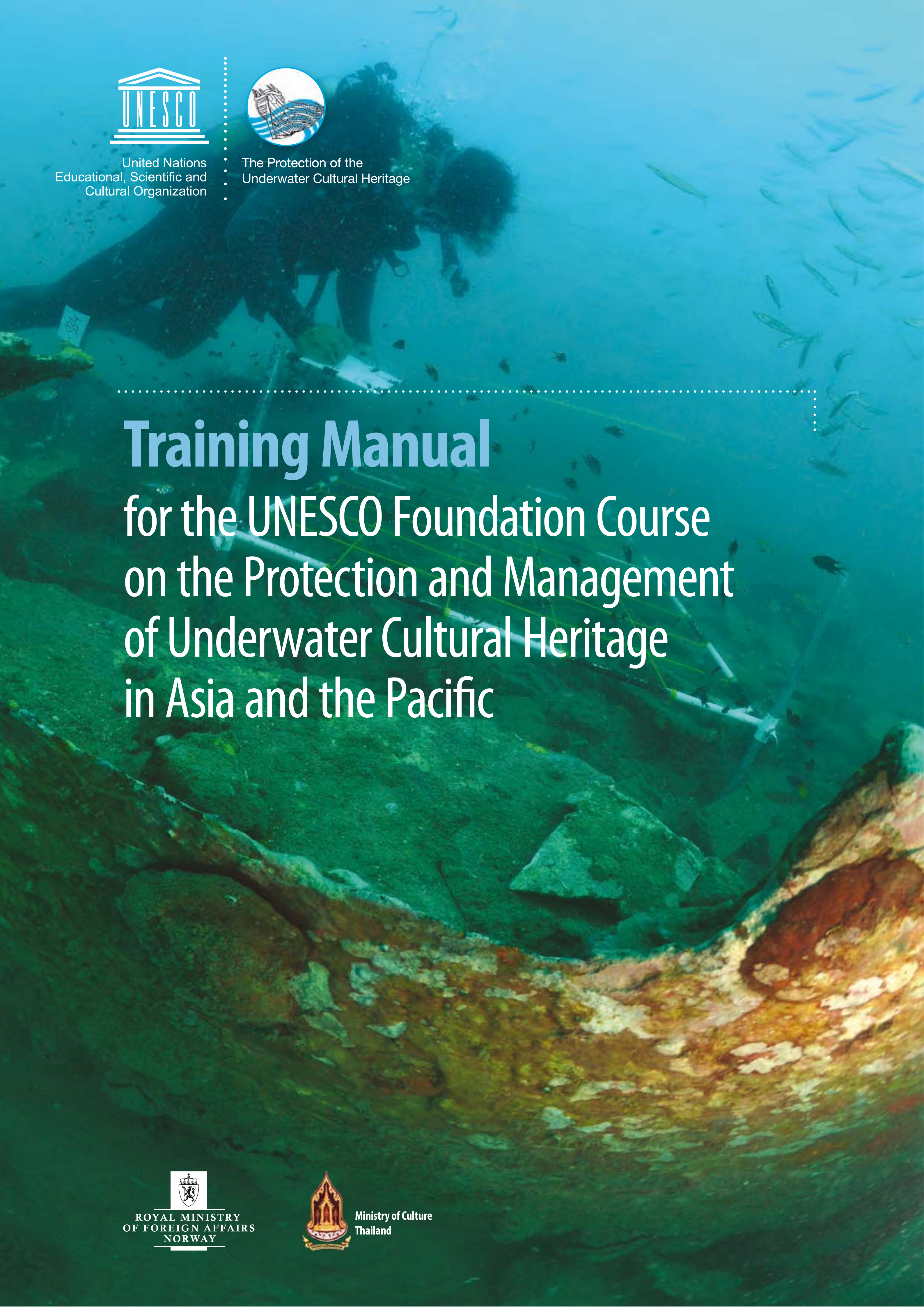

United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

Training Manual

for the UNESCO Foundation Course on the Protection and Management of Underwater Cultural Heritage in Asia and the Pacific

ROYAL MINISTRY
OF FOREIGN AFFAIRS
NORWAY

Ministry of Culture
Thailand

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Front cover photo: A trainee working underwater during the practical dive session at the Mannok Island shipwreck site, Gulf of Thailand. © UAD/Arpakorn Kiewmas

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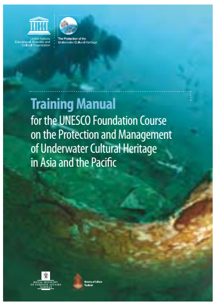
Training Manual

for the UNESCO Foundation Course on the Protection and Management of Underwater Cultural Heritage in Asia and the Pacific

FOREWORD

Francesco Bandarin

Assistant Director-General for Culture, UNESCO



Our underwater cultural heritage forms a significant part of humanity's shared heritage. Lying in the depths of the world's oceans, lakes and rivers are an abundance of hidden relics; shipwrecks and the ruins of lost cities and civilizations, each containing precious historical information that bears testimony to life across the ages.

For centuries, this heritage has remained well-preserved and to some extent protected by the waters that surround it. In recent decades, however, commercial exploitation of marine resources and advances in diving technology have rendered these archaeological sites more accessible and, therefore, more vulnerable to looting and destruction. The vast nets of fishing trawlers drag and damage the timbers and cargo of submerged ships; treasure hunters salvage valuable artefacts with little regard for the archaeological context that they are dismantling, while natural disasters and man made developments sweep away all traces of what once existed, often before they are even discovered.

The increasing threats to this fragile archaeological resource led to the adoption of the Convention on the Protection of the Underwater Cultural Heritage by the UNESCO General Conference in 2001. At the time the Convention was adopted, only a few countries in the Asia-Pacific region had the expertise and equipment necessary to conduct scientific excavation on shipwrecks found in their territorial waters. By ratifying the 2001 Convention, States Parties can take advantage of international cooperation to protect underwater archaeological sites wherever they are located.

For the effective implementation of the 2001 Convention and the Rules of its Annex, UNESCO focused its efforts on raising public awareness on the importance of underwater cultural heritage and in building the capacity of Member States to protect and manage their underwater archaeological sites. In response, UNESCO Bangkok formulated and implemented a regional capacity-building project entitled *'Safeguarding the Underwater Cultural Heritage in Asia and the Pacific'* which was funded under the UNESCO-Norway Funds-in-Trust Cooperation. UNESCO is especially grateful to the Norwegian Government for their generous support to this innovative and important project.

