Report on the fieldwork at the sites of the Dutch submarines O16 and K-XVII

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Introduction

In the last couple of years, information about the illegal salvage of World War 2 wrecks in Asia has regularly come to light.[1] For many this has come as a shock, in particular for the relatives of those who died there. Already in 2013, a salvaging ship was photographed in the vicinity of the location of the HNLMS O16, a Dutch submarine. Eventually there was not enough evidence to link the ship to the salvaging of the wreck at that time. Photos taken at the location of the wreck site show parts of the wreck laying squashed and heavily damaged on the deck of the salvage ship. A formal inquiry from the Netherlands Government did not result in much more information.

The examples of this Dutch wreck and similar information we received about Australian, American, British and Japanese wrecks give us a sense of urgency to make up our mind about what we think the future should be for these wrecks. They are, not only(often shared) heritage, but also war graves and sovereign objects that are still owned by the governments that once deployed them. At the moment it has proven to be difficult to find the salvors responsible and stop what they are doing. This is of great concern to both the coastal states[2] and the flag states[3] of those sites that are being looted.

In 2017 talks between the Netherlands and Malaysia were initiated to investigate the four known Dutch submarines in Malaysian waters: the HNLMS O20, HNLMS O16, HNLMS K-XVI and HNLMS K-XVII. Meetings on the subject were held with the relevant organisations (see below) in March 2018 (in Putra Jaya) and May 2019 (via video conferencing and in Putra Jaya). The latter was to prepare the joint Malaysia-Netherlands fieldwork that was set between the 28th of June and the 8th of July 2019. The subjects of this investigation were the two submarines O16 and K-XVII that were lost in 1941, close to Tioman island. The aim of the research was to assess the sites, to determine their current condition and to assemble information in order to enable the possibility for a joint management plan that could be made for both sites in the near future.

Cooperation

The fieldwork has been conducted as a joint Malaysia-Netherlands cooperation. The team from the Netherlands, the flag state of the vessels, was led by the Cultural Heritage Agency of the Netherlands (Ministry of Education, Culture and Science), in collaboration with the Ministry of Defence (Royal Netherlands Navy) and the Ministry of Foreign Affairs (the Embassy of the Kingdom of the Netherlands in Kuala Lumpur). From Malaysia, the coastal state, the expedition was coordinated by the Ministry of Foreign Affairs (MOFA) in

[1] In 2016 a group of divers supported by the Karel Doorman Foundation (KDF) discovered the disappearance of the three Dutch WWII wrecks of the Hr. Ms. De Ruyter, Hr. Ms. Java and Hr. Ms. Kortenaer in the Java Sea, Indonesia. This was for the Netherlands an incentive to actively investigate the whereabouts and conditions of other Dutch WWII wrecks in the world. See for an overview of salvaged wrecks in Asian waters, also https://www.theguardian.com/world/ng-interactive/2017/nov/03/worlds-biggest-grave-robbery-asias-disappearing-ww2-shipwrecks (accessed 6-8-2019).

[2] The states within whose borders the wrecks are found

[3] Owner of the vessel, under whose flag the ship was active

collaboration with the Ministry of Tourism, Arts and Culture, Department of National Heritage, Ministry of Defence (the Royal Malaysian Navy), Ministry of Home Affairs (the Malaysian Maritime Enforcement Agency), Ministry of Transport (Marine Department), and Prime Minister's Department (the National Security Council).

The costs for the expedition, including the related costs and liabilities, were borne by the Netherlands. The Cultural Heritage Agency (RCE) has provided the funding for the expedition (see attachment 2), while the Royal Netherlands Navy (RNN) provided a team of experts and organised the transport of the equipment to and from Malaysia. The Embassy of the Netherlands in Kuala Lumpur has been the liaison for talks while preparing the fieldwork with the Malaysian Ministry of Foreign Affairs, that was also responsible for the coordination in Malaysia itself and for the help in obtaining the necessary permits for the work. The Malaysia Maritime Enforcement Agency (MMEA) would accompany the team to the site every day for security and the other partners provided personnel for the exchange of knowledge and training.

Formally a Letter of Intent (LoI) was signed on the 26th of June 2019 by the General Director of the Cultural Heritage Agency of the Netherlands – Ms. Susan Lammers – and the ambassador of Malaysia to the Netherlands – H.E. Mr. Dato'Ahmad Nazri Yusof – setting the basis for the cooperation in the field.

