sometime during the year 1783 (Arne Myllenbergs arkiv, Karlskrona). The two ships were the first ones of the new fleet. The Kronprins Gustav Adolf was the 128th vessel built at the Karlskrona shipyard; the shipyard built a total of about 400 vessels during its 300 years of operation (Glete 1993, 196; Myllenberg 1981, 87; Rollof 1958, 512–513; Svenska flottans historia 1943, 347). Kronprins Gustav Adolf was built in a twenty metre high shelter named Vasa to protect against wind, moisture, snow, and ice. The building had been raised in 1763 according to Carl Cronstedt´s drawings. The frigate Bellona was built outside, next to the shelter (Lepasoon 1993, 230; Rollof 1958, 512)[19].

In order to complete the new fleet, the shipyard aimed at building three pairs of vessels each year. One frigate and one ship of the line were always built simultaneously. Between 1782 and 1785 ten ships of the line and ten forty-gun frigates were built. The average time for building the first six pairs was 122 days; for the rest of the pairs the average building time was only 52 days (Brome 1930, 525; Harris 1989, 123). Work was done seven days a week and extra remunerations were paid to increase efficiency (Rollof 1958, 513).

The yearly cost of building the fleet was estimated at eighteen barrels of gold, or 300,000 riksdollars, at the fleet´s planning stage. The total cost of one fitted out ship of the line was 78,000 riksdollars. The estimated costs were exceeded by about 40%. Of the planned 15 ships of the line and 15 frigates only ten of both types were built (Halldin 1928, 22; Lepasoon 1993, 233; Glete 1993, 186, 192–193; Harris 1998, 106; Svenska flottans historia 1943, 344).

19 Other sources claim that the ship was built in "Stora skeppstapeln gamla varvet" (Arne Myllenbergs arkiv, Karlskrona).

Acquiring and transporting building materials

Building materials were decisive to the success of the shipyard´s task. All materials had to be purchased and transported to Karlskrona. Inside the shipyard, they had to be distributed to the right places for storage, building or processing. The materials used were in different stages of processing. For example, timber was processed at the shipyard, sails sewn from the sail cloth, and guns only fitted on board (Lepasoon 1993, 224). Ships were sent from Karlskrona to fetch materials and products like timber, hemp and guns (Glete 1993, 157–158, 161, 176, 194).

The ship´s equipment like rigging, ropes, sails, cannons, ammunition, and sometimes also ballast was stored ashore for the winter and overhauled before spring. Also the ships were overhauled during the winter. The masts were stripped using cranes, which operated on manpower. Ship´s equipment was stored in so-called inventory rooms with separate locations for each ship´s equipment (Glete 1993, 157–158, 161, 176, 194).

Oak

In 1782 alone 45,000 m² of oak was felled in Sweden for building the new fleet. Later, even more oak was needed. The crown had right of first refusal for all oak in Sweden. The oak needed for shipbuilding had to be large enough, and the largest oaks needed for the ships were transported from Poland and Pomerania. The existing old stocks of oak were used for building the first ships of the new fleet. Well-dried oak suits shipbuilding better than freshly felled timber. After 1783 only new timber was available; the ships built of this material were heavy and their draught was one or two feet more than planned (Glete 1993, 179, 197; Rollof 1958, 522). The result of

using new timber was that comprehensive repairs had to be carried out after ten to fifteen years of service. Some vessels were, however, still fit for service sixty years after they were built.

The Kronprins Gustav Adolf was built mainly of oak. In 1997 four samples for a dendrochronological analysis were taken: two of the keelson, one of a floor timber, and one of a frame. All samples were oak. Dating could only be established for the keelson. The growth rings of both samples start from the turn of the 15th century, one sample reaches the year 1591 and the second 1607. The results would thus indicate rather the 16th than the 17th century. If we assume that the timber had been felled in the 1770´s or 1780´s, between 170–190 years are missing from the samples, which would be equivalent of 15 to 20 cm of planning the timber while shaping the keelson. The samples indicate that the timber had grown in northern Germany of southern Sweden.[20] The knees of the Kronprins Gustav Adolf would not have been oak, as a decision was made already in 1780 not to use oak because there was a shortage of oak grown crooked, needed for knees; it was decided that spruce roots be used instead. According to Chapman, cast iron knees could not be used because the capacity of the foundries was not sufficient (Lepasoon 1993, 233–234; Glete 1993, 194). No knees have been found so far at the Kronprins Gustav Adolf´s wreck site for determining their material.

To reduce costs and speed up the work, the ships were not finished off in the normal way. In Chapman´s own words: ”They are already good enough to be shot in pieces” (Harris 1998, 127).

Shipbuilders and their work

Before industrialization, shipbuilding was a workforce – intensive activity. Labour was organized according to different tasks; in addition to directors and officers, the workforce consisted of carpenters, other craftsmen, and unqualified labour. Part of the workforce was permanent and part temporary. Most of the unskilled workers were soldiers of the navy or army. Soldiers were often commanded to the shipyard when there was a work phase which required a lot of manpower. For the naval seamen, working at the shipyard was considered good training for sailing on board the warships. Those naval seamen who were experienced in carpentry often worked as carpenters. Some of the naval seamen working on the dockyard were signed on when the ship sailed. The army personnel were mainly used for construction and fortification work, timber transport and such. Most of the workforce came from Karlskrona or the areas nearby (Glete 1993, 156, 16).

It is difficult to estimate the number of people that were working at the shipyard under the most intensive period of building the new fleet. Already in 1780 eight hundred men were commanded to work at the shipyard from the Helsingeland Regiment. In 1784 it is said that about 1,150 people were working at the shipyard, of which about 550 men were carpenters and about 300 nail wrights, mast makers and sawmen. Two naval regiments were also stationed in Karlskrona, and at least one of them was directly involved with shipbuilding (Harris 1998, 120; Myllenberg 1981, 74)[21].

Building one ship of the line took, according to the different estimates, between 50,000 and 80,000 workdays of the carpenters. A rough estimate for the work needed to build and fit out the ship of the line and one frigate at the same time would be about 250,000 man-days, or 800–900 man-months (Halldin 1928, 22; Lepasoon 1993, 233; Glete 1993, 186).

The main tasks at the shipyard were organized between three departments: The construction department was responsible for the hull, masts and spars. The weaponry department dealt with the cannons and other armoury. The outfitting department was responsible for the rigging, sails, ropes, anchors, and other equipment. At the risk of simplifying, it could be said that each department was responsible for a certain type of material: one dealt with timber, the other with metal and ammunition, and the third with textiles. Each department made inventory lists of all materials and equipment they were responsible for (Glete 1993, 156, 175). Different professions within departments included glazier, compass maker, painter, rope maker, sailmaker, and bell maker (Lepasoon 1993, 224).

20 At the moment, there is not enough archaeological data for making more exact conclusions. To determine how much of the keelson has been planed off, a cross section sample should be taken. Dendrochronological research report by Pentti Zetterberg, the University of Eastern Finland 1997.

21 Karlskrona was at the time the third largest town in Sweden with a population of 11,000.

Construction department – the hull

The work of the construction department took place at the building site, numerous workshops, and outside. The work included sawing timber, hewing masts and spars, forging iron, shaping hundreds of treenails to joint different parts together, building and painting the accommodations, and carving the ornaments for the ship (Glete 1993, 159).

The side planks were sawn. The Kronprins Gustav Adolf´s starboard planking at the stern is between 38 and 78 cm wide and 10 to 12 cm wide. The inside planking´s width is about 28 cm and thickness about 11 cm at the wreck´s stem. An adze was used to shape the keelson and the frames. The keelson of the Kronprins Gustav Adolf is about 45 cm wide and 40 cm high, measured at the midship of the wreck. The keelson is constructed of at least two pieces joined together. The few frames which have been measured at the wreck´s stem are 35–36 cm wide and 44–45 cm thick (Tikkanen *et al.* 1997; Tikkanen *et al.* 1998, Tikkanen *et al.* 1999).

Outfitting department – ropes, blocks, sails and ballast

The main tasks of the outfitting department were ropemaking, sailmaking, and making blocks and parts of the rigging in the so called tackle – chamber. The department also dealt with timber transports, hauling out the smaller vessels, moving vessels at the dockyard, and ballast (Glete, 1993, 159).

The ropes for the Kronprins Gustav Adolf were twisted and laid in the 300-metre ropery building, built in 1696, with seven rope machines. The length of the rope was decided by the length of the ropemaking track. In the cellar of the ropery there were rooms for hackling and tarring hemp. Hemp was tarred before twisting according to the description of ropemaking from 1703; earlier the finished rope was tarred (Lepasoon 1993, 224–225). Since the Middle Ages, the hemp needed for ropemaking had been bought mainly in Riga, Tallinn, and Narva; this hemp was grown in Russia. A Royal Letter from 1774 assures that the best hemp was the Riga brand of Rigaer Marin Reinhanf and that of Königsberg (Nilson 1961, 32; Rollof 1994, 167; Tikkanen 2000, 48).

Anchor line was the thickest rope, traditionally made of 36 strands. One of the strands was blue to indicate the rope was Navy´s property. The length of cordage on board a ship of the line was several kilometres; the anchor line was stored on the rope deck between main mast and fore hatch below the lower gundeck and above the water barrel hold (Nilson 1961; Rollof 1994, 170–177; Wiklund 1995, 35; Harris 1989, 114; Webe 1986, 91). Some anchor line was also stored together with an anchor in the lowest hold.[22] Remains of thick rope have been discovered in these parts of the wreck. A one-metre piece of rope, the diameter of which was about 18 cm, was raised from the wreck in 1997 (Tikkanen *et al.* 1997).

A late 18th century ship of the line carried thousands of deadeyes and other types of blocks. A deadeye was usually a round wooden disc with three holes, made fast to the low end of the shrouds which support the mast; its function was to tighten the shrouds. Three deadeyes have been raised from the wreck. Also one block sheave and one large three – sheaved block with remains of an iron hook have been raised. The latter could have been used a threefold purchase. Other parts of the tackle have not been discovered at the wreck site (Tikkanen *et al.* 1997).

Iron bars were used as ballast in the Kronprins Gustav Adolf. There are between twenty to thirty bars visible in the midships of the wreck, laid alongside next to the keelson. Three of the bars have been raised. The one raised in 1997 is 69,5 cm long, 8,5 cm wide, and 8,5 cm thick, and weighs 16 kg. It bears the inscription “A.F.” which could stand for the Swedish name for the coastal fleet (Arméns flotta), or be the

22 Type drawings of the Gustav Adolf series of vessels (Chapman arkivet, SMM).

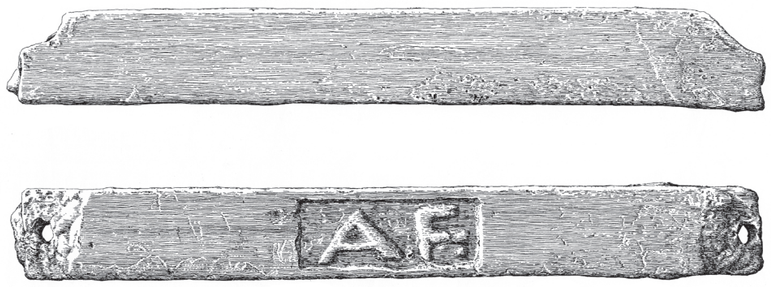


Figure 6. *The iron bar used as ballast in the ship.*
The letters AF mean most likely Arméns flotta, the coastal fleet of Sweden.
Illustration by Mikko Rautala, Finnish Heritage Agency.

mark of the iron works (Fig. 6). The two bars raised in 1999 have no inscriptions; they are 92,5–87,6 cm long, 11,4 cm wide, and 12,3 – 9,6 cm thick (Tikkanen *et al.* 1999).

Ballast was used to stabilize the vessel. It was placed as low as possible in the hold. Traditionally the ballast consisted of sand or stones; using metal bars represented a modern trend. Iron bars had been used in Sweden since 1748. lron bars were heavier than e.g. a stone of same dimensions and thus saved space. Bars were also easier to handle, when the ballast had to be moved. Chapman recommended using iron bars with a layer of washed gravel on top of them. Also pieces of cannons, anchors and old cannon balls were used as ballast. Chapman considered 1/10 or 1/11 part of the vessel´s displacement as the required amount of ballast (Hägg 1941, 41, 114; Harris 1998, 232)[23].

Using iron bars instead of stones somewhat improved hygiene on board. The larger the total surface free of the ballast, the more room there was for the growth of bacteria, fungi and algae (Simmons 1984, 4). Using iron bars also improved the ventilation of the holds and meant fever blockages in pumps and limber holes (Harris 1998, 232). The hygienic problems of holds and ballasts had been known for years; it was clear that the filthy and damp holds were connected to the diseases on board. The stinking holds and bilges were a problem in the Swedish Navy in the 1780´s, according to the Navy´s doctor Arvid Faxe (Simmons 1984, 5; Grönquist 1998, 138–139).

23 There is no evidence of gravel on top of the ballast at the wreck of Kronprins Gustav Adolf. According to the geologist who dived at the site, the soil at the site does not differ from the soil of the surrounding area (Tikkanen *et al.* 1998).

Anchor foundry – prisoners´ work

Two anchors have been found at the wreck site, one in the middle of the wreck and the other behind the stern. They are both stock anchors, the wooden stock of them both have been destroyed. A ship of the line had many heavy anchors. There were two anchors; the port side was called the "daily anchor" and the one on the starboard side "mooring anchor". The port anchor was normally used. There were two anchors in amidships also for emergencies. In addition to these, there was even a reserve anchor stored upside down in the hold. All the anchors were of the same weight, though some sources insist that the starboard emergency anchor and the one stored in the hold were the heaviest. There were also a sea anchor and a couple of kedge anchors on board (Webe 1986, 166; Färnström 1993, 68; Hägg 1941, 38; Harris 1998, 231; Stjerncreutz 1982, 19–22; Tikkanen 2000, 50; Chapman arkivet, SMM).

The arms of the anchor found at the middle of the wreck point aft; if it is the anchor stowed below decks it must have fallen towards the aft of the vessel. The shank of this anchor is 5,3 metres long and the width between the flukes is 3,30 metres. The anchor is bent in the middle of the shank. There are no inscriptions on the anchor. The anchor´s arms are somewhat bent, which is typical for Scandinavian and Dutch anchors of the time as opposed of the to the British anchor with straight arms (Marx 1985, 52; Tikkanen *et al.* 1997). The anchor outside the wreck of Kronprins Gustav Adolf´s wreck site has not been measured.

One of the anchors of the Kronprins Gustav Adolf´s sister ship, the Försiktigheten, is on display outside the National Maritime Museum in Stockholm. This anchor´s shank is about five metres long, the width between flukes is about three metres and the length of the stock four metres; the anchor weighs four tons. At the Söderfors iron works there are some anchors on display, made for the Försiktigheten, but for some reason never delivered (Webe 1986, 166; Färnström 1993, 68; Hägg 1941, 38). This indicates that some anchors were manufactured outside the Karlskrona shipyard.

The anchors of the Kronprins Gustav Adolf were made in the anchor foundry of the Karlskrona shipyard. In this gloomy place about one hundred prisoners, many sentenced for life, were serving their sentences of hard labour. The prisoners came from all parts of the country, their crimes including murder, robbery, arson, and church thievery, i.e. the worst crimes in the society. The prisoners worked wearing chains in their necks, around their bodies, and around their feet. They were closely guarded by armed soldiers. Their work was very hard, even according to the standards of their time (Halldin 1928, 50, 88; Harris 1998, 120; Glete 1993, 159).

Provisioning

When the Kronprins Gustav Adolf was made ready to sail to the Finnish waters in the spring of 1788, the provisions for her crew of more than five hundred men was taken aboard. This was such an important part of the ship´s function that some thought had been given to her provisioning already at the planning stages. Chapman´s design was based on the concept of the ship carrying provisions for five months and drinking water for two and a half months. The idea was that the ship was to be self – sufficient in order to be an effective weapon against her enemies (Rollof 1958, 506). The amount of victuals needed was so large that the Admiralty was responsible for organizing the needed food processing industry. The buildings for bakery and brewery were built by the Admiralty in Karlskrona, while the businesses themselves were rented out to town´s burghers. Also spirits-making was rented out. The buildings were situated near the docks in order to facilitate transportation (Lepasoon 1993, 236–237; Swahn 1999, 146; Hägg 1941, 41).

Loading of provisions

The provisions were loaded mainly in the lowest hold in the barrels. Food, mainly salted fish and meat, was loaded in the hold abaft of the main mast. Peas and grain were stored in bins in the aft hold. Bread and spirits were stored in separate compartments. The barrels used for food were smaller than water barrels, and stored before the main mast[24]. Remains of barrels have been found at the wreck site, which, judging from their location, were water barrels. In places the remains are in four rows, stored alongside the vessel. Some parts of barrels, presumably made of oak, have been raised but no inscriptions have been discovered on them (Tikkanen *et al.* 1997; Tikkanen *et al.* 1998, Tikkanen *et al.* 1999).