FOREWORD

Under the project, a Regional Field Training Centre on Underwater Cultural Heritage was established in Thailand within the precinct of the Underwater Archaeology Division of the Fine Arts Department. UNESCO is also very grateful to the Royal Thai Government for providing the venue, the equipment and human resources needed to run the training courses. From 2009 to 2011, three six-week Foundation Courses and two ten-day Advanced Courses were successfully held, benefitting seventy national experts from sixteen Asia-Pacific Member States, as well as one participant from Kenya in East Africa.

This publication combines all of the curriculum material developed by our pool of international expert trainers. Designed to be both practical and user-friendly, this training manual will be used to form the basis for future six-week Foundation Courses hosted by the Regional Field Training Centre. It is my sincere hope that this manual will also be used or adapted for similar training courses in other regions.

Francesco Bandarin
Assistant Director-General for Culture
UNESCO

Acknowledgements

UNESCO Bangkok would like to express sincere gratitude to the Royal Government of Norway, whose generous financial support made the project possible. We acknowledge also the invaluable contribution of the Royal Government of Thailand and the Underwater Archaeology Division of the Fine Arts Department, Ministry of Culture, for hosting the Regional Field Training Centre and for their interest to sustain the Centre over the long term, in particular Erbprem Vatcharangkul who ensured that the trainings were held in a smooth and professional manner.

The development of the project and the creation of the training manual were made possible thanks to our team of international expert trainers, who shared their expertise with the regional trainees and worked tirelessly to prepare the curriculum material. Special thanks go to Martijn Manders and Christopher Underwood, whose expertise and dedicated efforts brought together this manual.

Finally UNESCO Bangkok also wishes to acknowledge the contribution of Richard Engelhardt, for initiating the project in the first place, and to Ricardo Favis for his perseverance and professionalism in bringing the project to its completion.

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Cover photo: The Regional Field Training Centre on Underwater Archaeology in the Asia-Pacific region, Chanthaburi province, Thailand. © Martijn R. Manders

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INTRODUCTION

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INTRODUCTION

Authors Ricardo L. Favis, Martijn R. Manders and Christopher J. Underwood

The Development of the Regional Capacity Building Programme on Underwater Cultural Heritage

Welcoming banner from the First Foundation Course on Underwater Cultural Heritage. © UNESCO/Takahiko Makino

Background

At the time when the Convention on the Protection of the Underwater Cultural Heritage was adopted by the UNESCO General Assembly in 2001, maritime archaeology was a relatively new discipline in Asia and the Pacific. Therefore, it was no surprise that during the UNESCO Asia-Pacific Regional Workshop on the 2001 Convention on the Protection of the Underwater Cultural Heritage (Hong Kong, SAR China, November 2003), the delegates identified the urgent need for a regional capacity-building programme to prepare them for the ratification of the Convention and to enable the effective implementation of the Convention in their countries. An offer by the Sri Lankan delegation to host a regional field training centre (hereafter referred to as the Centre) within the precinct of their Maritime Archaeology Unit at the World Heritage Site of Galle, Sri Lanka, was welcomed and accepted.

In response, UNESCO Bangkok formulated a project entitled 'Safeguarding the underwater cultural heritage of Asia and the Pacific: building regional capacities to protect and manage underwater archaeological sites through the establishment of a regional Centre of Excellence field training facility and programme of instruction'. The regional training programme aims to embed the capacity-building and human resource development through the participation of site managers and national experts nominated by the competent national agencies responsible for safeguarding underwater cultural heritage. Moreover, beneficiaries are expected to share the skills and knowledge acquired from their training with their pool of national experts in their home countries.

The development goals towards which the regional project contributes are: (a) to protect underwater cultural heritage; and (b) to foster peace and social cohesion among participating Member States. The protection of underwater cultural heritage also has an important economic aspect, considering that tourism may develop around underwater sites if properly managed and interpreted in on-site museums.

Through the establishment of a Centre, the project aims to achieve the following objectives:

1. Build regional capacity in the protection and management of underwater cultural heritage through professional training in field techniques on underwater archaeological site inventory and mapping, non-invasive techniques of site identification, inventory and investigation, museology techniques, and site monitoring and protection according to international professional standards. The application of the provisions of the Annex to the Convention is particularly stressed.

2. Provide an effective networking platform among partner Member States by encouraging close collaboration and dissemination of best practices, thereby promoting regional cooperation through exchange of information on the conservation and management of a shared heritage.

3. Prepare Member States in the ratification and implementation of the 2001 Convention and its Annex.

With the approval and funding support of the Royal Government of Norway, the project started to be implemented in March 2008 with a training course for Sri Lankan archaeologists and conservators to prepare them to be the future trainers of trainees coming from the region.

In April 2008, a Project Steering Committee Meeting was convened in Galle, Sri Lanka to decide on the project implementation strategy. The Committee decided to implement the project in the form of Foundation Courses and Advanced Courses on specialized topics. Within the approved duration of the project, two Foundation Courses and two Advanced Courses were foreseen to be organized. The Committee also planned to organize the first Foundation Course in October 2008. After the committee meeting, a training curriculum began to be developed and efforts were made to locate shipwreck sites in southern Sri Lanka that would be used for the practical components of the fieldwork.

However, despite the interest and commendable effort of the Sri Lankans, the first Foundation Course was postponed due to domestic difficulties. As these issues did not improve sufficiently during the following months UNESCO decided to find a new location for the training centre.

1 Thailand as Host to the Regional Field Training Centre

The Underwater Archaeology Department (UAD) of the Fine Arts Department of Thailand was approached to discuss the possibility of transferring the venue of the Centre to Thailand. The facilities and diving equipment of the UAD were found to be more than adequate to support the regional training activities. The Director of the UAD expressed his interest and enthusiasm to host the Centre, using the department's human and technical resources. Given the positive response, UNESCO sought the approval of the Government of Norway donor to change the venue of the Centre to Thailand, which was granted.

In May 2009, the Government of Thailand through its competent authority, the Fine Arts Department of the Ministry of Culture, agreed to host the Centre within the infrastructure of the UAD in Chanthaburi, Thailand, 250 kilometres away from Bangkok where the UNESCO office is located.