With this LoI, MOFA and RCE, as the implementing agencies acknowledged the importance of intensifying the bilateral cooperation on research in maritime archaeology and underwater cultural heritage management. Both signatories recognise that cooperation will improve the exchange of knowledge and the quality of underwater cultural heritage management and preservation. This is also the reason why a component of training related to maritime archaeological research and underwater cultural heritage management activities was included in the expedition.

Figure 1: The RV Discovery.

Equipment for the assessment

It was agreed to hire the RV Discovery, a 35 metre long vessel owned by the Universiti Malaysia Terengganu (UMT), a Malaysian Technical University. This was in compliance with the Malaysian Merchant Shipping Ordinance 1952.

With this ship the team went back and forth every day, from the village of Tekek on the island of Tioman to the respective sites. This was due to the amount of people that were present on board each day in comparison to the size of the ship.

For the fieldwork a team of five experts from the RNN were flown in from the Netherlands with a double set of REMUS and ROV equipment. They performed the technical survey on the sites. The REMUS is an Autonomous Underwater Vehicle that can be programmed to do its runs by itself without being wired to the ship. The REMUS had a high frequency side scan sonar and a camera on board.

The Remotely Operated Vehicle or ROV was equipped with a camera and needed to be operated from the mothership with a line. Unfortunately the ROV could not be used at this site, due to the natural conditions, the type of ROV and the fact that the mothership could not anchor on site.

Assessment of the O16

The O16 is a submarine that sank on the 15th of December 1941 when going back to its base in Singapore after a mission to defend the oil fields in Borneo against a Japanese invasion. The ship ran into a mine field, exploded and sank. Of the 42 crew on board, 36 died immediately. Six men that were outside at the time of the explosion tried to reach the shore. Only one of them made it. Before the start of the assessment, we knew that the O16 had been subject to salvage in 2013. The hypothesis was that the central part of the ship with the conning tower would have been lost during the salvage but that maybe large parts of the aft and bow of the submarine would still be there. On the 29th, 30th of June and 1st of July, the site was meticulously mapped with the REMUS. First a 'box' of approximately 500 by 500 metres was scanned.

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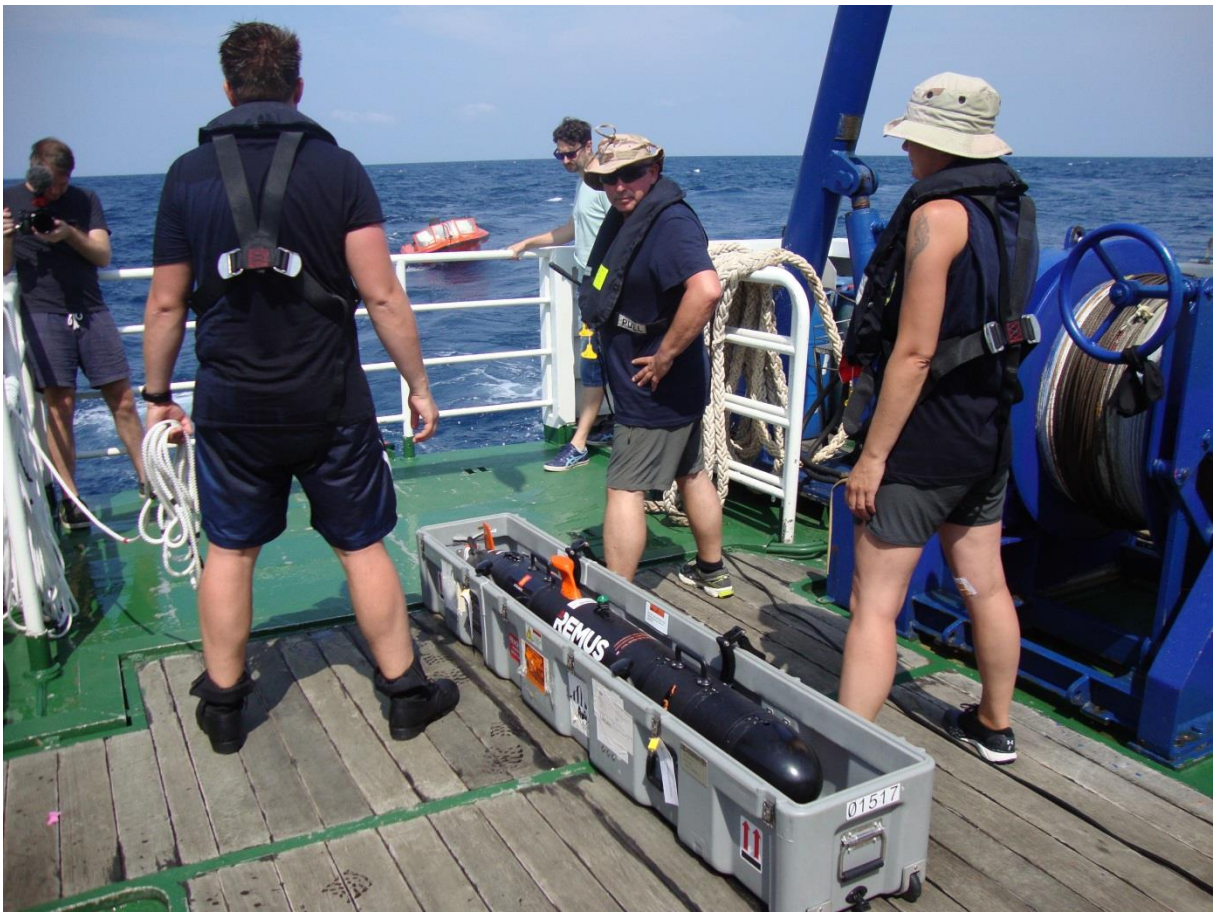