Different barrels and casks were the tins of the time, used for storing salted fish and meat, water, beer, spirits, and even gunpowder. The barrels were made at the shipyard and stored in storage rooms on Stumholm. At least 650 barrels of various types went on board a ship of the line. Water barrels and kegs had different names depending on their size. Various sizes were needed in order to make good use of the storage capacity of the hold. The normal number of water barrels was 453; the number of food barrels for five months' consumption was 375. All barrels

24 Type drawings of the Gustav Adolf series of vessels 18.7.1780 (Chapman arkivet, SMM).

were stowed above the ballast (Lepasoon 1998, 237; Webe 1986, 197; Hägg 1941, 41).

The barrels were kept in place by athwart beams with hollows for the barrels (Lepasoon, 1993, 236–237; Swahn 1999, 146; Hägg 1941, 41). These beams were always used in pairs. Some hollowed beams have been found at the wreck site. The visible parts of the beams were measured, being 3,35 and 3,15 metres long. Three hollows are visible on both beams being 55–65 cm deep (Tikkanen *et al.* 1997; Tikkanen *et al.* 1998, Tikkanen *et al.* 1999). On the diagonal cross section model at the Karlskrona Maritime Museum the barrels are stowed on a floor built above the ballast. On the other hand, the accommodation drawing in the National Maritime Museum does not show such floor. Investigations of the wreck have not brought to light evidence of any floor above the ballast.

Drinking water for the warships in Karlskrona came mainly from the river Lyckeby. It was transported by vessels called water sloops, from which it was taken on board and stored in the barrels already in the hold by water hoses. When water was needed on board, it was siphoned from the barrels (Stenholm 1998, 33; Hillbom 1979, 138; Kisteförnöjelse 1981, 72).

Weaponry department

The arms depot of the shipyard was situated on the island of Trössö. Gun carriages, weapons, and artillery tools were built and repaired at the depot. It was no coincidence that the depot was on an island, as charges were made and gunpowder stored there. Some of the powder was made in the shipyard´s laboratory, and the rest at the crown´s gunpowder factories in Torsebro and Huskvarna. Cannons and gunshots were not made at the shipyard (Glete 1993, 159; Lepasoon 1993, 234–235; Wenster 1998, 37).

Kronprins Gustav Adolf´s weaponry

Cannons

Chapman´s starting point for warships design was the artillery on board. The vessel was just a means of using the cannons effectively. Chapman was a specialist on cannon design and wrote theoretical texts on the subject[25]. Traditionally, old cannons were used in new ships still in the 1780´s. Some of the cannons were captured from the enemy; and in any case the cannons on board any warship were different from each other. The reason for this was that the useful life of a cannon was longer than a ship´s; a cannon could serve more than hundred years. The muzzle – loaded cannons were solid cast and the bore and breach were made after casting (Berg 1993, 38).

The original plans were changed and more powerful cannons were ordered for the ships of the line. Chapman wanted lighter cannons and more firepower. The new types of cannons included a 36 pounder with a short barrel, being lighter and more powerful than the old 24 pounder with a long barrel. The results of a new cannon´s trials were so good that the Admiralty decided to arm the lower gundecks of the new ships of the line with 36 pounders, while the old 24 pounders were placed on the upper gundeck. Finally, even the old 24 pounders were replaced by a new model of the same bore, only slightly heavier than the old 18 pounders.

In the autumn of 1783 the shipyard placed orders at several Swedish foundries for a total of 104 pieces of 36 pounders, 132 pieces of 24 pounders, and 52 pieces of 12 pounders. First shipments arrived at Karlskrona that same year (Glete 1993, 172–173, 192, 196, 208). The foundries had difficulties in meeting the orders, and only six new ships of the line could be armed with the new cannons by the spring of the 1788, including the Kronprins Gustav Adolf (Harris 1998, 111). The rest of the new ships were armed with old 24 and 18 pounders (Munthe 1914, 199; Glete 1990, 44; Svenska flottans historia 1943, 362; Gustav Klint´s diary, 19).

25 E.g. ”Försök till en Theoretisk Afhandling att gifwa åt Linie-Skepp Deras Rätta Storlek och Form likadeles för Fregatter och Bevärade mindre Fartyg” (Rollof 1958, 542).

Planned armoury for the Kronprins Gustav Adolf:
26 pieces of 24 pounders on the lower gundeck
26 pieces of 18 pounders on the upper gundeck
8 pieces of 6 pounders on the poop deck
Total 60 pieces

Actual armoury[26]:
26 pieces of 36 pounders (new type)
on the lower gundeck
28 pieces of 24 pounders (new type)
on the upper gundeck
8 pieces of 6 pounders (old type)
on the poop deck
Total 62 pieces

Different sources give a slightly different picture on the vessel´s armoury. A standard number of cannons was 62 pieces and the maximum number 64 pieces. Some sources claim that the maximum number was 68 pieces. According to the Unger register the Kronprins Gustav Adolf carried also “some swivel guns (nikhaka) and two mortars or howitzers.” These discrepancies are understandable in the light of the fact that the vessel probably carried a different number of cannons from year to year. The weaponry was seldom exactly the one originally planned (Arne Myllenbergs arkiv, Karlskrona; Ungers register, SMM).

The cannons of the Kronprins Gustav Adolf

There are at least 71 cannons in the wreck of the Kronprins Gustav Adolf. Some more cannons are outside the wreck (Tikkanen *et al.* 1997; Tikkanen *et al.* 1998, Tikkanen *et al.* 1999). The fact that the number of cannons exceeds the maximal weaponry of the vessel is perhaps explained by some cannons which were part of the ballast. It is possible that some cannons were carried as part of the cargo[27]. Navy divers raised two cannons in 1998. The cannons were placed in watertight wooden boxes and transported to Halikko, Rautaruukki factory for conservation. They were placed in an annealing oven inside metal pressure chambers while hydrogen gas was circulated in the chambers to restore the corroded metal into iron (Sorsa 1998). The third gun was lifted in 2000, and conserved at the Metropolia University of Applied Sciences. The conservation of the cannon took four years. Also a replica of a gun carriage was built for the cannon and it was located in the lobby of the school for several years.

Both guns lifted at 1998 and 2000 are 24 – pound ship´s cannons. One of the guns lifted in 1998 was manufactured at the Swedish Ehrendahl foundry, judging from the inscription “E.B.” on the right kingpin (Fig.7). The inscription was taken into use in 1784 or 1785. A part of the kingpin is destroyed; the year of manufacture can have been marked on the kingpin too. The cannon lifted in 1998 weighs today 1,800 kg, according to an inscription on the cannon, it´s original weight has been 2,091 kg. The calibre of the cannon is 155 mm. The other cannon is manufactured in the Åkeri foundry, as witnessed by the inscription “AB” on the right kingpin; “1785” is the inscription on the other kingpin. The cannon weighs today 1,700 kg, while its original weight has been about 2,070 kg. The cannon balls for both guns have been 150 mm in calibre and weighed about 11–12 kg[28]. The gun lifted in 2000 is also a 24 pounder. The type is the so-called Ehrensvärd model and it is manufactured at the Ehrendal foundry. The original weight of the cannon was 2091 kg.

The firing range of the cannons used by the Swedish Navy in the 1780´s is not dealt with very much in literature. According to test firing results from 1839, a 24 pounder could hit a target the size of a frigate two times out of three from 900 metres[29].

Gun carriages

Af Chapman was also interested in the design of carriages and he developed the models used on board the Swedish warships. A carriage was a wheeled support for the cannon. The wooden carriages usually had four wooden wheels, but Chapman wanted to replace this design with a wheelless one known as

26 A list of the ships of the line by Chapman, Kriget till sjös LXIV, Krigshistoriska handlingar, KrA; Åhlund 1998, 59).
27 Compare e.g. Brown, 1997, 106.
28 Paulaharju Jyri, letter 30.6.1998 and interview 8.2.2000.
29 Curator Tapani Ahvenisto, oral comment. The Finnish Heritage Agency.

a "hill carriage". [30] Chapman's new design was put on trial on the Kronprins Gustav Adolf's sea trials in 1787, and the wheelless model was approved. All the new ships of the line got the new carriages on the lower gundeck and for the lighter cannons at the fore and aft of the ships. The rest of the cannons still used a wheeled carriage, though a modified version. The models of the Kronprins Gustav Adolf in the Maritime Museum in Stockholm and the Maritime Museum in Karkslkrona show the cannons on the upper gundeck on wheeled carriages and on the lower gundeck on wheelless carriages. On the fore deck the carriages are without wheels, whereas the poop deck has four wheeled carriages. The naval battle of Hogland proved that Chapman's new carriage design was not a complete success (Åhlund 1998, 59; Harris 1998, 234; Rollof 1958, 543)[31].

Projectiles

The projectiles used included solid cannonballs, bar shot, shallow balls, grape shot, and cartridges (Svenska flottans historia 1943, 199, 364; Paulaharju 1992, 128). Two iron cannonballs were raised from the wreck in 1997. One of the balls is 16–17 cm in diameter and weighs about 10 kg. The other, not so well preserved, measures approximately the same. According to the scale used in Sweden form 1705 until the early 19th century, the diameter of the 36 pounder cannonball was 17,2 cm and the weight about 18 kg using the so called Nynberg pound. It is possible that the cannonball has lost almost half of its original weight in the water because of corrosion. Remnants of cannonball bins and cannonballs have been found near the main mast of the wreck (Fig. 7; Tikkanen *et al.* 1997).

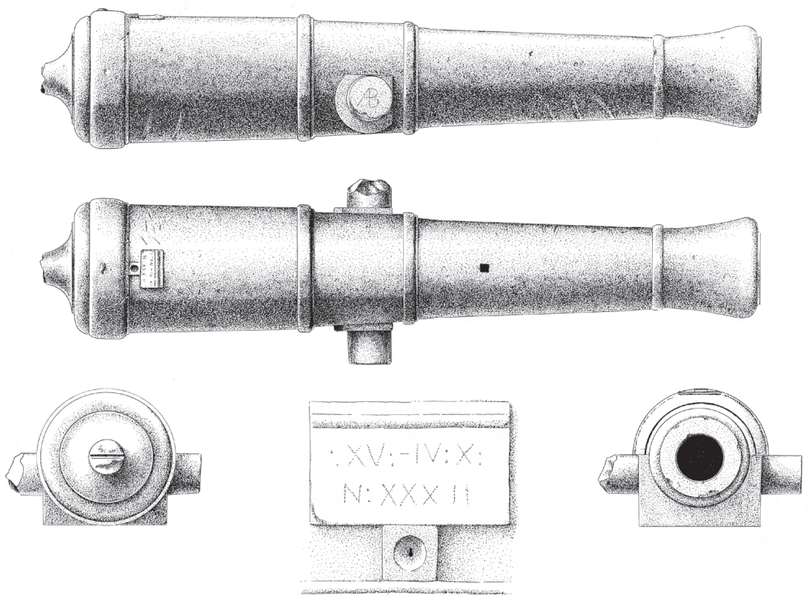


Figure 7. *The iron gun lifted from the wreck. The gun was produced in Åkeri foundry, Sweden 1785. Illustration by Mikko Rautala, the Finnish Heritage Agency.*

30 In Swedish: Kursörlavet

31 *Svenska flottans historia* claims that Chapman's new design was not used (Svenska flottans historia 1943, 365).

Small arms

In the summer of 1999, 23 different brass parts of small arms were raised from the wreck, including back covers, trigger covers, lock mountings, and ramrod tubes. The parts were situated on the starboard side of the wreck's stem. All the parts are from flintlock guns (Tikkanen *et al.* 1999). No locks have been discovered, which is not surprising as the locks were usually made of iron and would thus have corroded. The mountings of older guns were made of iron in Sweden; the first gun with brass mountings was the flintlock, model of 1738 (Flöög 1999).

Several types of small arms were in use in the Navy in the late 18th century. The most traditional of naval weapons were the grappling hooks and axes, of which probably the newest model of 1780 was mainly used in the war of 1788–1790. The naval seamen also carried a short sword, a model of 1784. The flintlocks, shotguns, and arms for firing grenades completed the Navy's selection of small arms. The flintlocks included the cavalry's short barrelled m/1704, and the m/1716, m/1725, m/1731, m/1738, and m/1747. Most guns were old. The guns were often modified for naval combat by shortening the barrel. The Navy needed about 40,000 flints for its flintlocks in 1788 alone. The master of a ship carried the pistol m/1738 and the officer's sword, a model of 1770–1780. The two edged master's sword m/1744 was mainly symbolic. On the basis of the archive material available it is impossible to say which models of small arms were used on board of the Kronprins Gustav Adolf (Alm 1954, 93–101; Hägg 1941, 62; Flöög 1999, 12, 14, 30 "Livet ombord på ett örlogsfartyg på 1700-talet" exhibition in the Maritime Museum of Karlskrona, exhibition leaflet).

The Sea Trials of 1787

An interesting match race took place on the North Sea during the summer and autumn of 1787, when the Kronprins Gustav Adolf designed by Chapman and the Drottning Sophia Magdalena designed by Gilbert Sheldon, master of shipbuilding, raced against each other. The sailing characteristics and

Figure 8. *Remnants of cannonballs. Photo: Pekka Tuuri.*

seaworthiness of the two ships, designed from different starting points, were put to test. Cannons and carriages were also tested. The verdict of the Sea Trials Committee was that the Kronprins Gustav Adolf was better or at least as good in almost all the features tested. They specially remarked that she was able to sail with her lower gunports open (Harris 1989, 132–134; Svenska flottans historia 1943, 358).

The spring of 1788 – fitting out

The king ordered on April 19, 1788, that the ships of the line, five frigates, and three smaller vessels be fitted out and be ready to sail before the end of May. These vessels had wintered at the shipyard. Now they were rigged, their anchors and cordage taken on board, the cannons and ammunition stowed, provisions and drinking water taken, and finally sails and gunpowder carried on board. Provisions would only last for one month, even though normally there would have been provisions for up to five months and drinking water for two and a half months. Everything was ready and the ships at the roads before the end of May in spite of the shortage of work force and materials, and tight schedule (Backström 1884, 242; Harris 1998, 60, 137; Mattila 1983, 143; Myllenberg 1982, 51; Munthe 1914, 104; Flöög 1999, 27).

On May 31, 1788 Gustav III inspected the new squadron of the Karlskrona Open Sea Navy, and the ships set sail on June 6, 1788. The squadron sailed under the command of the kings younger brother Fleet Admiral, the Duke Carl on board the ship of the line Hedvig Elisabeth Charlotta. The Kronprins Gustav Adolf sailed as the last ship of the squadron, thus being the leading ship if the squadron changed direction. This position demanded an experienced master, Lieutenant – Colonel Harald af Christiernin[32]. After a week of exercises on the Baltic near Gotland, the squadron took course for the Gulf of Finland. The Sveaborg fortress off Helsinki was to be the next harbour in which to replenish provisions. Some gear like ropes were on their way, on board other ships sailing to Sveaborg (Munthe 1914, 112, 148).

32 Harald Christiernin, later af Christiernin, 1751–99, Rear Admiral 1795 (Svenska flottans historia 1943, 432).

The Crew

From the ship's boy to the master

The crew of the Kronprins Gustav Adolf consisted of about 570 men, including the following groups:

Officers: 1 Lieutenant – Colonel, 2 Captains, 2 Lieutenants, 2 Sub-Lieutenants, 3 Officers of the Army, 2 Cadets

Junior officers: 1 Midshipsman, 5 Sub-Midshipsmen, 4 Constables, 9 Artillery Officers, 1 Chief Petty Officer, 3 Petty Officers, 6 Leading Seamen, 4 Junior Officers of the Army

Crew: About 70 Corporals, 20 seamen, 250 naval seamen, 110 soldiers, 30 ship's boys, 20 stewards (Svenska flottans historia, 433)[33].

In addition to the above, there were also a priest, a sailmaker, surgeons and cooks on board of the ship. The officers were responsible for military operations and navigation. Junior officers were professional sailors; sailing and gunning practice were their responsibility. They, together with the enlisted volunteers, formed a small permanent crew of the ship. Most of the naval seamen belonged to the military tenure system and lived on their crofts when not working on board a naval ship or the shipyard in Karlskrona. Most of the naval seamen had no experience of seafaring or great ships, but some of them had been involved in peasant sailing. They were regarded as good sailors and gunners. The main advantage for maintaining the military tenure system for the Navy was the fast mobilizing of the forces when needed for action (Arteus 1992, 135; Hägg 1941, 37–38; Ericson 1997, 278).

There were very few Finns serving in the Open Sea Fleet, the crews being mainly Swedish. Part of the army personnel on board the warships came from the Finnish regiments. Finnish naval seamen served mainly in the Coastal Fleet (Toivanen 1989, 106).

During the first year of the war, 1788, there was no recruiting for the Coastal Fleet in the coastal towns of Finland, making it improbable that many Finns would have been recruited for the Open Sea Fleet based in Karlskrona. At least some dozens of

33 Munthe 1914 gives somewhat different figures.

Finnish merchant seamen from Ostrobothnia were recruited and served in the Open Sea Fleet in 1789 and 1790. The records show that Jakob Johan Linsenius, a shipmaster from Helsinki, went missing in the battle of the Bay of Vyborg while serving on board the ship of the line Enigheten on July 3, 1790 (Toivanen 1989, 106, 113–114; Hornborg 1950, 457; von Busch 1993, 45).

In the spring of 1788 it proved problematic to sign on experienced crews for the new warships. Members of the crews mostly met each other for the first time when going on board their ships (Svenska flottans historia, 418; Harris 1989, 138).