As the venue of the Centre, Thailand offers many advantages, as follows:

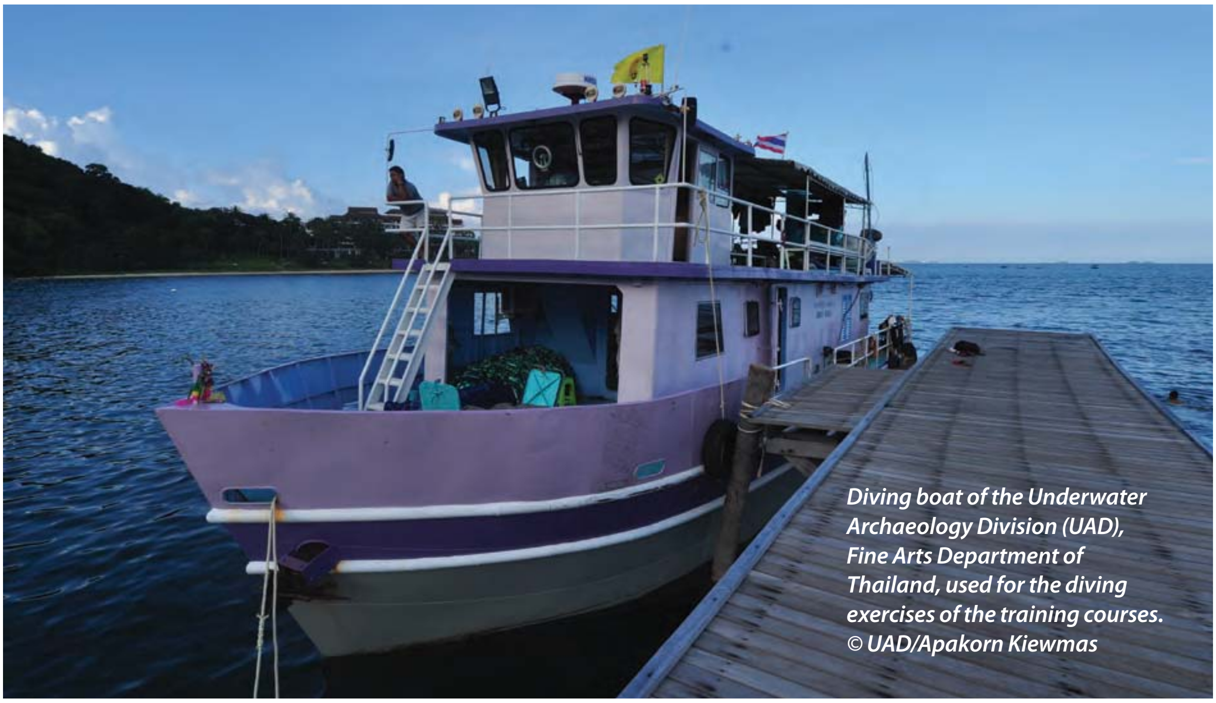
Accessibility: Thailand is centrally located in the Asia-Pacific region, thus reducing international transport costs of students to attend training courses. Its excellent road network facilitates local transfers between the airport in Bangkok, the Centre and coastal locations of field components of training courses. The UNESCO Asia-Pacific Regional Office is also located in Bangkok, thereby facilitating project supervision and monitoring.

Technical expertise and resources: The UAD has a professional staff of two maritime archaeologists and a technical diving team of ex-navy personnel. Since 1974, the UAD has had a long experience in underwater archaeology and collaborated closely on field surveys, scientific investigation/excavation and training activities with the Royal Thai Navy, the Regional Centre for Archaeology and Fine Arts of the South-East Asian Minister of Education Organization (SEAMEO-SPAFA) and the Faculty of Archaeology of the Silpakorn University based in Bangkok, Thailand. Furthermore, the UAD has never dealt with commercial enterprises in shipwreck excavation. The UAD is well equipped with surface supply equipment, scuba, trimix and rebreathers. It also has a newly commissioned diving vessel equipped with a rigid inflatable support boat, decompression chamber, adequate communication facilities and other equipment needed for underwater archaeological activities.

Logistics: The Fine Arts Department has provided a building as a venue for the Centre. It is conveniently located near the mooring place of the UAD diving vessel by the shore of the Chanthaburi River. The Centre has a fully equipped lecture room and accommodation facilities for students and trainers. It is also located near the UAD offices and the National Maritime Museum. Moreover, a modern naval hospital in nearby Pattaya provides medical care, if required by students during their field diving exercises.

Underwater cultural heritage sites: From 1974 to 2008, fifty-two shipwreck sites within Thai territorial waters have been identified and recorded. Among them, fourteen shipwrecks have been scientifically excavated by the UAD, providing a significant knowledge base and material culture for use by the Centre.

ICOMOS-ICUCH mobilized Martijn R. Manders to assist in the project implementation in Thailand. As an initial step, Mr. Manders alongside the UAD team conducted a survey of shipwreck sites in July 2009 to identify site(s) to be used for the practical field component of training courses. The Mannok shipwreck (also known as the Ruea Mail) was selected. It is a steamboat located at a depth of 20 metres near Mannok Island, Kleng District in the Rayong Province, an hour away from the venue of the Centre. The diving season of the selected site is from October to April, thus the First Foundation Course was organized from the 26 October to 4 December 2009.



Diving boat of the Underwater Archaeology Division (UAD), Fine Arts Department of Thailand, used for the diving exercises of the training courses. *© UAD/Apakorn Kiewmas*

The Regional Field Training Centre for Underwater Cultural Heritage in Chanthaburi Province, Thailand. *© Christopher J. Underwood*

2 Development of the Training Courses

The Foundation Course aims to bring national experts from different academic backgrounds and varying experience in underwater cultural heritage to a common level of understanding about the multi-disciplinary nature of maritime archaeology. Considering that the target students often have government jobs which they cannot leave for an extended period of time, and given the complex nature of maritime archaeology, the project proponents decided on a six week duration for the Foundation Course. The course was designed to cover four weeks of intensive classroom and practical sessions on land plus two weeks of field work on underwater survey techniques at the selected shipwreck site.

Lecture on metal shipbuilding technology by Christopher Underwood during the Third Foundation Course (February to March 2011) © UNESCO/Montakarn Suvanatap

Practical exercise on material culture analysis during the Third Foundation Course. © UNESCO/Montakarn Suvanatap

Underwater survey of the Ruea Mail site during the field component of the Foundation Course, Mannok Island, Rayong Province, Thailand. © UAD/Apakorn Kiewmas

BELOW: Recording ship construction details of the Ruea Mail site, Mannok Island, Rayong Province, Thailand. © UAD/Apakorn Kiewmas

Through lectures, practical sessions and field work, students are introduced to the 2001 Convention and its Annex, and trained on the basics of a number of subject areas, including: maritime archaeology, site significance, material culture analysis, finds handling and conservation, management of underwater cultural heritage, *in situ* preservation and topics related to the regional context, such as Asian ceramics and Asian shipbuilding technology.

The Mannok shipwreck, Mannok Island, Rayong Province, Thailand. © UAD, Thailand

Advanced Courses are designed to train students on specific topics in more detail, using state of the art technologies and latest developments. Based on the recommendations from students of earlier Foundation Courses, a ten-day Advanced Course on the Use of Geographic Information System (GIS) in the Management of Underwater Cultural Heritage was organized in September 2010, followed by an Advanced Course on *In Situ* Preservation of Underwater Cultural Heritage in December 2011. The Advanced Courses were facilitated by international experts who have extensive experience in their field of expertise.