Figure 2: The AUV Remus from the Royal Netherlands Navy, with its operators.

Figure 3: Side scan sonar mosaic made with the Remus at the O16 wreck site.

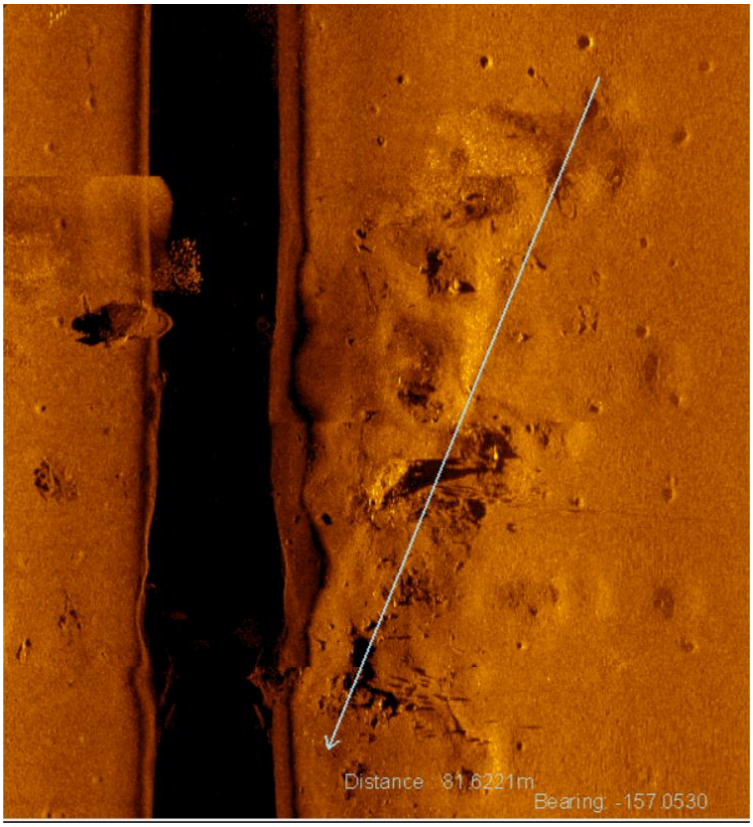

Figure 4: Detail of the wreck of the O16. Only small fragments of the wreck still exist onsite.

After that a more close range mapping of the located objects on the seabed was executed. This resulted in the conclusion that indeed the middle part of the ship is completely gone. An impression that resulted from the salvage operation is still visible on the seabed. The areas of the bow and stern have been heavily damaged and are almost gone as well. Fragments and lower parts of the cylinder body can be spotted on the side scan sonar.

The data collected during the fieldwork will be analysed in more detail after September 2019.

Assessment of the K-XVII

On the 21st of December 1941 the K-XVII ran into the same mine field as the O16, also when returning to its base. This ship is also located just over 20 miles from Tioman island. The submarine sank with all hands, a crew of 36.