Gunners' work

During battle, most of the crew worked on the gundecks. An enlisted gun leader commanded each gun, while the gunners were mostly naval seamen. Ships of the line usually fired simultaneously point blank at the same target. The artillery officers on the upper deck gave the gunleaders information about the direction of the target, the ship's heel and the distance of the enemy. Gunfire aimed first and foremost to destroy the enemy ship's rigging. The primary target was the main mast. The number of men serving a cannon depended on the size of the gun. Usually a 36 pounder cannon was served by 14 men, a 24 pounder by eleven men, and an 18 pounder by nine men. Ship boys carried shots from the hold to the gundecks. Gunners trained handling and firing the cannons daily. The procedure was described in the 1787 gunners' manual. At the sea the gunports of the lower gundeck were normally closed and the cannons secured to the sides of the ship. The upper gundeck cannons were run out while sailing (Bäckström 1884, 244; Grönquist 1924, 87–88; Webe 1986, 275; Svenska flottans historia, 387, 442).

The gundecks and gun carriages were traditionally painted red so as not to show blood during battle, in order to keep up moral of the crew (Hägg 1941, 26). The kingpins of the canon rested against hollows on the gun carriage. The steps of the back of the carriage formed a support for the bar used for lifting the back of the cannon. When at the desired angle, the carriage was wedged at its place (Hägg 1941, 58).

When the cannon was fired it recoiled inboard, restrained by the large ropes attached to the rear of the gun barrel and to the sides of the ship. The cannons of the 18th century had no sights, so aiming was based on experience.

The charge and ball were inserted into the barrel, recharging was always made with the cannon taken inboard. A wad was used to hold the charge tightly in place. Some powder was poured down the firing hole. The powder was ignited by a lowering the burning fuse rope onto the fire hole. In the late 1770's the so-called Aschling flintlock was taken into use. After firing, a cleaning rod with a leather bulge was thrust down the barrel. A special screw was used if the charge was to be removed. There was a special set of tools for cleaning the fire hole (Golowin 1924, 91; Berg 1993, 38; Paulaharju 1992, 120, 149, 151; Svenska flottans historia, 364–365).

Twenty-five balls were stored beside the cannon. Rest of the balls were stored in the hold of the ship next to the main mast (Svenska flottans historia, 199, 364). It was part of the ship's boys' work to carry shots from the magazine to the gundeck.

Gunners' work was tough; the ship was rolling on the sea, work was heavy, noise deafening, air full of gunpowder smoke, the crew frightened and unused to the sea and battle.

Life on board

All work on board was divided into watches. The crew slept in hammocks on the gundecks during their free watch. Sleeping in hammocks got some getting used to and the right position quite uncomfortable. Things were not made easier by the fact that in 1788 the Navy did not have blankets for everybody. Personal belongings were kept in a chest or a ditty bag (Hägg 1941, 113–114; Grönquist 1998, 139; Munthe 1914, 112; Svenska flottans historia, 454).

The food on board was monotonous, unhealthy, and very salty. It consisted mainly of salted fish and meat, dried fish, bread, peas, grain, butter and beer. Often the fish was rotten, bread stale, wormeaten and mouldy, butter rancid, beer and water bad-tasting. On the other hand, there was enough to eat, which was more than some men were used to

at home. Meals were taken on tables seating seven or eight men between the guns, and stowed away after the meal. The quality and quantity of food was based on the "spisordning" of 1782. Spirits formed part of the meal. The late 18th century saw first efforts to improve the conditions on board warships; e.g. the doctor of the Navy, Arvid Faxe, strove to improve the food and health of the sailors (Svenska flottans historia, 445, 455–456, 459).

Some plans were made and orders given concerning the clothes worn on board the warships in the 1780´s. A uniform was taken in use only in the mid-19th century. The plans included identical coats, vests, trousers, hats, shirts, socks, boots, and scarves for the crew. In practice the crew was far from identically clothed. A part of life at sea is the fact that the clothes were usually wet or a least damp (von Busch 1993, 46; Svenska flottans historia, 450–452).

The Naval Battle off Hogland

The battle

The Open Sea Fleet arrived at Helsinki on July 9, 1788. On July 14 the fleet sailed from its anchorage at Isosaari off Helsinki to engage the Russian fleet in battle. The Russian fleet, commanded by Admiral Greighin, was spotted to the west of the island Hogland early in the morning of July 17, 1788. The two equally strong fleets were engaged at about 1700 hours (Enqvist 1982, 2; Hornborg 1950, 447; Mattila 1983, 147; Withol 1993, 74).

The master of the Kronprins Gustav Adolf, Harald af Christiernin, described the start of the battle as follows: "I commanded every hand on the deck and, leaving matters in God´s hand, said Lord´s Prayer. After this we opened fire fearlessly and full of confidence" (Hägg 1941, 189).

The Russian line attacked the Swedish who were on the lee side. The wind died towards the evening. The Swedes disabled the 74-gun ship of the line Vladislaff and surrounded it. The Kronprins Gustav Adolf and the Drottning Sophia Magdalena together seized the Russian ship which was towed behind the Swedish line. The Swedes lost the ship of the line Prins Gustav to the Russians (Samoilov 1993, 22; Vuorenmaa 1993, 63; Munthe 1914, 214; Mattila 1983, 147–148; Svenska flottans historia, 434).

Back to Helsinki

After the battle the Swedish fleet sailed to Helsinki, anchoring by Mjölö and Sveaborg at noon on July 18, 1788 (Anckarsvärd 1898, 19; Samoilov 1993, 22; Ericsson 1987, 126)[34]. Both sides considered themselves victorious. Strategically, victory belonged to the Russians, who prevented the Swedes from attacking St. Petersburg. It has been claimed that the Swedes were deprived of victory because their supply of shot, especially the balls for the 36 pounders, was not sufficient (Samoilov 1993, 22; Vuorenmaa 1993, 63; Mattila 1983, 148; Bäckström 1884, 244–246; Rådlund 1975, 34).

According to the Swedish count, they lost 127 naval seamen and 59 soldiers while 290 men were seriously injured. Most of the injured died in a few days. Some wounded officers were taken to private homes in Helsinki. The losses for the Kronprins Gustav Adolf were the leading seamen number 7, Sune Herlin, and the seaman no 64, Staffan Bossa, both "shot to death". Two men were seriously wounded. Baron Fleetwood was wounded in the leg by a bullet. The Russian losses were 580 dead and 720 seriously wounded. The Russians taken prisoners on board the Vladislaff were taken first to Sveaborg. Orders were given to treat the prisoners respectfully and to tend their wounds as the wounds of Swedish men (Handlingar rörande sjöexpeditioner, KrA; Wahlbom´s diary, SMM; Munthe 1914, 214, 245; Norrman 1994, 24–25; Samoilov 1993, 22; Vuorenmaa 1993, 63; Mattila 1983, 147–148.; Svenska flottans historia, 434).

Three officers, Count Horn, Captain von Horn, and Captain Fust, died on board the ship of the line Wasa. They were buried in Helsinki on July 22, 1788. The warships fired salute at the time of the funeral (Wahlbom´s diary, SMM).

34 The Russian Navy was based in Kronstadt and Tallinn, where the ships of the line wintered.

36 pounder cannon balls

As mentioned earlier, two probably 36 pounder balls have been raised from the Kronprins Gustav Adolf´s wreck. It has been estimated that one cannon shot about fifty shots during the battle of Hogland, meaning that the cannons of Kronprins Gustav Adolf were fired about 3,000 times. According to the sources, the Swedish ships exhausted their stores of 36 pounder balls. After the battle, some fresh supplies were taken in Sveaborg, but apparently not 36 pounder balls. More balls were ordered from Sweden, but 36 pounders were not available either in Karlskrona, Stockholm or the foundries (Munthe 1914, 224, 237–238).

So where did the 36 pounder balls raised from the wreck come from? Are they from a later time? Did the ship acquire more 36 pounder balls after the battle? The balls were discovered on some structural parts of the wreck. There are some balls left inside of the wreck, covered with rust. They have not been raised as not to break the entity of the find.

Celebrating the victory in Helsinki

The celebrations of what the Swedes chose to regard as victory were held in Helsinki on July 21, 1788. Gustav III´s vessel the Amphion was anchored in the harbour of Helsinki, from where the parade marched to the Ulrika Eleonora church. A guard of honour lined up all the way form the harbour to the church. The masters of the Swedish warships carried flags and pennants from the captured Russian ship of the line Vladislaff, "stained in blood". The celebrations culminated in a thanksgiving service, during which several psalms, including Te Deum, were sung. The King delivered an address, decorations were handed out, and promotions made. In fact, every officer who had taken part in the battle were automatically promoted to the next rank. The master of the Kronprins Gustav Adolf, af Christiernin was promoted to the rank of Colonel because of his outstanding accomplishments in handling his ship (Arne Myllenbergs arkiv, Karlskrona).

A memorial ceremony for those killed in action preceded the victory celebrations, attended by the King and the Fleet Admiral, Duke Carl. Victory celebrations were held also in Stockholm and Karlskrona. As the battle had two winners, the Russians naturally celebrated their victory over the Swedish fleet in St.Petersburg (Wollin 1988, 8).

The *Kronprins Gustav Adolf*'s assignment

The warships were in dire need of reparations after the battle of Hogland. "…the ships had many an enemy shot on board and carried the wound of Russian cannons on their hulls and waterlines. The ropes of their rigging were shot to pieces…" (Anckarsvärd 1898, 19–20; Munthe 1914, 222). Repairs were not easy because there was shortage of materials and experienced carpenters.

In August 1788 the Russian fleet was sighted off Helsinki. The Swedish could only send out three ships of the line and some frigates. The materials used in repairing these ships were taken from the captured Russian ships (Bonde 1911, 298). One of the three was the Kronprins Gustav Adolf, who was sailing towards her final destiny.

Epilogue: "The typhus fever"

After the loss of the Kronprins Gustav Adolf, the Russian fleet blockaded the Swedish ships in the Sveaborg fortress. Shortage tried the Swedish troops and the Russian prisoners alike. The Commander of the Sveaborg Coastal Fleet, Anckarsvärd, described the situation in July 1788:"… they lack food, water, medicine, and nurses; they are lying on bare floor without linen or even straws" (Anckarsvärd 1898, 55). This, however, was just a foretaste of what was to come. A contagious disease, called the "typhus fever" at the time, spread in the fortress. The disease originated from the Vladislaff, captured by the Kronprins Gustav Adolf. The disease is caused by a bacterium carried by lice (Svenska flottans historia, 433, 464).

Situation worsened during the autumn. In October 1788 forty to fifty men died each week of the disease. Circumstances in the hospital at the fortress island were disastrous, and there was nothing the Navy could do to help the sick (Anckarsvärd

1898, 54–55). As there was not enough room for the sick in the fortress hospital, some were moved to the town of Helsinki. Thus the disease spread in Helsinki. The number of deaths in the Helsinki parish grew from the average of 103 in 1778–87 to 213 deaths in 1789, and 295 deaths in 1790 (Anckarsvärd 1898, 54–55; Hyvönen 1987, 66; Hornborg 1950, 452, 457; Svenska flottans historia, 433, 464). The exact number of deaths caused by the disease in Helsinki is not known.

The Swedish Open Sea Fleet did not dare to sail to Sweden because of the Russian fleet. Sailing orders came only when the coming winter made it improbable that the Russians would attack. The fleet sailed on November 20, 1788 when the coastal waters were already icing. Five hundred men of the crews were left in Sveaborg. The voyage to Karlskrona was cold, snowy, and stormy. Eight hundred men went down with the fever at sea (Harris 1998, 139; Ericsson 1987b, 149; Munthe 1914, 148–149; Hägg 1941, 115–116; Haeger 1971, 27–36).

The fleet arrived at Karlskrona on November 27, 1788. The disease spread to the Navy, the shipyard, and the town, killing about 8,000 people (Harris 1998, 139). Because of the disease, the Swedish Navy was not fully operational in 1789 and could only fight one indecisive battle against the Russians near Öland. The soldiers returning to their homes from Karlskrona spread the disease to many parts of the country. On June 17, 1790, a great fire broke out in Karlskrona. After this disaster the disease recurred and claimed five sixths of the population (Myllenberg 1981, 11; Färnström 1993, 41; Munthe 1914, 147; Hornborg 1950, 457).

This shows how helpless the Navy was in fighting diseases in the late 18th century. The war of 1788–1790 cost Sweden the lives of estimated 20,000 people of which only 1,500 men died in battle, while the rest were the victims of various diseases (Glete 1993, 209; von Bush 1993, 43; Brome 1930, 538; Toivanen 1989, 101).

The Helsinki Underwater Park Kronprins Gustav Adolf

As part of the exhibition "Ships Lost at Sea" by the Maritime Museum of Finland at Kaapelitehdas 2000 in Helsinki, an underwater park at the wreck of Kronprins Gustav Adolf was opened in June 2000. Underwater parks are one way of making archaeological findings known to the diving community and wider public, and making the shipwrecks more accessible and safe to divers. Experiences gathered from around the world show that these parks are a good way to promote the preservation of underwater cultural heritage. There are two mooring buoys for attaching the divers´ boats safely without anchoring near the wreck and for divers two smaller buoys located on both ends of the wreck. Divers can follow a marked route with 12 information signs along the route. Also a sign telling about flora and fauna was added along the route. The route is marked with a rope and arrows pointing the right direction. There are also signs marking the bow and stern of the wreck and a guest book where divers can write their signature and comments (Fig. 9). The pages of the guest book are changed annually. A plastic diver's map and a booklet of the park and the history of Kronprins Gustav Adolf was published in 2000.

Since the opening of the park hundreds or even thousands of divers have visited the park. The divers have also helped in monitoring the condition of the wreck and the infrastructure of the park. The co-operation with the Finnish divers´ federation and the diving community has been very fruitful. There were voluntary divers who tested the diving route before official opening and since the opening, and many divers visit the park regularly. Despite the amount of dives, the site has preserved almost intact. During the first seasons, some cannon shots were touched, but not taken. Also some incidents happened, once the divers left their boat alone in the buoy, and the boat sank. Luckily the coast guard was near and the divers were unharmed. The other incident happened because of the wave action caused by the passing passenger ship. There were divers in the water and air tanks and some furniture dropped into the water from the deck of the divers´ vessel. The divers were part of the team of volunteers conducting monitoring and maintenance work at the site (Fig. 10). Luckily no-one was injured, but both of the situations were risky. The site is very open to winds, and sometimes the buoys come off from the ropes and chains they are attached to. Also the passenger ship traffic causes wave action. Because of the risks, the park has had safety rules since the opening to secure the divers and also the historically and archaeologically significant site. The wind limit for attaching the boat and diving is 6 metres per second to avoid the previous situations.

It is also important to monitor the site regularly. It was clear from the beginning, that the corrosion process is going on at the iron cannons, cannon balls and all iron parts of the wreck. The cannons were covered with a thick layer of rust, and for example the inscriptions at the cannons were invisible. Rami Kokko, who was employed at the Maritime Museum of Finland, was a diving with maritime archaeology students and studied conservation of waterlogged findings, too. He started a project of protection of the cannons and cannon balls as part of his studies in Metropolia University of Applied Sciences in 2001 and did some tests with the sacrificing anodes. The aim was to lower the corrosion potential and slow the corrosion process of the artefacts with the method. At first, he made some tests in the laboratory. The results in the laboratory and in situ were promising, but the longterm effect was not certain. The method needs more developing. After that, a guideline for monitoring of the site was written by Rami Kokko and Mari Salminen, who has the same education as Rami Kokko (Kokko 2002).

Most of the divers visiting the park have been Finnish. There have been some inquiries from foreign divers and there are some companies, who do dive charters regularly during the summer season,

Figure 9. *A guest book.*
Photo: Pekka Tuuri.

but all the information about the park has been this far in Finnish[35].

A new chapter of the park was opened in 2015, when co-operation with the city of Helsinki and a company called Sea Safety Scandinavia started for maintaining and promoting the park. There was a pop up exhibition from June to October 2015 about the Kronprins Gustav Adol*f* at Kisahalli, which is a traditional sports hall in Töölö, Helsinki. About 40 000 people visit the sports hall per month.

The next step was a project Baltacar, which gave an opportunity to improve the park and make it finally accessible to foreign divers also. This far all the material like booklets and brochures had been only in Finnish, and it was difficult to answer to the interest of foreign divers, because there was not information to provide. Also the non-divers and tourists taking the cruises and guided tours around Helsinki would have been interested. There were some video clips in the Internet, but for a non-diver, the experience was not very informative, and the sense of a dive was not possible. With the support of the project, it will be possible to make a 3D-model of the wreck and give a better view of the famous Kronprins Gustav Adolf, a representative of our common European history.

35 See the Internet site of the Finnish Heritage Agency https://www.museovirasto.fi/en/cultural-environment/archaeological-cultural-heritage/underwater-cultural-heritage-in-finland/helsingin-hylkypuisto

Figure 10. *Diver Pasi Lammi cleaning the dive trail and information boards. Photo: Jesse Jokinen.*

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History above the bedrock – carvings and shipwrecks at Hauensuoli area of Hanko

PÄIVI PIHLANJÄRVI

Hanko, defined by the sea

Hanko is the southernmost municipality of Finland, surrounded by the sea on three sides. Only when travelling north can you find a strip of land a few kilometres long, connecting Hanko to its neighbouring municipality of Raseborg. The sea has always been an integral part of life in Hanko: the town's history is all about sailors and naval warfare, fishermen and harbour pilots.