The Advanced Course on the use of a Geographic Information System (GIS) in the management of underwater cultural heritage (September 2010). © UAD/Apakorn Kiewmas

Monitoring the site for changes after installation of the artificial seagrass. During the Advanced Course on In Situ *Preservation (October 2011). © UAD/Apakorn Kiewmas*

3 Development of the Curriculum

The curriculum and training units for the Foundation Course have evolved over time. The curriculum of the Foundation Course started to be developed in late 2008 by two experts representing ICOMOS-ICUCH and the Nautical Archaeology Society (NAS) in the Project Steering Committee. Their initial concern was to design a curriculum that aimed to train students from different academic backgrounds and levels of professional experience and to bring them to a common understanding of the complex nature of maritime archaeology within a limited duration of six weeks. This entailed the identification and selection of topics according to their relative importance in understanding underwater archaeology and how the 2001 Convention and the Rules of its Annex are applied in the proper safeguarding and management of underwater cultural heritage.

Given the diverse backgrounds of the students, it was decided to begin the Foundation Course with the Introductory and Part I training units developed by NAS on Foreshore and Underwater Archaeology (a license to use the NAS training units was secured for the Centre).

During the first Foundation Course, the trainers were requested to develop the training material for the topics assigned to them using their knowledge and experience, building upon what was developed earlier by the representative of ICOMOS-ICUCH. After the completion of the initial training course, feedback from the students and trainers was evaluated and used to improve the curriculum for the succeeding Foundation Courses. Some training units were enhanced further with the knowledge and experience of other expert trainers who were brought in to replace those who were not available to teach during the succeeding courses.

The delivery of training units was dictated by the logical order of topics, with each topic building upon the knowledge gained from the previous ones. The first week of the Foundation Course started with lectures on the 2001 Convention and the Rules of its Annex, followed by the Introductory and Part I NAS training units on Foreshore and Underwater Archaeology. The second week was focused on topics such as site significance, material culture analysis, Asian shipbuilding technology, finds handling and conservation, which are needed by the students to prepare them for their field survey exercises on an underwater archaeological site scheduled for the coming two weeks. The last two weeks were devoted to topics that enabled the students to prepare a management plan for the surveyed shipwreck site, which was presented during the closing ceremony of the training course. The order of training units was slightly altered over the first three Foundation Courses to suit the availability of selected trainers.

Practical exercises were group oriented. The organizers therefore scheduled a free day per week to provide students with time to relax and reflect, and organized social events and weekend tours to heritage sites to provide opportunities for team building among students. These arrangements facilitated group exercises during the training and enabled the graduates to network after their training.

4 This Training Manual and How to Use It

This manual aims to provide a consistent curriculum for Foundation Courses and a high standard of delivery of the training units. It also provides future trainers with a framework that enables them to create personalized presentations, practical sessions and assessments.

The manual is divided into eighteen units, one unit for each of the topics covered in the Foundation Course. The contents of each unit are:

- *Title of the unit*
- *Authors in the order of contribution*
- *Core knowledge of the unit*
- *Introduction to the unit*
- *Full text of the unit*
- *Unit summary*
- *Suggested timetable*
- *Suggested reading*
- *Teaching suggestions*
- *Additional information*

The units as presented in this manual are the result of the interaction between UNESCO, the trainers, students and the insight that was developed during the delivery of the first three foundation courses. This interaction resulted in the content of the units; the sequence of delivery of topics refined to maximize the educational benefits for the students. The curriculum presented here will continue to be used after the publication of this manual.

4.1 Assessment

The assessments on the performance of the students have been relatively informal and may take various forms, such as verbal questions to determine to what extent the lectures are assimilated by the students and to gauge their oral communication skills in responding to questions. Assessments are needed to provide a basis for future trainers to improve the structure of their presentations, thereby further enhancing the training units in future courses.

4.2 Criteria for the Selection of Students

In accordance with UNESCO protocol, notices regarding training courses are sent to the National Commissions for UNESCO of all Member States in Asia and the Pacific. In turn, the National Commissions are requested to notify concerned ministries and competent authorities, who in turn are requested to nominate qualified national experts to take part in the training courses.

To ensure that only qualified parties are nominated by the competent authorities, the following criteria for the selection of students for a Foundation Course are indicated in the official notice and on the nomination form attached to the notices.

Education: must have a college degree from a reputable academic institution.

Profession: must be an archaeologist in a scientific institution, a site manager of an underwater archaeological site, a conservator or college graduate with an interest in underwater cultural heritage and/or identified by competent authorities to play a lead role in the protection and management of underwater cultural heritage.

Commitment: must be involved in and committed to the safeguarding and proper management of underwater cultural heritage, in accordance with the principles of the 2001 Convention and the Rules of its Annex.

Diving qualifications: should have a minimum of fifty logged dives of which twenty dives should have been conducted under supervision by a recognized research/academic/scientific institution. They should have logged five dives deeper than 25 metres (considering the depth of the 20 metres depth of the Thai shipwreck used for the field training exercises).

Health: must be medically certified to be fit for diving. A medical certification from an established medical facility is required for a nominee/applicant to be considered eligible for selection.

Language skills: must have good comprehension, written and communication skills in English (nominees are required to submit proof of their English skills).

For qualified nominees who have not logged the required number of dives, the UAD was able to arrange for further dive training/experience prior to the start of the Foundation Course.

The criteria listed above should also be applied to the selection of nominees/applicants for an Advanced Course. Moreover, ideally nominees/applicants for an Advanced Course must have completed the requirements of a Foundation Course. In case the Advanced Course has field diving components, the nominee must have the requisite logged dives and be covered by diving insurance.

The majority of the students have met the above criteria, but in a few circumstances exceptions have been made to enable the participation of partner countries. In these situations additional diving training was provided by the UAD. In other cases non-divers have been assigned other relevant tasks during the field dive session.

4.3 Expert Trainers

The selection of trainers is essential in ensuring a high standard of delivery of training activities. A number of possible trainers should be identified well in advance, so that comparative assessments of the candidates can be made, and a shortlist of trainers identified. As an initial step, the *curricula vitae* of potential trainers may be obtained to provide information regarding their academic background, areas of expertise, work experience and publications, leading to the identification of topic(s) that each potential trainer would be capable of handling.

The selection of trainers may also depend on their availability to deliver their assigned training units during the dates specified by the training programme. In some cases, another trainer has to take the place of the selected trainer due to prior engagements, thus it is recommended that trainers are provided adequate time to make themselves available during the training period. Given the cost of bringing international trainers to the training venue, it is recommended that their contribution is maximized by assigning each of them two or more topics.