Figure 5: Side scan sonar mosaic of the K-XVII wreck site made with the Remus sonar.

The last information the team has had from a diver was that he dived the site on the 18th of May 2018. At that time, according to his report, at least large parts of the wreck were still visible on the site. When surveying the site with the REMUS it became immediately clear that the site was now almost completely salvaged. In a 'box' of 500 by 500 m, there is a small seabed area of approximately 90 metres of length that has been disturbed.

Traces of salvaging are visible, including anchor dragging. Here and there, small pieces of deformed wreck material were detected, not more than a few metres long. The image was clear enough to conclude that the wreck has been salvaged. Due to the fact that the imagery was already at its best, it was decided by the team that there was nothing to gain with further research.

Figure 6: Sonar detail of the K-XVII wreck site. Hardly any wreck material is left onsite.

The salvage of the wrecks has been reported to the responsible authorities in Malaysia and the Netherlands. The data collected during the fieldwork will be analysed in more detail after September 2019.

Training

The expedition also consisted of some small training sessions in the field and in the classroom. It was decided to do no specific training on board of the ship RV Discovery except for some explanation of how the equipment works.

The classroom training was conducted on the 1st and the 5th of July. Diving was set up for the 5th of July in the afternoon.

The subjects of training were:

1. Dutch Cultural Heritage in Malaysian waters
2. Cultural Heritage Management
3. Forensic/preventive Marking
4. 3D photogrammetry

Figure 7: The small island (Rengis island) in front of the resort where the 3D photogrammetry and the forensic marking was tested.

All training was conducted by the RCE. Dive cylinders for the training were provided by the Malaysian Navy. For this training a dive location near Tioman island was jointly arranged where the 3D photogrammetry and the forensic marking was deployed. The forensic marking training consisted of a theoretic explanation of the materials used and a practical exercise to deploy the material on a metal shipwreck. The idea is that wrecks are marked with a gel that includes small microscopic markers that can be traced again underwater and when the metals have been salvaged. The training was also used to test new methods of deploying. This information will be fed back into the project.

The forensic marking works really well, although the application of it is still a bit complicated. This will be improved in the near future. All trainings were executed successfully.

3D photogrammetry or Computer Vision Photogrammetry reduces underwater recording time and can produce an accurate, detailed and objective three-dimensional result. It is therefore that we chose this as a subject for training. It will be the new main method for documenting wreck sites. Afterwards the created model can be used for measurements and further research.

This training also consisted of a theoretical and a practical part. In the practical exercise divers filmed the site with a GoPro, thereby trying to ensure overlap. In an ideal situation the wreck would be filmed in a lawnmower pattern ensuring at least 60% overlap.

After filming, the video footage was loaded into a program that takes still pictures from the footage called Free Video to JPG Converter. Finally, the pictures were then loaded into dedicated software called Agisoft Photoscan.

Agisoft Photoscan uses a so-called 'feature detection algorithm' to automatically identify and match features in overlapping pictures. Based on the detected features and the camera calibration parameters, Photoscan aligns the pictures relevant to one another. Afterwards the Photoscan results can be used to produce a site plan.

Both, 3D photogrammetry and forensic marking may not be of much use for the O16 and the K-XVII anymore, since they are largely gone. However, maybe other wrecks in the waters of Malaysia, or in other places in the world could still be protected. The test was therefore useful.