The Hanko Peninsula has served as an important port throughout the centuries. It is located along busy but dangerous routes at the hub of maritime transport to the east and west (Fig.1). The earliest written mentions of the Hanko Peninsula's harbour date back to the 13th century and can be found in the land register of King Valdemar the Victorious of Denmark. They describe a sea voyage from Blekinge in Sweden to Reval (now Tallinn) in the Baltics (Boström 1968, 14–15).

This sheltered sailing route used by commercial vessels ran from Eastern Sweden across the Sea of Åland to the coast of Finland and onwards to the east and south towards the Baltics. A resting spot along this route, nowadays known as Hanko, was called "Hangethe", or "Kumionpää" in Finnish during that period. Furthermore, this route was probably also used during the 9th century by the Vikings as their eastern route from Scandinavia towards Nyenschantz and the large rivers of Russia (Ericsson 1987, 106).

Figure 1. *Sailing routes passing the Hanko Penninsula in the 18th century. Boström, 52.*

In the 16th century at the latest, the importance of the Hanko Peninsula became evident when the fight for the control over the Baltic region intensified and Sweden began transporting its troops south via Hanko (Boström 1968, 45). A fortress was constructed on the nearby island of Skansholm, which these days is part of the Tulliniemi Peninsula, to protect merchant ships and troop transport vessels (Aaltonen 1969, 9).

Pilot boats were used to assist vessels navigating the challenging local waters, and this had a major impact on a permanent settlement being established in Hanko (Ekström 1987, 25). The 17th century residents of Hanko lived in so-called pilot houses, which were owned by the state and whose land could only be cultivated in return for pilot boat services. Therefore, Hanko was inhabited for centuries by the old pilot-boat families and their descendants (Forsman 1987, 10, 23).

In the windy Hanko Peninsula, where the land is barren and the crops are poor (Forsman 1987: 9–10), the sea was the main source of livelihood. In the 16th century, the townsfolk of Hanko would even pay their taxes in the form of cod, salted Baltic herring and dried fish. Eels were caught with fish traps, whilst nets were used to fish for Baltic herring, and any excess catches were exchanged for grain. (Nikula 1938, 271, 279, 286, 312.) The peasants also used the sea for seal hunting, and the islands south of the Hanko Peninsula served as summer pastures. The peasants living in the archipelago made frequent trips on their boats to Stockholm, and occasionally also visited Tallinn (Ekström 1987, 28–33).

The Hanko Peninsula has been dubbed "the gateway to Finland" or "the windiest corner of Finland", both of which are probably accurate in terms of the politics and history of warfare in the region. In the 18th century, Hanko was engulfed by the Great Northern War and became occupied by Russia. The famous Battle of Gangut, during which the Russian Tsar Peter the Great's fleet beat the Swedish coastal vessels, was fought off the shores of the Hanko Peninsula in 1714. However, the exact location of this battle remains unknown (Ericsson 1987, 113–116).

A guestbook on the rocky shores

Hauensuoli ("Pike's Gut") forms a zigzag off the coast of Hanko, approximately 400 metres southwest of the tip of the Tulliniemi Peninsula. It is a narrow strait between two islands with rounded profiles, Kobben and Tullisaari, and is long and winding like the intestines of a fish (Fig. 2). The strait is roughly 120 m long and its width varies between 3 and 25 m. The tall cliffs, strong as fortress walls, offer protection to the strait from both east and west and stand ready to face even the stormiest of weathers.

The centrally located yet sheltered cove of Hauensuoli by the sea route was well-suited to be used as Hanko's natural harbour, unlike the steep and rocky southern shores of the Hanko Peninsula (Ericsson 1987, 107). Towards the end of the Middle Ages, the sea level outside of Hanko was approximately two metres higher than today, due to post-glacial rebound, which meant that also the Hauensuoli Strait used to be significantly deeper and suitable for sailing (Norman 1976, 4). Before being dubbed Hauensuoli, this area was called Kalhamn or Vanha Tullisaari ("Old Customs Island"), which refers to the customs duties charged from ships sailing through the deep strait between the Tulliniemi Peninsula and Tullisaari Island (Boström 1968, 11, 26). The customs office was most likely established on the island as early as the 16th century, during the reign of Gustav Vasa of Sweden (Boström 1967, 15).

The treacherous waters and unpredictable winds around the Hanko Peninsula forced vessels to stay in Hauensuoli for longer on average than in any other port. Sometimes it took several days, even weeks, for the winds to become favourable again, and in order to help pass their time the bored sailors began carving messages onto the smooth rocky shores surrounding Hauensuoli.

The total of around 650 coats of arms, house marks, names, initials, images and even stories have been discovered around Hauensuoli, an area just three hectares in size. These carved markings cover a period from the late Middle Ages to the 20th century (Fig. 3). The carvings indicate that the island was visited by craftspeople, merchants, sailors, soldiers, officials and the nobility (Hamari *et al.* 2001, 22.)

Some of the drawings in Hauensuoli probably date back as far as the 15th century. The oldest date carved in Hauensuoli is the year 1508, but the coat of arms below is so eroded it can no longer be identified. The majority of the carvings were made during the 16th and 17th centuries when maritime transport via Hanko towards the Baltics, in particular, increased significantly (Boström 1968, 33–37.)

Making these carvings helped pass the time, but often the aim was also to commemorate famous men. This is particularly evident in the high number of Swedish and Finnish coats of arms of noble families found in Hauensuoli. Cobblers, blacksmiths, merchants, clerks and tavern landlords would carve the symbols of their trades a suitable distance away from the noble families' crests. Swedish historian Olaus Magnus dedicated an entire chapter to Hanko, its vitally important haven and unique petroglyphs in his work "A Description of the Northern Peoples", published in 1555 (Boström 1968, 28–30).

One of the most famous inscriptions in Hauensuoli was created in 1754 by an expedition and survey party led by the designer of the Sveaborg sea fortress, Colonel Augustin Ehrensvärd. The text reads: "The yacht Flickan and its cheerful crew came here on 21 August 1754. Hahn and Gethe surveyed the islands, Gerdes and Frese went on a hunt, Liedner fished, Skytte made some nice coffee, Ribbing had a rest, v. Spången carved the words on the rock and A. Ehrensvärd measured the depth of the water." Some distance away is another piece of text connected to the same event: "Fabian Casimir Wrede arrived here on 21 August 1754. His companions included Cederström, Creutz, Liliehök on the yacht Agneta." The original text is in Swedish. (Boström 1968, 285.).

Figure 2. *Hauensuoli strait and the islands in the front. Photo: Jesse Jokinen, Museovirasto.*

All in all, fewer of these petroglyphs date back to the 18th century in comparison to the previous centuries. This is partly explained by the reduced amount of transport towards the Baltics after the Great Northern War, partly by the shipbuilding techniques becoming more advanced. The post-glacial rebound also played a part, making the strait of Hauensuoli shallower while ships started to become bigger (Kokko 2007, 4–5).

Some of the carvings in Hauensuoli were destroyed in the fires during the Crimean War in the mid-19th century. Furthermore, the detonations required for the cable laying conducted in the 20th century caused damage to the rocks, and the site has also been vandalised. Hauensuoli did not become a protected ancient monument site until 1967 when museum intendant Birger Boström conducted an inventory of the islands' carvings, which were subsequently brushed clean with lye and toothbrushes and painted with falun red to make them more visible (Boström 1967, 7–8).

After the restoration work was completed, President Urho Kekkonen visited Hauensuoli to inaugurate it. Finland's coat of arms and Kekkonen's signature were also engraved on a rock during the ceremony. In addition to that, in honour of its 50th anniversary, the Coastal Artillery Battalion of Hanko was allowed to engrave its insignia on the rocks: a fortress with Russarö lighthouse adopted from Hanko's old coat of arms standing in the middle. In 1983, the City of Hanko had a water level mark carved next to another similar mark made by Carl Korsman 100 years earlier (Ekström 1995, 12).

The importance of Hauensuoli as a monument to the history of sailing has increased over the years, and currently the area is protected under several schemes. The Finnish Heritage Agency has defined Hauensuoli as a nationally significant built cultural

Figure 3. *Hauensuoli rock carvings.*
Photo: Kaisa Lehtonen, Museovirasto. AKDG433:2.

environment. The area has also been nominated for Finland's Tentative List for inscription on UNESCO's World Heritage List as an element of shared cultural heritage. In addition, it is also part of the City of Hanko's national urban park, founded in 2008, and the Tulliniemi Peninsula's bird sanctuary as part of the EU's Natura 2000 network.

Shipwrecks and research on sunken ships

The Hanko Peninsula is surrounded by a busy maritime route, which has been in use for a long time but is difficult to navigate and has seen many vessels sink there over the centuries. Over 200 shipwrecks have been discovered in the waters of Hanko, Kimitoön and Raseborg, approximately 150 of which are protected by the Antiquities Act as ancient monuments that are over 100 years old (Muinaisjäännösrekisteri, Register of Ancient Monuments). Some of the vessels sailing through Hanko's archipelago never made it to the safety of Hauensuoli, a few sinking just outside of it.

The most famous of the ships that sank in Hauensuoli is probably the so-called Cable Wreck (Fig. 4 and 5). Its nickname comes from an old electric cable that is no longer in use but still runs over the shipwreck towards the Tulliniemi Peninsula. This wreck of a single-masted oaken sailing vessel is located east of Hauensuoli, roughly 40 m from the shoreline rocks. The wreck is a little less than 20 m long and about 5 m wide. It is a small, flat-bottomed coastal sailing ship with a rounded stern, possibly a tjalk from the 17th century. Thanks to its shallow base, this trade ship was an excellent vessel for navigating the often rocky coasts of the Baltic Sea. The bow and stern of the wreck have been badly damaged, but the shape of the hull is still clearly visible.

Figure 4. *Diving at the Cable wreck.*
Photo: Jesse Jokinen, the Finnish Heritage Agency.

The ship's hold was located towards the stern and covered two thirds of the small vessel's hull. Its cargo consisted mainly of foodstuffs, such as grain, tallow and meat, which were stored in barrels and which the ship was most likely transporting to the Baltic Sea around the end of the Thirty Years' War (1618–1648) or at the time of the peace negotiations (Vaheri *et al.* 1998, 52.) Furthermore, so many hourglasses and their fragments have been discovered at the site that it is safe to assume they were intended for sale.

During maritime archaeological excavations in the 1970s, the wreck was thoroughly cleared of debris. Sediment and the ship's furniture and other movables were removed from inside the vessel with an airlift pump. During the excavation, many items were recovered from the wreck, including large, 40-kilo clumps of tallow, glazed bricks, a clay pipe and the lid of a wooden barrel, which are nowadays part of the Hanko Museum's collections. No report was ever compiled of this project, but dozens of documentation drawings describing the progress of the excavation work have survived.

Tiles decorated with blue dye and images of ships (Fig. 6), among other things, are from the Dutch town of Delft and date back to the mid-17th century (Muinaisjäännösrekisteri, Register of Ancient Monuments). The low number of tiles and their intentionally made holes would suggest that they were used as wall decorations aboard the ship. The galley at the bow also housed the ship's oven. In addition to the tile fragments, other artefacts discovered aboard the vessel and its structural details indicate that it came from the Netherlands.

Another famous wreck in Hauensuoli can be found in the shallow northern shores of the islet Lilla Ankargrundet. The wreck is assumed to be the barque Ajan, a large, wooden, carvel-built cargo ship

Figure 5. *3D model of the Cable wreck.*
Filming: Jesse Jokinen, the Finnish Heritage Agency.
Modelling: Niko Anttiroiko, the Finnish Heritage Agency.

whose home port was in Lemland, Åland. In the late autumn of 1890, Ajan was sailing under the command of Captain J. Svibergsson towards Hanko's Lappohja. Unfortunately, it never reached its destination. A violent autumn storm caused the heavily-laden Ajan to crash against the Ankargrundet islet on 24 November 1890. (Vaheri *et al.* 1996, 235).

The wreckage has broken into several pieces, with fragments of porcelain plates falling out from between the planks. The shipwreck sits in shallow water of only about 2 m in depth, which makes the site suitable for snorkelling and allows the wreck to be seen from the surface in clear weather.

In addition to these, Hauensuoli has several other shipwrecks and their fragments that have yet to be studied. For example, little is known of the vessel that sunk east of Kobben. However, the ship in question has a wooden, carvel-built hull and a single mast of approximately 10 m in height. The bow and the stern have broken down, but one of the sides almost up to the gunwale and parts of the deck still exist. Another stern fragment is located between the Cable Wreck and Kobben, and two anchors can be found roughly 200 metres east from there (Muinaisjäännösrekisteri).

An underwater excavation project was run in the strait of Hauensuoli in 1975–1976. Swedish maritime archaeologist Peter Norman wanted to discover which ships had left their mark at the anchorage over the centuries, or more precisely what evidence of their visits still remained there at the bottom of the sea. The excavation project covered approximately 13% of the strait of Hauensuoli, which Norman considered a sufficient sample of objects discarded as rubbish or accidentally dropped overboard by sailors (Norman 1976, 4–5).

The discovered objects illustrate the daily life aboard a ship. The discoveries include a number of intact clay pipes, hundreds of clay pipe fragments, glass fragments, flint for flintlocks left behind by armed forces and a large amount of pottery intended for everyday use. Most of the fragments of a tripod pot, which was used for cooking, date back to the 16th and 17th centuries, the heyday of maritime transport through Hauensuoli (Norman 1976, 4–5).

Figure 6. *Dutch tiles found from the Cable wreck are dated to the mid-17th century.*
Photo: Eero Ehanti, Suomen merimuseo.
SMM475: 6 and 7, SMM1174: 1a.

Hauensuoli for travellers and divers

The Finnish Heritage Agency is in charge of protecting the island group at Hauensuoli, but as the landowner, Metsähallitus is responsible for the area's administration. According to a visitor study, nearly 2,000 travellers make a stopover in Hauensuoli annually (Metsähallitus 2015). The old haven still provides a shelter from the winds, and landing on the islands is possible in nearly all weather conditions. In the summer, several travel companies offer regular cruises on their waterbuses from Hanko's Eastern Harbour. The three-kilometre boat trip takes about 15 minutes.

The guest pier of Hauensuoli is located on the eastern shore of Tullisaari. Walking along the uneven rocks is challenging, even though the steepest climb up to the top of the island is made easier by wooden stairs. However, the smooth shoreline rocks become dangerously slippery especially when it rains. The island has several guideposts explaining the history of the area and its rock carvings. In addition, the bronze plaque of Hangon kotiseutututkimuksen ystävät, an association in Hanko promoting research on local geography and history, reads as follows: "Voices from centuries past speak to you on these islets. Preserve and honour their memory."

Mooring near the shipwrecks is forbidden, but during the diving season from spring to autumn, mooring buoys for boats as well as diver buoys can be found floating just outside of Hauensuoli. Trails marked with guidelines and arrows run from the diving shots to three of the closest shipwrecks in Hauensuoli (Fig. 7 and 8). Divers can visit the Cable Wreck, the assumed wreck of the barque Ajan off the shore of Lilla Ankargrundet and the wreck east of Kobben. The guided trail from the Cable Wreck to Kobben also runs past the stern of an unknown shipwreck.

The development of the underwater park of Hauensuoli in 2017–2019 was made possible by joining the EU-funded project Baltacar (Baltic History Beneath Surface: Underwater Heritage Trails In Situ and Online). The shipwrecks in Hanko and Kimitoön have been documented by photographing and filming them, and by creating 3D models and 360° videos. In addition, underwater guideposts have been erected near the Cable Wreck. Furthermore, the Hanko Museum is planning to showcase the area's unique underwater cultural heritage in its upcoming exhibition in 2020.