In general, the following requirements apply to the identification and selection of trainers for both the Foundation and Advanced Courses:

- *Must be proven specialist in the assigned topic(s)*
- *Must have extensive experience in the protection and management of underwater cultural heritage, in accordance with the principles of the 2001 Convention and the Rules of its Annex*
- *Must have excellent communication, written and comprehension skills in English*
- *Must have prior teaching experience and the ability to deliver their training units in ways that are easily understood by the target students*

The following expert trainers shared their expertise during the Foundation and Advanced Courses:

Karina Acton, Senior Objects Conservator, International Conservation Services, Australia.
Course(s) taught: The First Foundation Course (Finds Handling and Conservation)

Ross Anderson, President of the Australian Institute of Maritime Archaeology, Maritime Archaeologist of the Western Australian Museum.
Course(s) taught: The First and Second Foundation Courses (co-trainer in Practical Dive Session)

Will Brouwers, Educational programme development, Museum het Valkhof, Netherlands.
Course(s) taught: Advanced Course on the Use of GIS in the Management of Underwater Cultural Heritage

Somlak Charoenpot, Former Deputy Director General, Fine Arts Department, Thailand.
Course(s) taught: The First, Second and Third Foundation Courses (Museology)

Wim Dijkman, Project Leader, Hydrography, Ministry of Transport, Public Works and Water Management, Region Ijssel Lake at Lelystad, Netherlands.
Course(s) taught: Advanced Course on the Use of GIS in the Management of Underwater Cultural Heritage

David Gregory, Conservation Scientist, National Museum of Denmark.
Course(s) taught: Advanced Course on *In Situ* Preservation

Martijn R. Manders, ICOMOS-ICUCH, Senior Maritime Archaeologist and Maritime Heritage Programme Leader of the Cultural Heritage Agency of the Netherlands; Lecturer at Leiden University, Leiden, and Saxxion University, Deventer, Netherlands.

Course(s) taught: The First, Second and Third Foundation Courses (Underwater Archaeological Resources, Managing Underwater Cultural Heritage, *In Situ* Preservation, GIS for Underwater Cultural Heritage, co-trainer in Practical Dive Session), Advanced Course on *In Situ* Preservation, coordinator for curriculum preparation for the Foundation Course

Bobby Orillaneda, Museum Researcher II, Underwater Archaeology Section, Archaeology Division, National Museum of the Philippines.

Course(s) taught: The Second Foundation Course (Asian Ceramics), The Third Foundation Course (Asian Ceramics and co-trainer in Practical Dive Session)

Charlotte Pham, Bursary of the Ecole Française d'Extrême Orient, Viet Nam/Brussels, Belgium.

Course(s) taught: The Third Foundation Course (Asian Shipbuilding Technology)

Sayan Prainchanjit, Dean of the Faculty of Archaeology, Silpakorn University, Thailand.

Course(s) taught: The First Foundation Course (Asian Ceramics), The Second Foundation Course (Public Archaeology and Awareness Raising)

Mark Staniforth, Director, Maritime Archaeology Programme, Faculty of Archaeology, Flinders University, South Australia.

Course(s) taught: The First Foundation Course (Significance Assessment, Desk-based Assessment, Material Culture Analysis and Archaeological Publication)

Christopher Underwood, International Development Officer, Nautical Archaeology Society, Argentina.

Course(s) taught: The First, Second and Third Foundation Courses (NAS Introduction and Part I; supervising trainer of Practical Dive Session)

Hans Van Tilburg, NOAA Office of National Marine Sanctuaries Regional Maritime Heritage Coordinator for Pacific Islands Region, Honolulu, Hawaii, USA, United States of America.

Course(s) taught: The Second and Third Foundation Courses (Desk-based Assessment, Significance Assessment and Archaeological Publication)

Erbprem Vatcharangkul, Director, Underwater Archaeology Division, Fine Arts Department of Thailand.

Course(s) taught: The First, Second and Third Foundation Courses (Asian Shipbuilding Technology)

Andrew John Viduka, Assistant Director Maritime Heritage, Department of Environment, Water, Heritage and the Arts, Historic Heritage Division, Maritime Heritage Section, Australia.

Course(s) taught: The Second and Third Foundation Courses (Material Culture Analysis, Introduction to Intrusive Archaeology, Finds Handling and Conservation)

Ricardo Favis, Culture Programme Officer and Project Coordinator, UNESCO Bangkok Office.

Course(s) taught: The First, Second and Third Foundation Courses (Introduction to the 2001 Convention)

Manitapone Mahaxay, GIS Programme Officer, UNESCO Bangkok Office.

Course(s) taught: The First, Second and Third Foundation Courses (GIS for Underwater Cultural Heritage), Advanced Course on the Use of GIS in the Management of Underwater Cultural Heritage

Takahiko Makino, Abhirada Komoot and Montakarn Suvanatap, Course Administrators

5 Organization of Training Courses and Cost Considerations

The Foundation and Advanced Training Courses in Thailand were successfully organized at a reasonably low budget due to the facilities, technical resources and logistic support provided by the UAD, the main project implementing partner. The Centre has classroom and accommodation facilities for the students, resulting in a reduced subsistence allowance for students. The UAD has more than adequate diving equipment and a diving boat equipped with a new decompression chamber and communication facilities, which ensured safety and economy during the field diving exercises. The central location of Thailand in the region and the excellent road infrastructure reduced international and local transport costs of the students. The assistance provided to the students by the UAD technical diving team and a medical nurse on board the diving boat during field diving exercises maximized output and minimized injury among the students. More importantly, the proximity between the Centre and UNESCO Bangkok Office enabled closer project coordination, supervision and monitoring.

Organizing costs were decentralized to the implementing partner (UAD) under a service contracts covering the following cost items:

- *Project administration*
- *Project coordination and supervision*
- *Secretariat assistance and maintenance crew for the centre (fees for secretariat staff, security, janitorial, helpers)*
- *Subsistence allowance for support staff (drivers, technical divers, boat crew, secretariat staff) on the days they are involved in training activities*
- *Food for students (meals and snacks provided by a local caterer)*
- *Training materials and supplies (stationary, communication costs, electricity and water, supplies for diving equipment such as air compressor, diving gears, diving boat)*
- *Local transport of students (rental of transport vehicles, fuel for transport vehicles and diving boat)*
- *Other organizing costs*

UNESCO Bangkok Office provided the students with the following:

- *International plane tickets (most economical plane fares)*
- *Travel allowance*
- *Reduced daily subsistence allowance (excluding allowance for accommodation and meals)*
- *Other travel costs of students (visa fees, airport fees)*

UNESCO Bangkok established consultant contracts with the international expert trainers, covering the following cost items:

- *Consultant fees*
- *Cost of international plane tickets (most economical plane fares)*
- *Travel allowance*
- *Daily subsistence allowance for external consultants*
- *Other travel costs*

To ensure the safety of students during field diving exercises, UNESCO Bangkok secured a one year membership and standard diving injury insurance coverage for students (without insurance coverage) from the Divers Alert Network (DAN), the only provider of diving insurance in Asia and the Pacific.