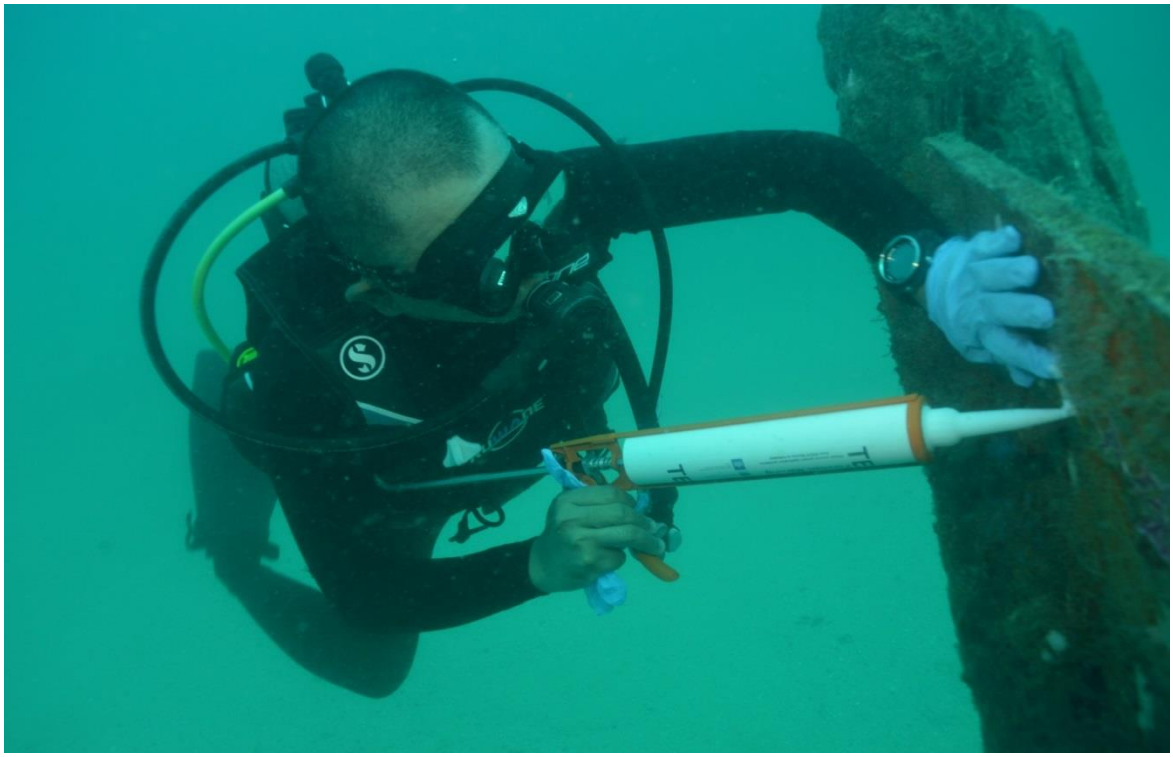

Figure 8: Forensic marking gel being deployed on a shipwreck. This was an exercise to test the materials.

3D photogrammetry is a new way of documenting sites where visibility allows this. Like in the Netherlands, this can be a valuable tool for Malaysian archaeology as well. The lectures and training were set up as a trial to look for opportunities in cooperation and training subjects. For future cooperation it would be good to jointly determine the subjects, (diving) classification of the students and amount of trainees. The training conducted during the expedition forms a good basis for this discussion.

Figure 9: 3D-photogrammetry was part of the training.

Overall conclusions

The two submarines O16 and K-XVII can be considered to have largely disappeared from the seabed as result of salvaging. We already knew the O16 was subject to salvage in 2013. On the seabed we noticed an impression in the middle of where once the intact submarine lay. Parts of stern and bow are still visible though heavily damaged and eroded. The K XVII is even more extensively salvaged. Almost nothing has been left on the seabed, except for small pieces of debris. The area where the ship used to lay has been heavily 'ploughed' and therefore it is clear that we are in the right area.

The forensic (or preventive) marking that was tested in the field on a wreck near Tioman Island works well. However, an easier application of the materials underwater needs to be invented. It may not be useful to apply this material on the two submarines that are largely gone (O16 and K XVII), but it would be an interesting new way of making a case of illegal salvaging easier to prove in court and therefore may be best applied on steel wrecks of the WWII era rather sooner than later.

The training on 3D-photogrammetry and underwater cultural heritage management has been perceived as interesting and valuable. This can be further extended and pinpointed to the needs of the Malaysian attendants.

Suggestions for the future

The images made with the REMUS will be further analysed by experts of the RNN and the RCE after September 2019 in order to (hopefully) learn more about the salvage process and to get a more detailed image of the sites. This will take a few months. The analyses will not change the overall outcome of the fieldwork.

The information we have on the O16 and K-XVII makes us worried about the state of condition of the O20 and K-XVI. A first idea of the condition, executed on short notice with a multibeam and/or side scan sonar would be a good option before setting up a larger cooperation again.

The two locations of the O16 and K-XVII may have been deprived of a large part of the wreckage and the sailors that died there, however these sites might still be of value for the relatives of the crew. Therefore we suggest to discuss the future of these sites with this stakeholder group before the Netherlands and Malaysia will decide together what to do. Options are to leave the sites further unattended and not to take any more action, or we may try to protect the locations against further damage and preserve the areas as 'lieux de memoire' (preservation in situ), or we recover whatever is left and we want to keep from the seabed, including the remains of the crew if encountered (preservation ex-situ).