Figure 7. *Diving trails at the underwater park of Hauensuoli. Photo: Jesse Jokinen, the Finnish Heritage Agency.*

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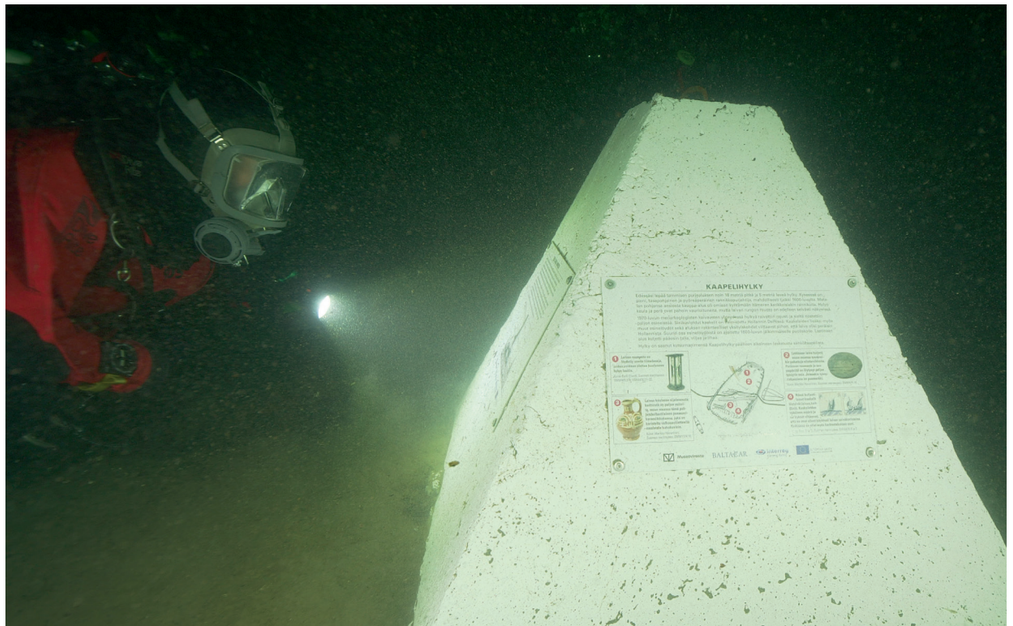
Figure 8. *Information signs at the Cable wreck. Photo: Jesse Jokinen, the Finnish Heritage Agency.*



The monuments of naval warfare: minesweepers, submarine and cargo steamer

ARTO OLL and MAILI ROIO

World War I (1914–1918) resulted in dramatic changes in the political situation in Europe, where former empires (Russia, Germany, Austria-Hungary and Ottoman) fell apart, giving rise to new smaller countries. The governments of Finland, Estonia, Latvia, Lithuania and Poland also declared independence as a result of Russia's defeat on the Eastern front. Soviet Russia launched military aggression against the newly independent small states with the Russian Civil War that began at the same time. The Bolsheviks, who seized the power in Soviet Russia, believed that the aforementioned territories had to be incorporated into Russia in order to allow the latter to use the Baltic States as a base for spreading the ideas of the world revolution to Central and Western Europe (Ullman 1968, 55). The Estonian War of Independence began on 28 November 1918 when the Red Army launched an attack on Narva and ended when the Tartu Peace Treaty was signed on 2 February 1920.

For Estonia, World War I started with military activities at sea, one form of which was mine warfare. The selected monuments of naval warfare, the history and fate of ships, also present an overview of the war and military operations in Estonian waters.

Minesweeper No 1

Historical overview

Operated as a cargo ship under the name of Linnea in Finnish waters until 1914. The vessel was commission to the Baltic Fleet of Russia on 14 August 1914 after the outbreak of World War I. At first, it was used as a transport vessel by the navy, but fitted into a minesweeper at the end of the same year. The Linnea was renamed the minesweeper No 1 after it was commissioned in the Baltic Fleet. As a cargo and passenger ship, the Linnea had cabins for passengers, which were equipped with everything necessary for a comfortable voyage and luxuriously furnished (Fig. 1). It soon became clear that the size and limited manoeuvrability of the vessel were not that suitable for minesweeping. However, finding a more suitable vessel at the start of the war was not possible, which is why the ship continued serving as a minesweeper also in 1915.

On 16 September 1915 the minesweeper No 1 hit a mine laid by the German submarine UC-4 five nautical miles northwest of Vormsi island and sank (Strelbitski 1994, 8).

Figure 1. *A lampshade was found on the wreck and retrieved by the Estonian Maritime Museum in 1997. Photo: Vello Mäss, MMF4163.*

No crewmembers were lost, as the minesweeper No 10 managed to save them (Kirejev 1939, 103–108). The mine blast tore the ship into two parts. The stern side of the wreck has a well visible chimney, decking, stern rail, propeller and steam engine. There is an anti-aircraft cannon and anchor on the bow. One gun was raised from the wreck, conserved and put on public display at the Seaplane Harbour Hangar of the Estonian Maritime Museum.

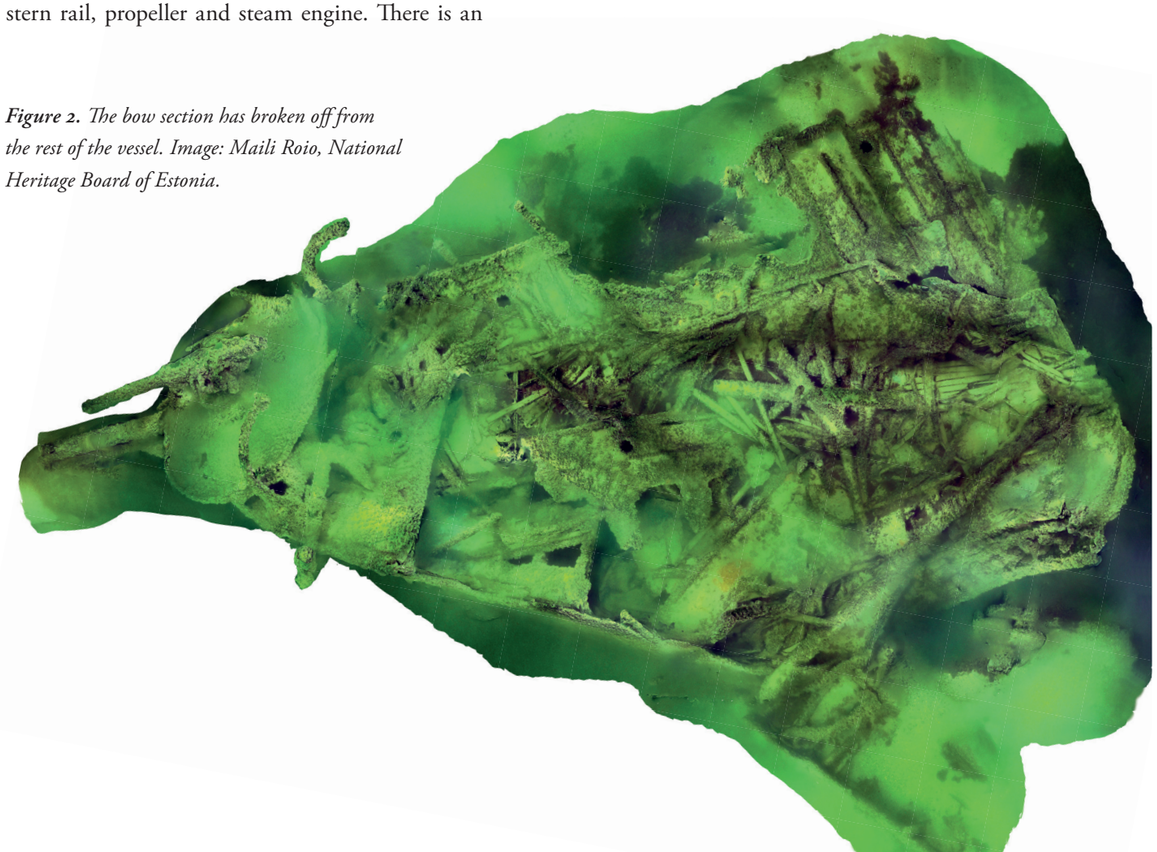


Figure 2. *The bow section has broken off from the rest of the vessel. Image: Maili Roio, National Heritage Board of Estonia.*

Technical specifications

Year of construction: 1892
Built at: W. Lindbergs Varvs- och Verkstads AB Shipyard in Stockholm, Sweden
Length-breadth-draught: 56,5 x 8,2 x 4 metres
Tonnage: 739 grt
Propulsion: 2-cylinder compound steam engine with the total power of 850 hp, one propeller
Speed: 10 knots
Range of action: 1,800 nautical miles (at 10 knots)
Sweeping equipment: two Schultz and one Somov-type sweeps.

Armament

2 x 1-75 mm anti-aircraft guns (one in the bow and the other in the stern)

model name	Canet 75 mm M1892 (75/50)
in service from	1892
calibre	75 mm
weight	901 kg
total length of gun barrel	3.7 m
length of shell movement in gun barrel	2.9 m
sound volume in barrel	3.42 dm3
number of barrel grooves	18
groove thread for shell	1/30
groove depth	0.6 mm
groove width	10.9 mm
shell weight	4.9 kg
explosive charge of shell	1.5 kg
speed of shell upon exit from gun barrel	862 m/s
effective range	6.4 km at a 13-degree angle and 7.8 km at a 21-degree angle
shooting interval	12–15 shots per minute
lifetime of barrel	2000 shots

Submarine Akula

Historical overview

Naval architect Ivan Bubnov presented the draft of a new submarine to the navy in January 1905 in relation to the Russo-Japanese War. According to his idea, the submarine had to be able to operate in the territorial waters of Japan and also attack the warships located at the enemy's ports. Basically, the intention was to build a warship with an increased range of action. The Technical Committee of the Russian Navy approved the plan on 3 May 1905. According to the initial design, the submarine was supposed to use petrol engines, but the naval architect quickly changed this plan. The oil engines were replaced with three diesel engines (900 hp in total) and three propellers for security considerations (Afonin 2015, 7-12). Some data indicate that only two diesel engines were installed on the vessel and one of the propellers was therefore moved with an electric motor. The absence of watertight compartments was a unique feature of the submarine.

The construction of the submarine Akula started at the St Petersburg Shipyard on 7 December 1906. The main reason of the delay was the fact that since the submarine was a unique prototype, the Russians could not build the necessary engines quickly enough. The diesel engines were finally ready by March 1909 (Afonin 2015, 21).

The launch ceremony of the submarine was held on 22 August 1909 in St Petersburg. Various tests were carried out with the Akula from 1909 to 1911, mostly near Kronstadt, Björko and Tallinn. For example, the torpedoes were launched for the first time on 5 June 1910, the propellers were changed in June and diving was practised in Tallinn Bay in November. The submarine dove 40 times in 1911 alone and travelled 182 nautical miles when submerged. Testing the submarine Akula was officially finished on 14 September 1911, when the Technical Committee of the Navy allowed for the warship to be put to service. This was the first submarine fully developed in Russia, which could be used for patrolling and guarding on sea for longer periods of time. Although the technical leadership of the navy

considered the submarine an all-round success, they pointed out some deficiencies as well. One of them was the slow speed of the submarine (only 11.5 knots instead of 16 when surfaced and 6.5 knots instead of 7 when submerged) and the small capacity of the fuel reserve tanks. These deficiencies reduced the range of action of the submarine. However, they praised the steer ability, seaworthiness and manoeuvrability of the submarine, which is why the prototype vessel Akula was used as the example when building Bars class submarines (Norman 1991, 25).

On 6 November 1911 the Akula was commissoned in active service in the Baltic Fleet and on 25 March 1912 she was transferred to the 2nd submarine brigade (Afonin 2015, 63-65).

The Akula in World War I

The Russian Baltic Fleet had 11 submarines at the start of World War I, i.e. in 1914, and the Akula was considered the best of them. The remaining brigades consisted mainly of old Kaiman and Som class warships. For comparison, the German Baltic Navy only had three submarines at the start of the war in the Baltic Sea region.

Submarine Brigade 1	Submarine Brigade 2	Training submarines
Akula	Alligator	Beluga
Markel	Drakon	Peskar
Minoga	Kaiman	Streljad
Okun	Krokodil	

During World War I the submarine Akula conducted 19 patrol missions (Afonin 2015 70-83, Norman 1991, 42-45)[1]:

- the 1st operation from 1–3 August 1914. The submarines based in Paldiski were ordered to go to defence positions in the Gulf of Finland. The Akula had to position herself behind the mine fields to secure the operations of the patrolling surface vessels. If the warships of the enemy attacked, they had to be torpedoed, if possible. However, confusion in sending telegrams created a situation where the surface vessels did not go out to sea at all. The Akula was then called back to the port;
- the 2nd operation on 11 August 1914. According to messages received from destroyers, a German cruiser was spotted on the Baltic Sea and all submarines, including the Akula, were sent out to seek out and if possible sink the enemy vessel. It was probably a cargo steamer belonging to Sweden (a neutral country) and all the submarines were called back to the port;
- the 3rd operation on 13 August 1914. The submarine Akula was sent to Kõpu Peninsula, where a German cruiser had been spotted again according to reports. Failing to find the enemy, the submarine returned to port;
- the 4th operation from 15–16 August 1914. The submarine was patrolling in the Tallinn-Naissaar-Porkkala region but did not see any signs of the enemy. The Akula then arrived in Tallinn for repairs;
- the 5th operation from 7–9 September 1914. The management of the Baltic Navy used submarines for offensive purposes for the first time. The Akula was once again sent to Kõpu Peninsula, where she had to wait until night time and guard the movement of the enemy at sea. During the night of 8 September, the commander decided to sail into Swedish waters in order to torpedo enemy vessels in the open sea. After covering about 60 nautical miles, the submarine spotted the German cruiser Amazone, but the torpedo shot by the submarine missed the enemy vessel. This was the first time in World War I when a Russian submarine attacked an enemy vessel. The Akula was forced to dive and escape after the German destroyers turned up;
- the 6th operation from 9–10 October 1914. Patrol of the western coast of Hiiumaa. No enemy vessels were spotted and the vessel was taken to the docks in Tallinn for repairs;
- the 7th operation from 18–25 November 1914. A patrol to Danzig Bay, where a torpedo was unsuccessfully fired at an unknown cargo steamer on 22 November. The submarine then went on patrol around Gotland, but did not spot any other enemy vessels. The Akula returned to Tallinn on 25 November;

1 See further: http://akula1915.ru/

- the 8th operation from 13–18 November 1914. The submarine patrolled in Swedish waters, where she shot two torpedoes at a German cruiser. The enemy did not spot the submarine and the Akula returned to Tallinn. Various repairs were carried out on the vessel for winter and she was sent to her winter lay up until April 1915. The submarines of the Russian Baltic Fleet failed to sink any enemy vessels in 1914. Their contribution to combat at sea was basically non-existent.

On 17 March 1915, the submarine fleet was divided into three brigades in order to increase the efficiency of operational activities:

1. the Northern group (Alligator, Drakon, Kaiman, Krokodil, Beluga, Streljat, Peskar, Som[2]), which was ordered to defend the Gulf of Bothnia and the Åland archipelago;
2. the Southern group (Field Marshal Count Sheremetev and Kasatka)[3], which had to guard the shipping routes on the Irbe Strait;
3. the so-called active group *(*Akula alongside the commissioned Bars-class submarines Bars and Gepard, and British submarines *E 1* and *E 9)*, which had to patrol the Baltic Sea for 7–14 days;

- the 9th operation from 30 April–1 May 1915. According to military intelligence reports, the German Navy was planning an operation in the Gulf of Riga with a squadron consisting of light cruisers and destroyers. The Akula was ordered to head to the Gulf of Riga, but she failed to get through the Suurupi Strait because of the thick ice. The submarine returned to Tallinn;
- the 10th operation from 13–24 May 1915. The submarine only left Tallinn on the night of 14 May because of the superstitious crew. Due to technical complications with the ballast tanks, the submarine remained anchored near the coast of Latvia until 18 May, where the crew repaired the vessel. The submarine patrolled near Gotland and Memel on 18 and 19 May but failed to torpedo any enemy vessels. On 21 May, the Akula unsuccessfully shot four torpedoes at the German light cruiser Albatross and arrived back in Tallinn on 24 May. It was another long operation that failed to achieve anything;
- the 11th operation from 24–25 June 1915. A fruitless patrol in the Gulf of Riga and near the Irbe Strait. Enemy vessels were spotted, but not torpedoed;
- the 12th operation from 2–5 July 1915. A fruitless patrol in the Irbe Strait;
- the 13th operation from 18–19 July 1915. According to the instructions received by the Akula, the submarine had to move to the new operations base in Ventspils. Halfway there, the submarine suffered technical complications and as Ventspils had fallen into the hands of the Germans, she returned to the Gulf of Riga;
- the 14th operation on 24 July 1915. A fruitless patrol in the surroundings of the Irbe Strait;
- the 15th operation from 14–23 August 1915. The submarine was ordered to torpedo German warships in the Gulf of Riga and patrol around Gotland. Several German battleships with destroyers were spotted during the operation, but no attacks were launched due to unfavourable conditions;
- the 16th operation from 12–18 September 1915. The submarine was ordered to patrol the area west of Hiiumaa. It patrolled in the surroundings of Liepāja from 14–18 September and then returned to the dock in Tallinn. The submarine got stranded three times during the patrol and damaged all three of its propellers;
- the 17th operation from 28 September–7 October 1915. For the first time, the submarine was ordered to sink civil vessels near Liepāja. The operation was once again marred by technical complications and the vessel returned to Tallinn;
- the 18th operation from 23 October–2 November 1915. A fruitless patrol in Swedish waters. Enemy vessels were spotted, but no attacks were launched;
- the 19th operation in November 1915. The Akula was sent on a patrol west of Hiiumaa, where she hit a mine and perished with the entire crew. Four extra naval mines were placed on the submarine for this mission, which had to be laid in the

2 Some of the vessels were brought from Vladivostok.
3 Transported from Vladivostok to the Baltic Fleet.

fairway used by the enemy without being noticed. However, the Akula did not lay the mines.

The Akula was deleted from the fleet list on 15 March 1917. The total number of the deceased sailors was 35. The stern section of the submarine broke off as a result of the explosion. Some details of the wreck are scattered around it on the seabed. There are four mines with mechanical fuse mechanisms on the seabed by the port side. The casings of some mines have become dilapidated, exposing the combustion chambers inside. The torpedoes that may be in the launching tubes are not a threat. One torpedo stands upright between the bridge and the stern at an angle of ca 60 degrees. The upper end of the combustion chamber with the fuse is missing and the explosive in the chamber can be seen.