6 Project Achievements

Five training courses were successfully organized during the duration of the project funded by the Government of Norway, as follows:

- *First Foundation Course (26 October–4 December 2009)*
- *Second Foundation Course (1 February–15 March 2010)*
- *Advanced Course on the Application of GIS in the Management of Underwater Cultural Heritage (20–29 September 2010)*
- *Third Foundation Course (14 February–26 March 2011)*
- *Advanced Course on In Situ Preservation of Underwater Cultural Heritage (19–26 October 2011)*

Seventy site managers and national experts representing seventeen Member States from in Asia and the Pacific and Kenya, benefitted from the five training courses. The following chart shows the number of beneficiaries from each participating Member State.

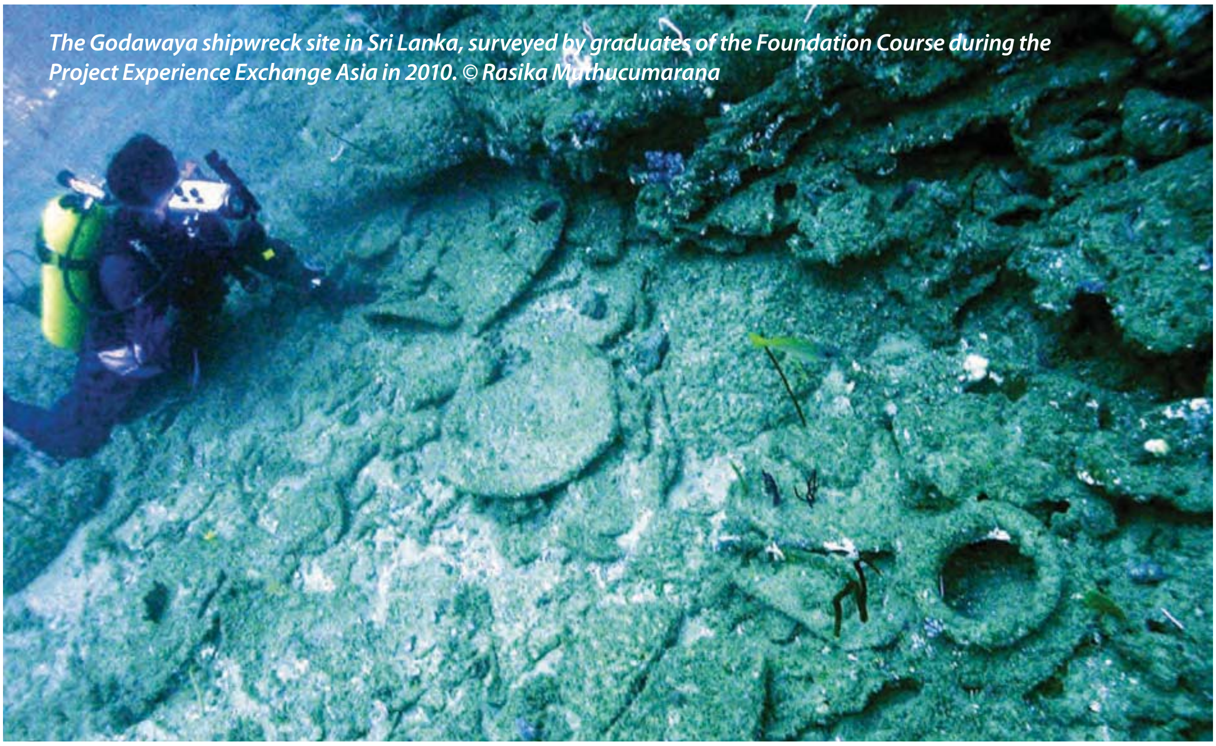
Beneficiaries of the Underwater Cultural Heritage Training Programme

COUNTRIES	First Foundation Course	Second Foundation Course	Advanced Course on GIS for Underwater Archaeology	Third Foundation Course	Advanced Course on *In Situ* Preservation	**TOTAL**
Bangladesh		1	1*	1		**2**
Brunei Darussalam		3				**3**
Cambodia	1	1	1	2	1*	**5**
Fiji			1	1*		**1**
India			1	1		**2**
Indonesia	2	3	2	4	3*	**11**
Kenya				1	1*	**1**
Kyrgyzstan				1	1*	**1**
Lao PDR	2			2		**4**
Malaysia	2	2	1		2*	**5**
Pakistan		1	1		1*	**2**
Palau			1			**1**
Philippines	2	1	2	(1*) 2	1*	**5**
Singapore			1			**1**
Sri Lanka	2	3	2	3	2*	**10**
Thailand	4	3	2	3	(2*) 3	**13**
Viet Nam		1	2			**3**
TOTAL	**15**	**19**	**17**	**(2*) 21**	**(14*) 15**	**70**

** Number of students who completed the requirements of a Foundation Course and an Advanced Training Course. All students of the Advanced Course on In Situ Preservation are graduates of an earlier Foundation Course, with the exception of a member of the Secretariat who also participated in the training activities during earlier Foundation Courses.*

A replica of the Ruea Mail Shipwreck featured in the international exhibition 'Saving Our Underwater Cultural Heritage' at Siam Ocean World, Bangkok, Thailand (August to October 2010). © UNESCO/Rojana Manowalailao

To bring the message on safeguarding underwater cultural heritage to a wider audience, UNESCO Bangkok Office organized the first ever UNESCO exhibition on global underwater cultural heritage in the Asia-Pacific region at the Siam Ocean World Bangkok from 16 August to 31 October 2010. The interactive exhibit featured underwater heritage scenes from around the world, a life sized replica of a Thai shipwreck, showcases of artefacts recovered from the seabed, special demonstrations of maritime



The Godawaya shipwreck site in Sri Lanka, surveyed by graduates of the Foundation Course during the Project Experience Exchange Asia in 2010. © Rasika Muthucumarana archaeologists in action and various interactive play zones for children. The exhibit was viewed by an estimated 150,000 local and foreign visitors. Exhibit items are now part of the permanent exhibition of the National Maritime Museum in Chanthaburi, Thailand.