Our advice is to make (shortened) management plans that will include the decision of what will be done with the sites in the (near) future, even though the wrecks have been largely salvaged (see the options above). The management plans can look like (a shortened version of) the format included in attachment 1. The work for this can be executed from September onwards.

ATTACHMENT 1

Management Plan of the [Name] Shipwreck Site

0. Administrative details

Date

Client The name of the sponsor, e.g. private client or State

Executed by (contractor) The name of the team facilitating the project

Approved authorities The name of the authority responsible for the site

Central registration number The registration number/database for the site

Location research area Description of where it is (Country, Province, district, place, etc.)

Coordinates Coordinated from Global Positioning System (GPS)

Environmental context Coastal Geology

Climate

Flora and Fauna

Human impact

Size of research area Total area measurement in square metres

Depth Depth in metres taking into account tidal differences

Owner terrain The owner of the area the site is situated in, e.g. the State

Reported by The name of the individual who first reported the site

Periods of research Dates of fieldwork

Site definition Short description of what the site is

Deposition of archives Where are they deposited

Legal status Protected or non-protected site

Recognized threats Short summary of major threats

Date of re-assessment/re-evaluation To be confirmed once the research is complete

1. Introduction

1.1 Previous studies Note any previous studies

1.2 Historical context Note any significant historical context

2. Assessment of the site

2.1 Description of research assignment Summary of why the research is being undertaken

2.1.1 Reference to working standards Outline working standards, e.g. national standards

2.1.2 Research objectives Summary of primary objectives

2.1.3 Expected results Summary of expected outcomes

2.1.4 Aims/wishes of the client Note any specific wishes or aims of the client

2.1.5 Imposed research conditions Note any limitations or guidelines that need to be followed

2.1.6 Evaluations in between Note the evaluation dates during fieldwork

2.2 Working procedure

2.2.1 Research methods Overview of proposed research methods

2.2.2 Imposed work conditions Note any constricting limitations or guidelines

2.2.3 Modus operandi Density or perception of the grid. Note any limitations of observation due to any environmental factors

2.2.4 Natural sciences, applied sciences and other research Note any other related field of study that can be incorporated in order to complete the investigation

2.3 Research results

2.3.1 Environmental research

2.3.2 Physical condition

2.3.2.1 Finds visible on surface

2.3.2.2 Completeness Note how much the site resembles its original state, e.g. quantity

2.3.2.2.1 Completeness of wreck parts

2.3.2.2.2 Stratigraphy intact

2.3.2.2.3 Mobile artefacts in situ Note any artefacts that can be moved in or near the wreck itself

2.3.2.2.4 Relation between mobile artefacts and wreck parts

2.3.2.2.5 Relation between mobile artefacts Note any relationship between the artefacts and how it can be distinguished

2.3.2.2.6 Stability natural environment

2.3.3 State of preservation

2.3.3.1 Organic wreck parts	Either indication or scientific analyses
2.3.3.2 Metal wreck parts	Either indication or scientific analyses
2.3.3.3 Organic mobilia	Either indication or scientific analyses
2.3.3.4 Metal mobilia	Either indication or scientific analyses

2.3.4 Cultural-historic and archaeological data

2.3.4.1 Identification

2.3.4.1.1 Cultural context	A specific period or culture that the site can be associated with
2.3.4.1.2 Century	The century that the ship dates from
2.3.4.1.3 Exact dating	The exact date the ship sailed/sank, e.g. 1783
2.3.4.1.4 Function	The function of the ship, e.g. trader or warship
2.3.4.1.5 Type	The type of ship, e.g. yacht or galleon
2.3.4.1.6 Operating area	The area the ship sailed in
2.3.4.1.7 Propulsion	The method of propulsion, e.g. sail or motor
2.3.4.1.8 Size	Size of the ship (metres)
2.3.4.1.9 Material	Construction materials, e.g. wood, iron or paper
2.3.4.1.10 Building tradition	The building tradition, e.g. Indigenous, European (Dutch, English, Spanish..), Etc.
2.3.4.1.11 Inventory	The artefacts found belonging to the ship
2.3.4.1.12 Cargo	The cargo carried by the ship
2.3.4.1.13 Personal belongings	Note any personal belongings aboard the ship
2.3.4.2 Constructional features	Note any specific construction elements specific to the ship