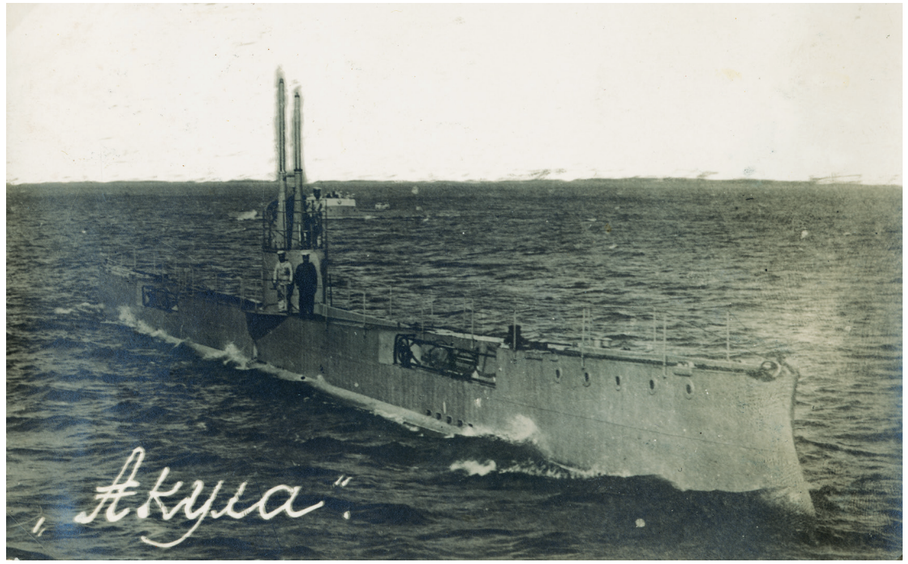
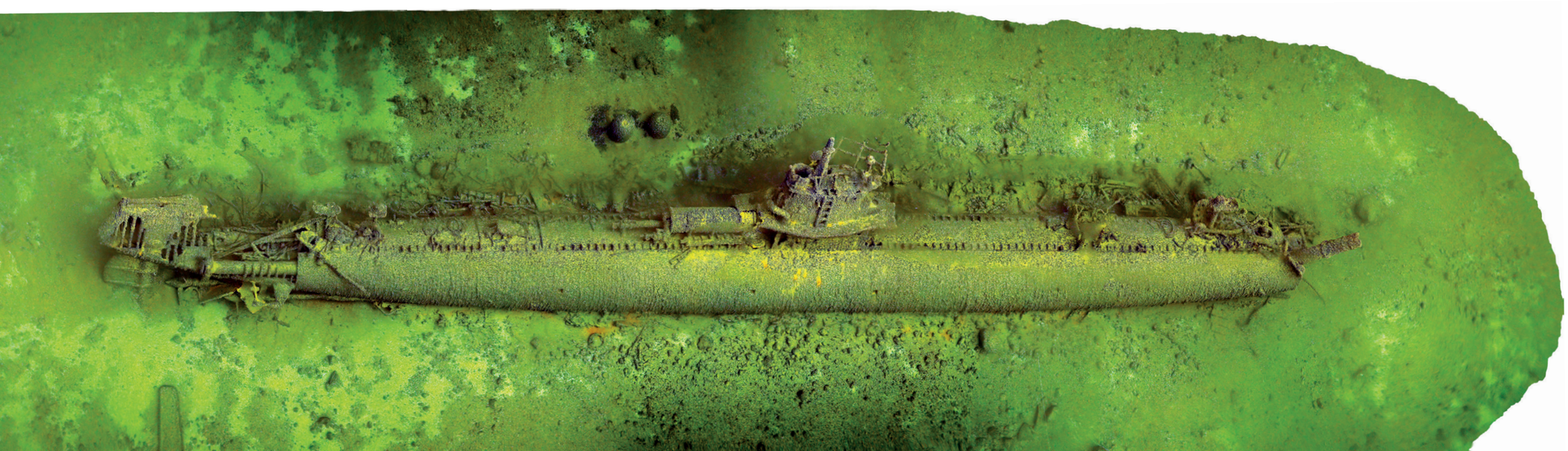


Figure 3. *Submarine Akula.*
Photo: Estonian Maritime Museum: MM F 1348/114.

Figure 4. *Image of the 3D model of the wreck of the Akula.*
Maili Roio, National Heritage Board of Estonia.



Technical specifications

Year of construction: 1909
Built at: Baltic Shipyard, St Petersburg, Russia
Length-breadth-draught: 56 x 3.7 x 3.4 metres
Surfaced and submerged displacement: 380/475 tons
Propulsion: main engines – three Nobel diesel engines with combined power of 900 hp, 3 propellers, main electric motors – one electric motors of 225 hp
Surfaced and submerged speed: 10.6/6.5 knots
Range of action: 1,900 nautical miles surfaced, 38 nautical miles submerged.
Diving depth: 50 m
Complement: 35

Armament

Armament: The submarine carried eight torpedoes in total and there were launching tubes on both sides of the board in front of and behind the conning tower, four in total. 4 x 1-457 mm launching tubes, 1 x 1-47 mm gun, naval mines of type M1908 or M1911 (could carry four naval mines).

A. 4 x 1-457 mm torpedo tube

model name	8 ТА x 45 см мин обр.
in service from	1904
length	5.13 m
weight of combat-ready torpedo	648 kg
quantity and substance of explosive	70 kg of pyroxylin
moving at 34-knot speed	1000 m
moving at 27-knot speed	2000 m

B. 1 x 1-47 mm gun[4]

model name	3pdr Hotchkiss Mk I[5]
in service from	1885
calibre	47 mm
weight	254 kg
total length of gun barrel	2.04 m
length of shell movement in gun barrel	1.4 m
sound volume in barrel	43.1in3
number of barrel grooves	20
groove thread for shell	1/25
shell weight	2.6 kg
explosive charge of shell	1.5 kg
speed of shell upon exit from gun barrel	587 m/s
effective range	5.9 km at a 20-degree angle and 7.2 km at a 45-degree angle
shooting interval	20 shots per minute
lifetime of barrel	6000 shots

C. Naval mines of type M1908 or M1912 (could carry four naval mines)

model name	M1908 (contact mine)
total weight	575 kg
explosive charge	115 kg pyroxylin
maximum depth	110 m
model name	M1912 (contact mine)
total weight	600 kg
explosive charge	100 kg of pyroxylin
maximum depth	130 m

4 In some research papers it is mentioned that the 47 mm gun was replaced with the A 37 mm air defence gun.
5 Produced in Russian arms factories on the basis of a patent.

Minesweeper Shchit

Building

The Imperial Russian Navy focused primarily on the development of underwater weapons in the early 20th century. A lot of attention was therefore given to the modernisation of the construction and mechanisms of naval mines. The Russians were the first who demonstrated the big military potential of the naval mine to the world during the Russo-Japanese War (1904–1905). However, the surface fleet of Russia suffered a devastating defeat in the Battle of Tsushima Strait in 1905. The focus then shifted to defensive activities, which included defending the capital St Petersburg in the Gulf of Finland. The officers of the navy decided that this had to be done by laying extensive mine fields and building a belt of coastal defence batteries.

Although the Russians managed to develop the most efficient naval mines in the world, the methods of laying them turned out to be a problem. Until the start of World War I, the Russians had no special warships for such operations, i.e. no minesweepers. The issue was finally raised in autumn 1914, when the officers of the Baltic Fleet wanted to increase the number of ships suitable for sweeping. Until then, minesweepers were usually installed on cargo or auxiliary vessels, which were actually not suitable for sweeping sea lines efficiently. However, a smaller vessel was needed during wartime; one that was specially built for laying and, if necessary, sweeping mines. The ship type also had to have a small crew because losing vessels of this type on sea was inevitable due to their operational assignments. In the event of an accident, losing a smaller ship would not be such a burden on the state's economy.

Commander of the 1st minesweeper squadron of the Baltic Fleet (the 2nd squadron was also formed at the start of the war), Captain 1st Rank P. Kitkin wanted to use the Mnirep type as an example when building the new warship types (Joltuhovski 1989, 71-74). Naval Minister Ivan Grigorovich ordered the Shipbuilding Department GUK to develop a design for sweepers with a small draught (up to 0.91 m). The GUK suggested equipping the vessels with internal combustion engines, but the officers of the Baltic Fleet decided that the use of steam engines must continue. Three sweeper designs were entered into the competition.

1. The GUK rejected the design prepared by the Russian-Baltic Shipyard and declared it unsatisfactory for being too unstable in the open sea.
2. An original design was sent by the engineer of the battleship Sevastopol, Staff Captain N. Artseulov, who placed the propellers in the middle of the ship along the edges of the boards, which would have allowed the vessel to better manoeuvre past the naval mines floating in shallow water. The GUK rejected Artseulov's design, as such ships had not been built in Russia before and the state would've had to hire engineers from abroad.
3. The design of the Technical Bureau of the GUK, where the metacentric (the point that determines the stability of the vessel) height of the ship would have been 2.7 m. The Naval Ministry approved the design on the basis that the sweeper should operate only in calm weather.

However, equipping the sweeper with boilers and mechanisms turned out to be a problem. A suggestion was made to get the latter from allied countries, but communication and trade proved difficult because of the war. In addition to this, Russia's own industrial companies were overburdened with various military orders. The advice of the engineers of the Russian-Baltic Shipyards was to get the mechanisms from the gunboats built for the Amur river, and the Naval Ministry agreed with this.

Thus, the sweeper design was based on the hull of the Buryat class gunboat and the breadth was reduced from the initial 7.8 m to 6.3 m. Kitkin suggested changing the navigating bridge by removing the helm, compass and telegraph, making navigation of the ship easier for the crew. He also advised making the bridge shorter to create a passage in front of the navigating bridge where a spotlight could run along mine rails if necessary. Kitkin found that adding a beam to the bow of the ship was essential for lowering and hoisting boats and a second winch had to be placed in the stern for sweeping mines. The Naval Ministry agreed with the suggestions in principle and requested the construction of eight minesweepers from the government in late 1914. 1.2 million roubles was allocated to this from the navy's shipbuilding budget for the next five years, which is why the decision made on 30 January 1915 was to build just four minesweepers at first. The GUK then organised a competition between eight shipyards. The conditions of the Putilov and Russian-Baltic Shipyards, i.e. 252,000 roubles per ship built in five to six months, proved acceptable. The precondition for such a short building time was the promise that the Naval Ministry was to supply the shipyards with mechanisms, boilers and propellers. The Naval Ministry had to organise the delivery of all necessary mechanisms to the shipyards at least two months before the launch of the ships. In February 1915, the GUK ordered both shipyards to start building the minesweepers (Joltuhovski 1989, 72).

The Russian-Baltic Shipyard in Tallinn started building the minesweepers Shchit and Krambol and the Putilov Shipyard in St Petersburg started building the Kapsiul and the Gruz in March 1915. The GUK appointed naval architect Lieutenant Colonel I Blagoveshchensky to oversee the ship building in Tallinn and naval engineer Colonel I Khranovitsky to do the same in St Petersburg. Staying on schedule became a problem as soon as the building process started. For example, there was a delay in Tallinn due to the late launch of the frigate Konstantin and the Komolensk Shipyard had failed to deliver 64 t of steel on time, which meant that building the vessels had to be postponed for a month. The decision was made to order the mechanisms required for the sweepers from the United Kingdom and Sweden, and their transport took another three months. The minesweepers Shchit and Krambol were finally ready in September 1915. In general, these developments demonstrated the bureaucratic weaknesses of the Russian Empire. Building two rather small vessels took twice as much time as initially planned. All this at a time when the navy really needed the minesweepers. The engines and mechanisms of the minesweepers were tested from October 1915 to May 1916. The minesweepers were officially taken into service in June 1916 (Kirejev 1939, 173).

The situation became even more complicated at the Putilov Shipyard, where the workers failed to place the superstructures correctly. Basically, they did the opposite of what Kitkin had advised because the narrow passages meant that relocating the mines on deck was impossible. The sweepers were also fitted with clumsy and heavy interiors, which increased their weight by 23 t and caused the draught to sink to 1.38 m. The sweepers Kapsiul and Gruz were finally completed in March 1916, nine months later than planned. Both vessels were taken into service on 1 April 1916. The performance of the mechanisms of the ships was then tested and the top speed achieved by the engines in the Gulf of Finland was 9.6 knots. Michman of the Admiralty A. Bers became the commander of the minesweeper (Kirejev 1939, 53).

Operations in World War I

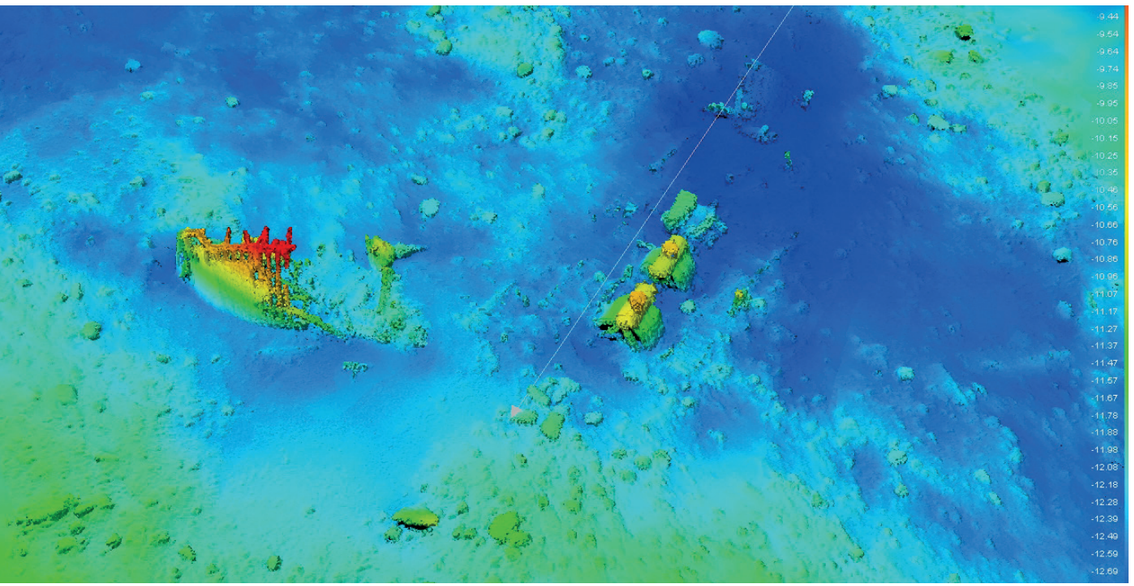
The Sweeper squadron (41-44 ships) was transformed into a brigade in 1915 and Captain 1st Rank P. Kitkin remained in charge. Sweeper departments were renamed groups and divisions in 1916. The new Kapsiul class minesweepers were assigned to the 3rd division of the 1st sweeper squadron with the other four sweepers that were in working order. The crews of the sweepers taken into service were sent to other sweepers for training purposes, but the progress was slow. The main reason for this was the inexperience of the commanders of the Kapsiul class sweepers, and the other crew members also had no previous experience in minesweeping. Kitkin thought that carrying out sweeping operations in battle conditions was the best teaching method (Kirejev 1939, 53).

Irrespective of the construction errors, the sweepers with low draughts performed many military tasks. A characteristic episode occurred on 28 August 1916, when all four sweepers arrived to

trawl the mine fields laid by the enemy on the Irben Strait. The sweeping conditions turned out to be difficult. The crews only had four days off from 29 August to 13 September, when strong winds did not allow them to carry on working. On the rest of the days, they lifted the anchor from 5–7 am and returned from sea at 8–10 pm. They also went on patrols, swept the sea at night and laid mines in the coastal waters of the enemy (near the Latvian coast). On 6 September, German destroyers fired at the minesweepers operating near the Irben Strait and the biggest number of hits was registered on board the Shchit. The vessel managed to return despite the gunfire. At the end of September 1916, the sweepers laid 300 naval mines on the Irben Strait, thereby expanding the Russian mine fields. On the night of 17 September, 100 mines were laid in strong winds, where the heel of the vessels was up to 35 degrees (Kirejev 1939, 201).

Only one of the Kapsiul-class sank in battle when she hit a mine laid by the Germans in the Soela Strait on 6 December 1916. The naval mine exploded near the stern of the ship, after which she started to sink. According to the report of First Lieutenant G. Dombrovski, order and discipline were maintained on the ship. The crew didn't panic and all orders of the commander were correctly followed. The commander of the Shchit conceded that saving the vessel was impossible, as the explosion had ripped off part of the stern. The commander therefore ordered the crew to evacuate the vessel, steam was released from the boilers and secret documents were handed over to the commander of the Gruz. An attempt to tow the vessel was made at first, but it failed as the stern of the ship was stuck to the bottom of the sea and only the bow remained above water. The towing line was soon removed, the Shchit sank and 3 sailors were killed from the inital explosion (Kirejev 1939, 220). The wreck of the minesweeper lies tight in the sediment of the seabed in the northeast to southwest direction. The stern section has broken off from the rest of the vessel and is located approximately 10 metres from the hull crosswise from the latter.