To encourage active networking and experience sharing among the graduates of our training courses, UNESCO and the Dutch Government supported the Project Experience Exchange Asia organized by the Central Cultural Fund of Sri Lanka in December 2010. Under the survey and research project, students conducted a non-intrusive survey on an ancient shipwreck, located at a depth of 31 metre in Godawaya, southern Sri Lanka. The shipwreck dates back to the first century, making it one of the oldest shipwrecks found in Asia. UNESCO sponsored the participation of one Malaysian and one Filipino, while the Dutch Government sponsored the participation of three Indonesians and one Indian.They joined the maritime archaeologists of the Maritime Archaeology Unit of Sri Lanka. All participants including the team from the Maritime Archaeology Unit of Sri Lanka are graduates of the Foundation Course.

The project also supported the participation of five graduates of Foundation Courses during the Inaugural Asia-Pacific Regional Conference on Underwater Cultural Heritage, held in Manila, Philippines from 8-11 November 2011. Their participation enabled them to present academic papers regarding their maritime activities and exchange information and best practices with other international experts and practitioners. Supported by other sponsors, twelve other graduates of the Centre participated and presented papers. The seventeen graduates of the UNESCO training courses made a showing during the conference which attracted more than one hundred experts and site managers from all over the world. The proceedings of the conference have been published. (See: www.themua.org).

Being the first training courses on underwater cultural heritage that are regional in scope, the project has achieved high visibility not only within the Asia-Pacific Region, but beyond. As a result of the regional capacity-building programme, participating Member States have started to strengthen their existing underwater archaeology units or establish new units. Five graduates of the Foundation Courses have established the Underwater Archaeology Unit in Cambodia. Five beneficiaries from the National Museum of the Philippines have initiated collaborative projects with other government and academic institutions for a shipwreck management programme in the Philippines. Amjad Ali of Pakistan (Second Foundation Course) has submitted project documents on underwater archaeology to funding agencies. Using knowledge and skills learnt during the Third Foundation Course, Caesar Bita of Kenya supervised an underwater cultural heritage impact assessment on an underwater fibre optic cable laying project and dredging of a harbor. Eko Triarso of Indonesia (Third Foundation Course) has mobilized a team to prepare a management and conservation plan for underwater archaeological resources in the Natuwa Waters in northern Indonesia. Chandraratne Wijamunige (Second Foundation Course) initiated the Project Experience Exchange Asia in Sri Lanka in December 2010, participated by graduates of earlier Foundation Courses from four countries. Beneficiaries working for the Malaysian Department of Heritage have launched an awareness campaign among divers and coastal communities. Nia Ridwan of Indonesia (Second Foundation Course) has conducted a survey of potential underwater archaeological resources to support the establishment of a Maritime Conservation Area in Bangka Belitung Waters, and a survey of a ship wrecked by a tsunami in Mentawai Waters. Other beneficiaries of the regional programme have sent their feedback on how they have improved their strategies in the protection and management of their underwater cultural heritage.

After the Norwegian funded project expires at the end of March 2012, the Fine Arts Department of Thailand has expressed its commitment to sustain the Centre over the long term and to nominate the Centre to be placed under the auspices of UNESCO as a Category II Centre in the near future. To realize these objectives, the Department shall explore long-term collaboration with the Association of Southeast Asian Nations (ASEAN), the Regional Centre for Archaeology and Fine Arts (SPAFA) of the Southeast Asian Ministers of Education Organization (SEAMEO), Silpakorn University (Thailand) and other institutions worldwide to assist in future activities of the Centre. The Department plans to organize an annual Advanced Course on specialized topics and new maritime archaeology technologies and a Foundation Course every two years. To take advantage of the relatively low cost of organizing training programmes in Thailand, national and sub-regional training initiatives are welcome to arrange with UAD of Thailand for the use of the Centre's facilities and to avail of the technical support of the experienced team of UAD.

Considering the multi-disciplinary nature of maritime archaeology and given the limited knowledge and skills acquired by students during a six week Foundation Course, participating Member States are encouraged to support their expert's continuing education and training in established universities offering maritime archaeology courses, and to enable them to participate in joint underwater research and survey activities in other countries. Relevant national agencies are therefore encouraged to seek bilateral cooperation with countries with expertise in maritime archaeology and financial resources to sponsor the training of their experts.

Summary

This manual includes all topics taught by trainers during the first three Foundation Courses organized by UNESCO Bangkok Office, in partnership with the Underwater Archaeology Division of the Fine Arts Department of Thailand, ICOMOS-ICUCH, other institutions and international experts. The curriculum of the Foundation Course has evolved since 2008 when the representatives of ICOMOS-ICUCH and the Nautical Archaeology Society (NAS) to the Project Steering Committee initiated its development. This manual illustrates the quality of the training under the project supported by the donor Government of Norway. By using this manual, other training providers will benefit from the experience gained during the duration of the project. It is anticipated that this manual will continue to evolve as future expert trainers contribute their own experience and expertise in succeeding Foundation Courses.

Suggested Reading: Full List

Gaur, A.S., Muthucumaran, R., Chandraratne, W.M., Orillandeda, B.C., Manders, M., Karunarathna, S., Weerasinghe, P., Dayananda, A.M.A., Zainab, T., Sudaryadi, A. Ghani, K.A.B.A., Wahjudin, J. and Samaraweera, N. 2011. Preliminary Assessment of an Early Historic (2000 years old) Shipwreck in Godawaya, Sri Lanka, *Bulletin of the Australasian Institute for Maritime Archaeology.* No. 35, pp. 9-17.

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United Nations
Educational, Scientific and
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The Protection of the
Underwater Cultural Heritage

UNIT 1

Author Ricardo L. Favis

The 2001 Convention on the Protection of the Underwater Cultural Heritage

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UNIT 1

Contents

UNIT 1

Author Ricardo L. Favis

The 2001 Convention on the Protection of the Underwater Cultural Heritage

Core Knowledge of the Unit

This unit provides students with an overview of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) and the Rules of its Annex concerning activities directed at underwater cultural heritage.

On completion of the unit students will:

- *Have a basic understanding of the 2001 Convention and the Rules of its Annex. The succeeding units and associated training activities, structured to illustrate the practical application of the Convention and the Rules of Annex, will provide students with a more in-depth knowledge of the 2001 Convention by the time they complete the Foundation Course.*

Introduction to the Unit

This Foundation Course was conceptualized and implemented primarily to promote the 2001 Convention on the Protection of the Underwater Cultural Heritage and apply the Rules of its Annex in the practice of maritime archaeology in the Asia-Pacific region. Therefore, students should have a thorough understanding of the 2001 Convention before they start learning about the different disciplines of and appropriate procedures in dealing with underwater cultural heritage.