2.4 Risk assessment

2.4.1 Natural impact	Note any natural risks to the site

2.4.2 Human impact Note any human risks/threats to the site

3. Cultural valuation of the [Name] shipwreck

3.1 Experience aspects (quality)

3.1.1 Aesthetic values

3.1.1.1 Visible

3.1.1.1.1 Visible as landscape element — Note if the site is visible in the landscape and can, therefore, be enjoyed by others

3.1.1.1.2 Visible as exhibition element — Note is the wreck site has the potential to be used as an underwater trail/museum

3.1.2 Memory value

3.1.2.1 Historic value — Note any 'collective' memory that the site holds for people

3.2 Physical quality

3.2.1 Structural integrity

3.2.1.1 Presence of ship construction — Note approximately how much of the ship remains

3.2.1.2 Completeness of the wreck parts — Note which of the wreck parts are complete or missing

3.2.1.3 Stratigraphical conditions — Note the stratigraphic conditions, e.g mixed sediments

3.2.1.4 In situ portable antiquities — Note the presence and quality of artefacts

3.2.1.4.1 Relation between portable objects and ship parts — Note any clear relation between the objects and the place where they are lying

3.2.1.4.2 Relation between portable objects — Note any clear relation between the different objects

3.2.1.5 Stability of the natural environment — Note the stability of the natural environment

3.2.2 State of preservation

3.2.2.1 Wreck parts

3.2.2.1.1 Organic material

3.2.2.1.2 Metal

3.2.2.1.3 Composite — Note any parts of the wreck that comprise of different materials, such as iron and wood

3.2.2.2 Artefacts

3.2.2.2.1 Organic material

3.2.2.2.2 An-organic

3.2.2.2.3 Composite

3.3 Quality of archaeological information

3.3.1 Representative value Note how representative the information is for the period or culture

3.3.1.1 Chronological Note how representative the information is for the time period and/or how much can it add to the understanding of the era

3.3.1.2 Regional Note how representative the site is for the region or how much can it add to the understanding of it

3.3.2 Significance of information See Unit 6: *Significance Assessment*

3.3.2.1 Geographical significance

3.3.2.2 Historical or archaeological significance

3.4 Conclusion

4. Site management

4.1 Cost-benefit analysis and general conclusion Summary of the estimated costs associated with the management of the site (*in situ* preservation/(part) excavation/monitoring, etc.). Note the importance or significance of the site

4.2 Site management agenda Summary of planned activities in the (near) future

4.2.1 Safeguarding

4.2.1.1 Legal Note what kind of legal actions are going to be taken

4.2.1.2 Physical Note what kind of physical protection methods are going to be taken

4.2.2 Monitoring	Outline how often, when, by whom and with what, the site is going to be monitored in the future. Note planned actions.
4.2.3 Visualizing	Outline how the site is going to be visualized, by whom and when. Note planned actions.
4.2.4 Finance	Summarize what budget is available, the costs associated with planned actions, the amount of budget spent so far, etc.
4.3 Date of re-assessments/re-evaluation	Note the date of the next re-assessment/re-evaluation (taking into account if time and money spent allow for it and if actions taken are effective)

Attachments

1. Map of research area
2. Planning
3. Dive logs
4. First sketch of all team members
5. Measuring plan
6. All the individual sketches
7. A site plan
8. Photographs

This format has been originally developed in the MoSS-Project (2002-2004), sponsored by the European Union. For more information, see: Manders, M. 2004. Safeguarding a Site: The Master Management Plan. *MoSS Newsletter*, 3/2004, pp. 16-19. It was adapted for: Martijn R. Manders & Chris J. Underwood (eds) . 2012. *Training manual for the UNESCO foundation course on the protection and management of underwater cultural heritage in Asia and the Pacific*, Appendix E, Bangkok.

ATTACHMENT 2

Budget RCE

Malaysia	**Kosten EUR**
Hire ship	€ 43.836,70
fuel RV Discovery (ship)	€ 6.462,47
Fuel Coast guard	€ 6.004,33
Daily allowances	€ 982,92
Documenting	€ 7.979,95
Transfers	€ 400,00
Cost shipping materials to Malaysia	28.493,80
Costs personnel	€ 17.600,00
Totaal	**€ 111.760,17**