Figure 5. *Multibeam sonar image of the wreck of the Shchit. Tuukritööde OÜ.*



Technical specifications

Year and place of construction: June 1916, Tallinn, Russian-Baltic Shipyard
Length-breadth-draught: 53 x 6.6 x 1.2 m
Displacement: 271 tons
Engine power: two steam engines with a total power of 650 hp, two Yarrow boilers and two propellers
Speed: 9 knots
Range of action: 450 nautical miles at economical speed (6 knots)
Fuel stock: 40 tons
Complement: 38

The ceiling of the top deck was made of 4 mm thick tin plates. The thickness of the tin plates under the anchor chains, winch and masts was 6 mm and the floor under the 75 mm gun carriages was covered with 10 mm thick tin. The exterior lining consisted of plates up to 7 mm in thickness and additional tin plates 6-9 mm in thickness were fastened to the hawse pipe and the under the bow pole (Joltuhovski 1989, 71-74).

The decision was made to use two steam engines with a capacity of 550 litres at 400 rotations per minute as the main engines. The pressure of the two water pipes of an operating Jarroy steam boiler was 13.5 kg/cm³. Their total heating surface was 180 m³. There were also two crew cabins for 40 people, a galley, a laundry room and a bathroom (*ibid.*).

Rescue equipment included two pilot boats and a Kebke-type boat. The anchor system consisted of anchors weighing 320 kg each, two anchor chains 160 m in length, one steam windlass and chain stoppers. The ordinary two-layer helm was launched manually with the helm steam engine. The water removal system removed water in five streams. There was also a direct current turbo generator that generated power for the grid, spotlight, telegraph, signal lights and ventilators.

Armament

A. 1 x 1-75 mm Canet gun (in the bow in front of the bridge, the ship also had two 2 x 1-7.6 mm light machine guns)

model name	Canet 75 mm M1892 (75/50)
in service from	1892.[6]
calibre	75 mm
weight	901 kg
total length of gun barrel	3.7 m
length of shell movement in gun barrel	2.9 m
sound volume in barrel	3.42 dm3
number of barrel grooves	18
groove thread for shell	1/30
groove depth	0.6 mm
groove width	10.9 mm
shell weight	4.9 kg
explosive charge of shell	1.5 kg
speed of shell upon exit from gun barrel	862 m/s
effective range	6.4 km at a 13-degree angle and 7.8 km at a 21-degree angle
shooting interval	12-15 shots per minute
lifetime of barrel	2000 shots

B. Naval mines of type M1908 or M1911 (could carry 50-60 naval mines)

model name	M1908 (contact mine)
total weight	575 kg
explosive charge	115 kg of pyroxylin
maximum depth	110 m

model name	M1912 (contact mine)
total weight	600 kg
explosive charge	100 kg of pyroxylin
maximum depth	130 m

6 Produced at the Putilov Shipyard on the basis of the patent of the French Canet gun.

Minesweeper Altair

Historical overview

The fish trawler Altair was built in Papenburg on building site no. 325 of the Jos. L. Meyer Werft Shipyard. The vessel was commandeered to the auxiliary fleet of the German Navy on 21 December 1916, soon after it was built. The Altair would have operated as a fish trawler on the North Sea after the war. In 1917 the Altair was included in the 3rd anti-submarine flotilla, which participated in Operation Albion. The trawler Altair perished at 7:18 AM on 14 October 1917 in a Russian minefield in Tagalaht Bay. 10 of the 31-man crew were killed (Gröner 1994, 189). The ship broke in half as a result of an explosion. The onboard weapons have survived.

Technical specifications[7]

Year of construction: 1916
Built at: Jos. L. Meyer Werft Shipyard in Papenburg, Germany
Length-breadth-draught: 39 x 7.1 x 3.95 metres
Tonnage: 237 grt
Engine power: steam engine with the total power of 500 hp
Speed: 11 knots
Range of action: 4,800 nautical miles (at 11 knots)
Complement: 31

7 Gröner 1994, 189.

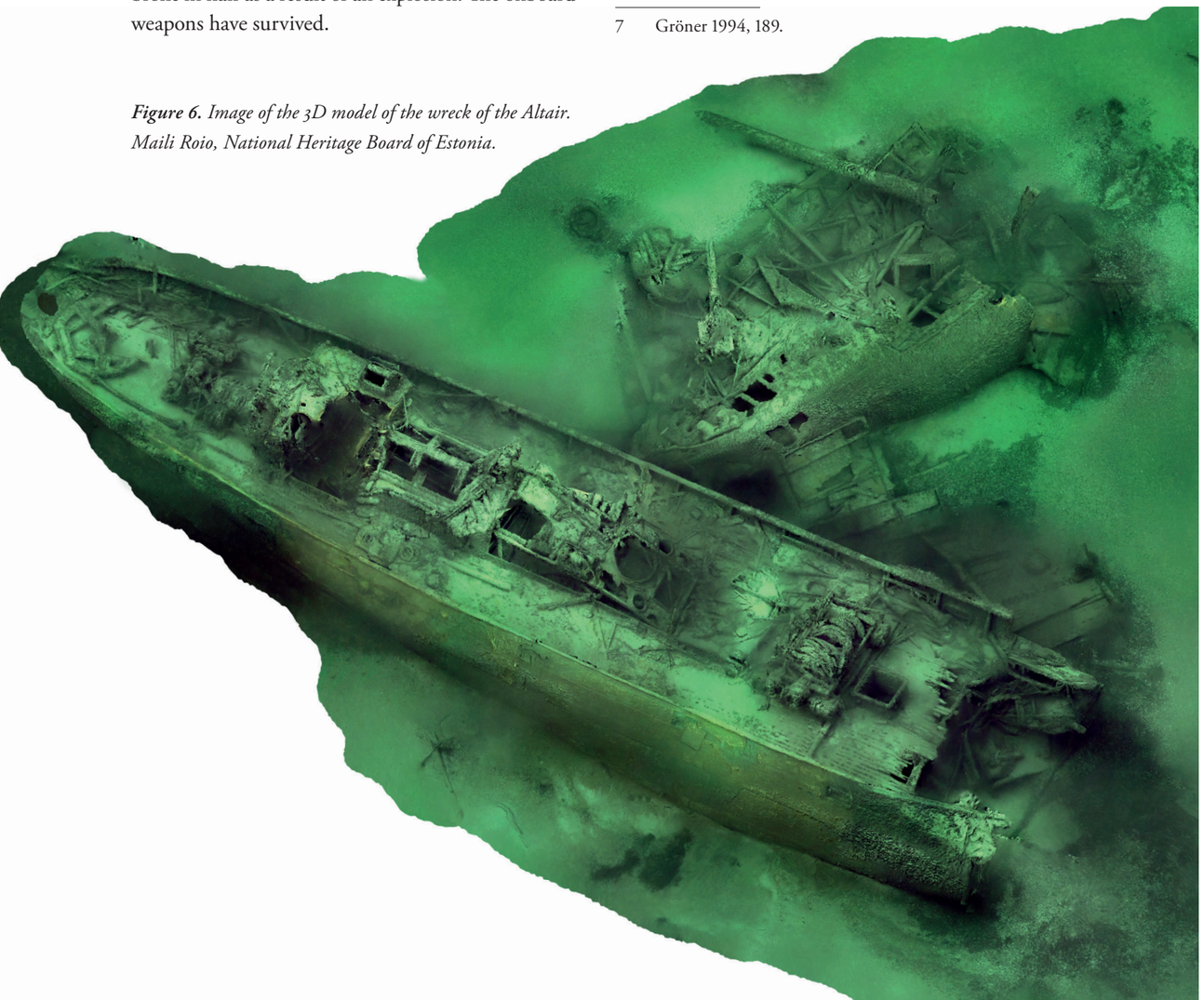


Figure 6. *Image of the 3D model of the wreck of the Altair. Maili Roio, National Heritage Board of Estonia.*

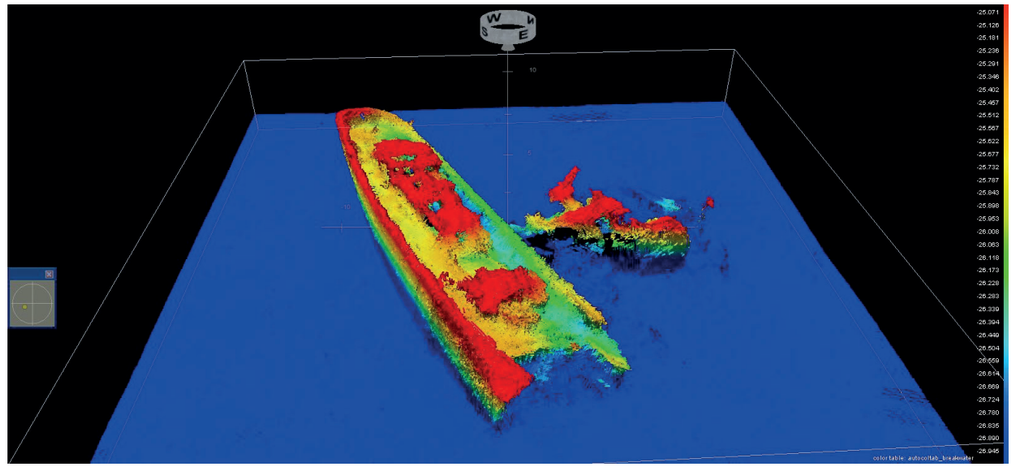


Figure 7. *Multibeam sonar image of the wreck of the Altair. Tuukritööde OÜ.*

Minesweeper HMS Myrtle

The Royal Navy of the United Kingdom started paying attention to mine trawling after the Russo-Japanese War (1904-1905). The main reason for this was the capacity of the Russians to efficiently use naval mines in defence against the Japanese fleet. Two old torpedo boat destroyers were reconstructed into minesweepers on the orders of the British Admiralty in 1908 and as of 1913, the Royal Navy already had six minesweepers in service (Brown 1999, 136). These vessels were used to regularly practice the liquidation of mine fields. In the event of a potential war, 82 vessels of the auxiliary fleet would have been equipped with minesweepers if necessary. However, the Admiralty did not have a design of the minesweeper as a specific type of warship with determined specifications. The old vessels used until then did not have the capacity required for operating in the open sea. This is why the development of a new warship was undertaken. The understanding was that the crews of the future minesweepers had to be small and the vessels could not be heavily armed or armoured. This meant that they were not intended for use in direct combat actions with the enemy fleet. The criteria were based on the fact that mine trawling inevitably leads to losses, which is why manning the vessels with large crews or investing large sums of money in the vessels would not be practical. Naval architects prepared the first drafts of minesweepers in early 1914.

Due to the start of World War I, the Admiralty decided to continue with the minesweeper project on 25 September 1914, but set new criteria for the vessels to be designed. Wartime required the vessels to perform different roles: mine trawling, anti-submarine operations, supporting convoys, towing vessels and transport. The need to perform various operational tasks influenced the design of the ships. Ordinary passenger steamers were used as an example, because the construction of the hull of the multi-purpose minesweeper of the navy had to be as simple as possible. This helped save considerable amounts of time for the construction of new ships, which was extremely valuable during wartime. Another reason for making such a decision was that ships similar to cargo steamers were unlikely to be taken for warships because of their shape and the enemy may therefore decide not to attack them. This in its turn reduced the workload of shipyards that specialised in military vessels, as the simple design of the ships mean that they could also be built in civil shipyards.

Flower class vessels had excellent nautical properties and their good steer ability made them easy to stabilise even at stormy seas. Three waterproof compartments were built in the bow of the ship, which prevented it from rapidly sinking in the event of hitting a mine. As the intention was to use minesweepers for transport as well, they were built with large decks and closed railings. This prevented water from building up on the deck. The deadweight of the vessel was also impressive. The deadweight of the deck alone was 50 tons, so that it could be used to transport up to 700 servicemen. Flower class vessels even transported horses on their decks during the war (Friedman 2014, 317–320).

Flower class minesweepers were built in 22 shipyards during World War I. The subclasses of Flower class ships were as follows: Acacia 24 ships (built in 1915), Azalea 12 (built in 1915), Arabis 36 (built from 1915–1916), Aubertia 12 (built from 1916–1917) and Anchusa 28 (built from 1917–1918) (Dittmar 1972, 93-95). The simple design of the Flower class vessels meant that shipyards could build them quickly–it usually took just 19 to 21 weeks to complete a vessel (for example, the Foxglove was built the fastest, i.e. in 17 weeks). The first order for 12 Acacia class ships (which carried a 120 mm gun) was placed on 1 January 1915 and the next 12 vessels were ordered on 12 January. The Azalea class[8] vessels (armed with 2 x 1-102 mm guns) were ordered on 4 May 1915. The slightly larger, i.e. 40 tons heavier and 1.5 m longer, Arabis class[9] minesweepers were ordered in July 1915 and six of them were built for the French Navy.

The minesweepers Myrtle and Gentian were launched on 11 October and 23 December 1915, respectively. In total 112 Flower class vessels were built for the Royal Navy and an additional eight ships were built for the French Navy from 1915–1918. 17 British and one French vessel perished in World War I. During the war, the vessels were mainly used as minesweepers and convoy escort vessels.

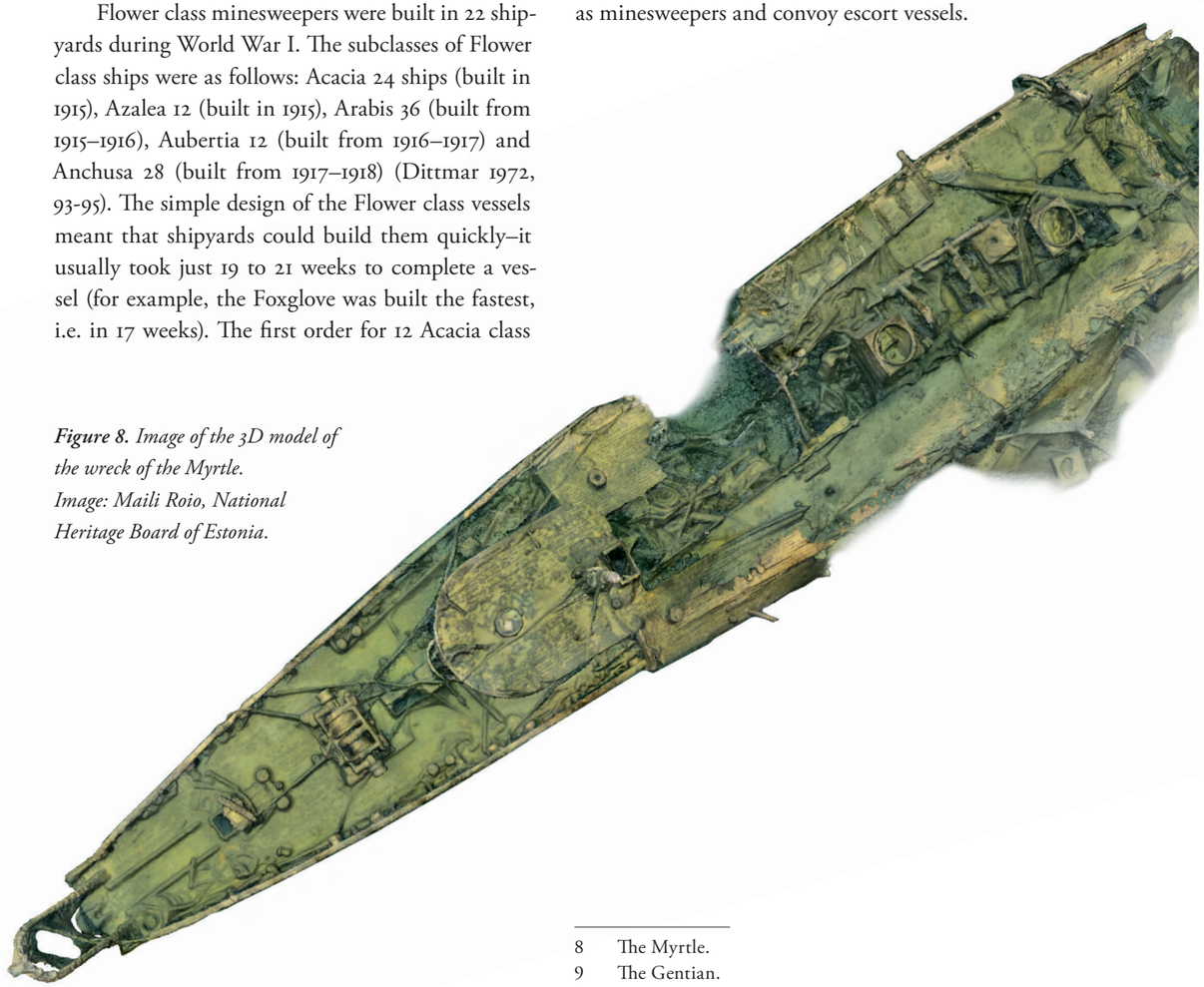


Figure 8. *Image of the 3D model of the wreck of the Myrtle. Image: Maili Roio, National Heritage Board of Estonia.*

8 The Myrtle.
9 The Gentian.

The perish of minesweepers in the Estonian War of Independence

The squadron of British light cruisers operated actively on the Baltic Sea during the Estonian War of Independence (1918-1920). They mainly helped the Republic of Estonia fight against Soviet Russia and controlled the activities of the German troops in the Baltic States. The majority of the British squadron was based at Björko in 1919, where they stopped the Russian Baltic fleet from entering the Gulf of Finland. A smaller part of the squadron was permanently based in Latvian ports. Irrespective of the busy traffic on the Baltic Sea, it was the most mined maritime area in the world. Russian and German fleets threw approximately 34,000 naval mines into Estonian waters alone during World War I. Only narrow fairways had been trawled through the minefields during the War of Independence, so navigation in Estonian waters only took place under the guidance of experienced mine pilots. The British fleet wanted to clear the fairways of mines in order to develop cargo ship traffic and expand its own operations. Rear Admiral Walter Cowan insisted that minesweepers be sent to the Baltic Sea.

The Admiralty agreed and the Daphne, Gentian, Godetia, Lilac, Lupin and Myrtle of the 1st minesweeper flotilla were sent to the Baltic Sea on 10 June 1919. Tallinn was designated as the base of the flotilla in July 1919. Next, the minesweepers were ordered to clear the sea lines west of the islands of Saaremaa and Hiiumaa. The flotilla left Tallinn for the minesweeping operation on 14 July 1919 (Ridley-Kitts and Daniel 2013, 235-236).

The minesweeper Myrtle perished during a minesweeping operation in a German minefield near Harilaid on 15 July 1919. Six marines were killed: stokers John Amey, Alexander Birch and Arthur Primmett, carpenter Robert Johnson and engineers James Gillies and Thomas Packman. A memorial plaque with the ship's name, an image of the flag of the Royal Navy and the date of the shipwreck was placed on the deck of the ship in 2000.

The ship broke in half as a result of an explosion, the stern section of the ship has survived, the bow of the ship sank approximately 8 kilometres west-southwest of the stern. The wreck lies on its straight keel on the bottom of the sea.

Armament

A. 2 x 1-102 mm guns (located in the bow and stern of the upper deck, 50 shells for each gun) (Friedman 2011, 102).

model name	QF 4-inch gun Mk IV
in service from	1908
calibre	102 mm
weight	2133 kg
total length of gun barrel	5.2 m
length of shell movement in gun barrel	4.3 m
sound volume in barrel	600 in3
number of barrel grooves	32
groove thread for shell	1/30
shell weight	14 kg
explosive charge of shell	4.5 kg
speed of shell upon exit from gun barrel	859 m/s
effective range	8.7 km at a 20-degree angle and 10.5 km at a 30-degree angle
shooting interval	13 shots per minute
lifetime of barrel	1200 shots

B. 1 x 1-47 mm gun (Friedman 2011, 118)

model name	3pdr Hotchkiss Mk I
in service from	1885
calibre	47 mm
weight	254 kg
total length of gun barrel	2.04 m
length of shell movement in gun barrel	1.4 m
sound volume in barrel	43.1in3
number of barrel grooves	20
groove thread for shell	1/25
shell weight	2.6 kg
explosive charge of shell	1.5 kg
speed of shell upon exit from gun barrel	587 m/s
effective range	5.9 km at a 20-degree angle and 7.2 km at a 45-degree angle
shooting interval	20 shots per minute
lifetime of barrel	6000 shots

Cargo steamer E. Russ

Historical overview

The steamer E. Russ was built in the Stettin Oderwerke Shipyard in 1909. The ship was 93,3 metres long and 13,4 metres wide, and its carrying capacity was 2,437 GRT (Kloevekorn 1993, 101). The vessel, which initially belonged to German shipping company Ernst Russ, was given to England on 2 July 1919. After the end of the world war, the Liquidation Committee of the US Army that was established on 11 February 1919 started emptying the numerous equipment warehouses in Europe by simply selling the stuff that was not being used. Estonia bought goods "...for getting the state in order and establishing national industry" via a private limited company Revalis. The distribution plan of the purchased goods was developed by a special committee, who mainly gave the items to the army, the Ministry of Commerce and Industry, the Directorate General for Health and the Ministry of Food Supplies (Pajur 2005, 57-58). Supplying the People's Army during the War of Independence has been considered one of the biggest challenges of the government, which was never completely solved. The national forces lacked almost everything: clothes, footwear, vehicles, tools, weapons, ammunition, horses, food, etc.

The steamer E. Russ arrived at the Port of Bordeaux in France in early August 1919 from where it was supposed to sail to Tallinn after being fully loaded. Loading the goods at the Port of Bordeaux took almost 17 days and the long voyage could finally start in early September. On 15 September, after being at sea for almost two weeks, the steamer reached Tahkuna Peninsula, where it hit a floating mine on stormy sea at 4 AM. Although the deck watchman spotted the mine, it was too late to save the ship. The ship sank in 15 minutes. The 27 crewmembers and eight passengers managed to escape. One crewmember got injured in the explosion (Roio 2013, 210).

Figure 9. *Multibeam sonar image of the wreck of the E. Russ. Tuukritööde OÜ.*

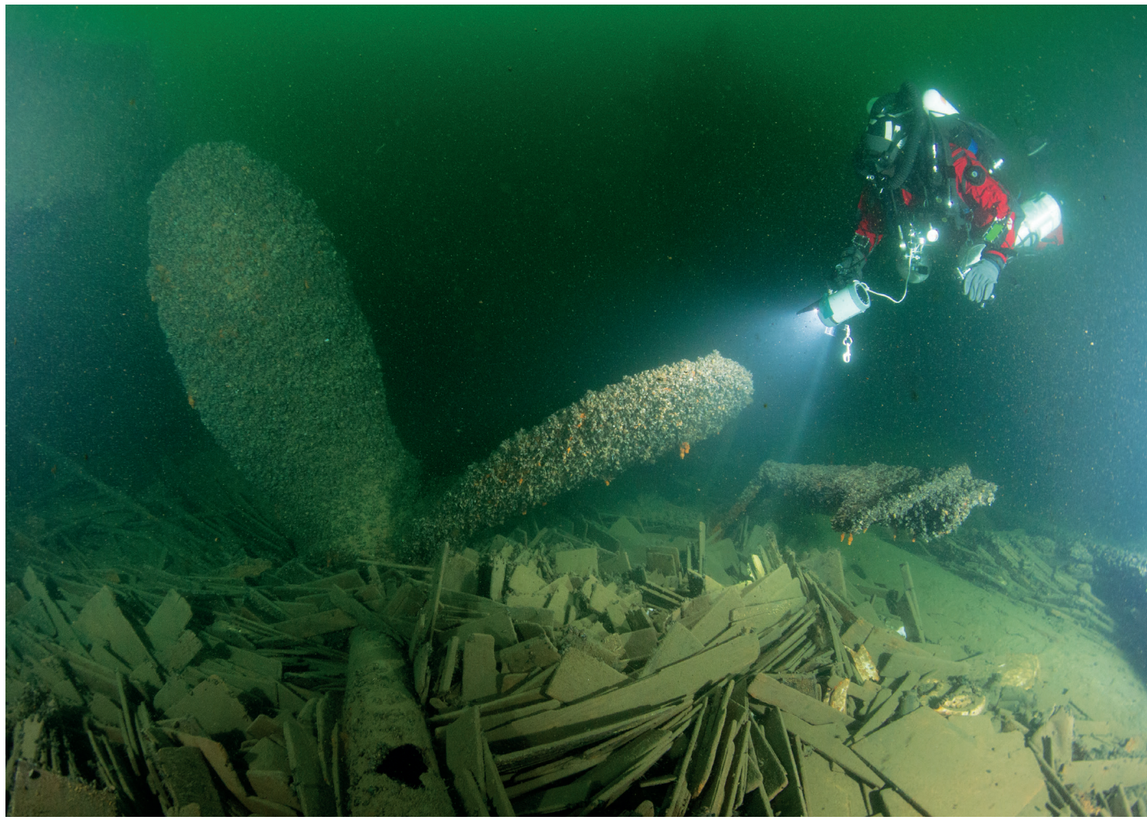


Figure 10. *A diver looking at the scattered cargo. Photo: Jouni Polkko 2013.*

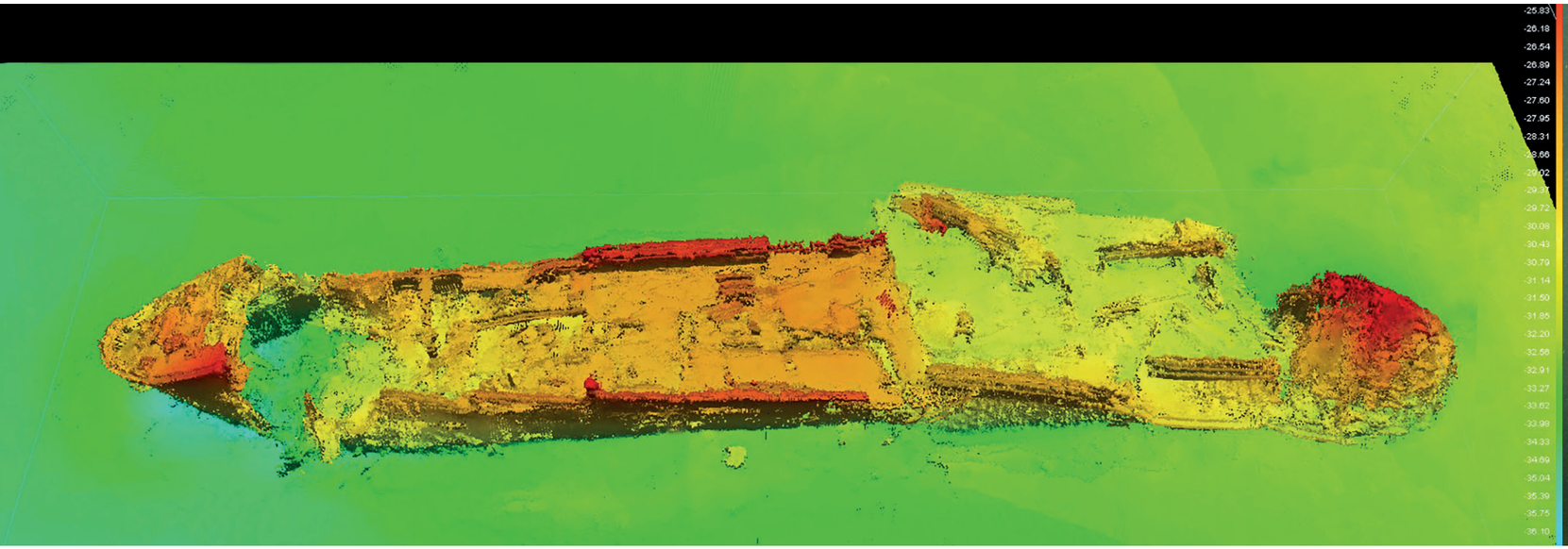
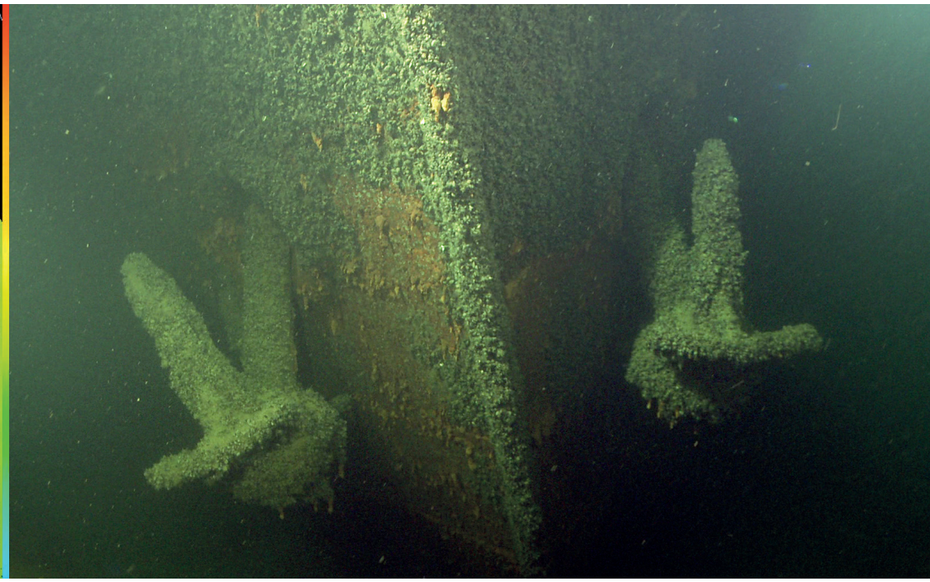


Figure 11. *The bow. Photo: Juha Flinkman 2013.*



The E. Russ carried goods for almost 2 million dollars, incl. cars. In addition to this, it carried spare car parts and two motorcycles. The hold of the ship mainly contained food: salted meat, bacon, sardines, oleomargarine, vinegar, dried potatoes and carrots, turnips and onions, plums and bread, marmalade, condensed milk, coffee and tea. The ship also carried tobacco, cigarettes, candles, towels, boots, clothes, medication. 102 barrels of alcohol had been placed on the deck of the ship (ERA.73.1.614).

All kinds of things were salvaged from the sea and the coast after the E. Russ sank, which were all carried to Haapsalu with the help of the coastguard, Kärdla militia and local people and sent to Tallinn by rail on 30 September. Goods worth 11,631.10 dollars were saved: twenty-odd barrels of spirit (3400 litres), approximately 100 boxes of medicines, a box of food, three inner tubes of cards, 20 empty rusted and broken tin containers, some barrels of turpentine, 13 wooden cart frames, a barrel of vinegar and three lifesavers (ERA.73.2.63). Several attempts were made to lift and demolish the wreck of the E. Russ after the Estonian War of Independence, but they all failed (Roio 2013, 212).

The damage caused by the naval mine explosion can be seen on the wreck of the steamer. The remains of the scattered cargo can be seen on and around the wreck, which have largely been well preserved. Several tools, incl. hammers, two-man saws, etc., footwear, bottles of various sizes (incl. medicine bottles), household items, tyres of different vehicles, cart wheels, etc., can be seen.

Figure 12. *Main cargo hold. Image of 3D model: Maili Roio, National Heritage Board of Estonia.*

Figure 13. *There were more than 2000 boxes with boots on board the E.Russ. Photo: Juha Flinkman 2013.*

Figure 14. *There were about 50 cars on board the E. Russ. Photo: Jouni Polkko 2013.*

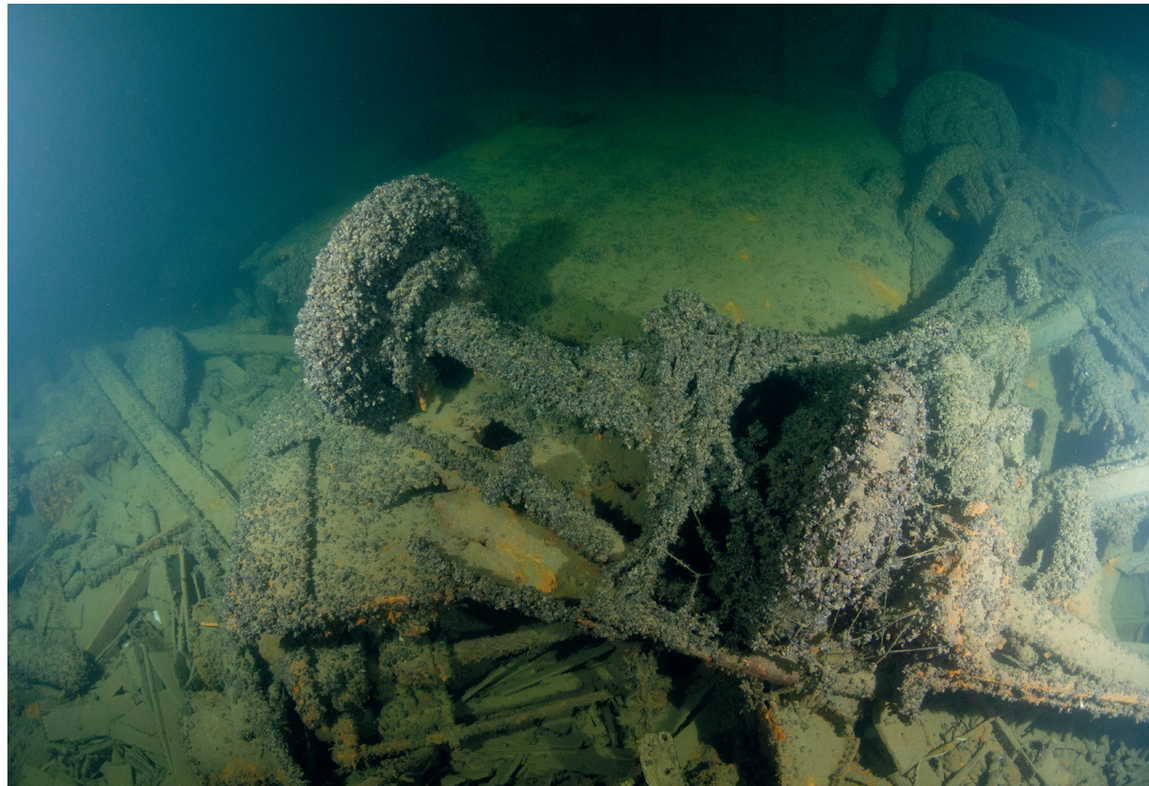


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Figure 15. *A seal observing the filming from the starboard side of the wreck.*
Photo: Tiffany Norberg 2019.