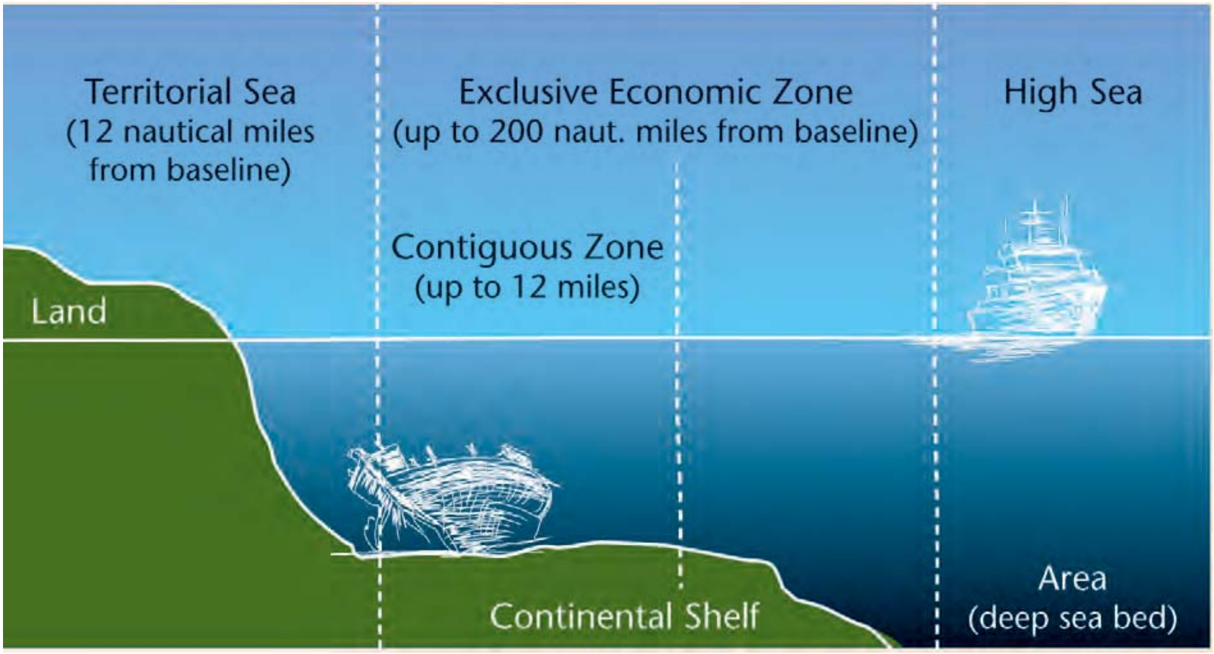
1 Convention on the Protection of the Underwater Cultural Heritage (Paris 2001)

The Convention was the result of four years of intense negotiations which started in 1998 and involved a wide range of stakeholders, including government representatives, archaeologists, lawyers and non-governmental organizations (NGOs). It was adopted by the UNESCO General Conference in 2001 and came into force on 2 January 2009.

Deliberation on the Convention among delegates from UNESCO Member States during the General Conference in 2001 at UNESCO Headquarters in Paris, France. © UNESCO

The 2001 Convention is the key international treaty that sets a common framework and standard for the protection of underwater cultural heritage against looting and destruction. The Convention begins by providing a shared understanding of what constitutes the underwater cultural heritage. It sets out basic principles for the protection of underwater cultural heritage and attempts to harmonize the protection of underwater archaeological sites with that of heritage on land. It proposes a State Cooperation System which provides a clear framework for cooperation among other States ensuring the protection of underwater cultural heritage wherever they are located. Finally, the Annex of the Convention provides practical rules for the treatment and research of underwater cultural heritage.

Maritime zones according to the 1982 United Nations Convention on the Laws of the Seas (UNCLOS). Under UNCLOS, a State usually has exclusive jurisdiction only within its territorial waters, limited jurisdiction over the exclusive economic zone and continental shelf, and jurisdiction only over its own vessels and nationals at high sea. Since the extension of jurisdiction of States at sea was not an option, the 2001 Convention chose to facilitate cooperation among States as the only way to resolve this situation. By joining the 2001 Convention, States agree to prohibit their nationals and vessels from looting underwater cultural heritage, regardless of its location. The Convention also provides specific regulations for the reporting and the coordination of activities, depending on the location of an underwater cultural heritage site. © UNESCO/C. Lund



To ensure the protection of underwater cultural heritage, the 2001 Convention has four main principles:

1. *States Parties have an obligation to preserve underwater cultural heritage*
2. In situ *preservation of underwater cultural heritage shall be considered as the first option*
3. *Underwater cultural heritage shall not be commercially exploited*
4. *States Parties should promote training and information sharing*

The Convention prohibits commercial exploitation for both trade and speculation; it also dissuades against the irretrievable dispersal of finds. Furthermore, the Convention requires States Parties to take measures against the illicit trafficking of cultural objects. In particular, they should prevent the entry into their territory, the dealing in, or the possession of underwater cultural heritage that was illicitly exported and/or recovered. States Parties are required to seize such property if it is found in their territories. The rationale is that if treasure hunters have difficulty in selling looted objects, the financial motivation for conducting illegal excavations will eventually decrease.

Approximately 10,000 pieces of ceramics illegally retrieved from the Klang Ao shipwreck site were seized from the ship of a treasure hunter in the Gulf of Thailand in 1982. The artefacts are now stored at the National Maritime Museum in Chanthaburi, Thailand.
© UNESCO/Montakarn Suvanatap

The 2001 Convention helps to strengthen the international framework that UNESCO has been supporting in the fight against the illicit trafficking of cultural property. As an instrument dealing specifically with underwater cultural heritage, it bridges the gap in international law and reinforces the provisions of three other important Conventions, namely:

- *The 1954 Convention for the Protection of Cultural Property in the Event of Armed Conflict (Hague), also known as the Hague Convention*
- *The 1970 Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Cultural Property (Paris)*
- *The 1995 UNIDROIT Convention on Stolen or Illegally Exported Objects (Paris)*

Finally, the Convention promotes information sharing, training in underwater archaeology and technology transfer, with a view to raising public awareness concerning the significance of underwater cultural heritage. States Parties are encouraged to cooperate and assist each other in the protection and management of such heritage, including collaborating in its investigation, conservation, study and presentation.

Member States can join the Convention through ratification. By ratifying the Convention, a State Party makes absolutely clear its determination to protect underwater cultural heritage, in cooperation with other States Parties. There are forty-one States Parties to the 2001 Convention as of January 2012, with only two (Cambodia and Iran) from the Asia-Pacific region.

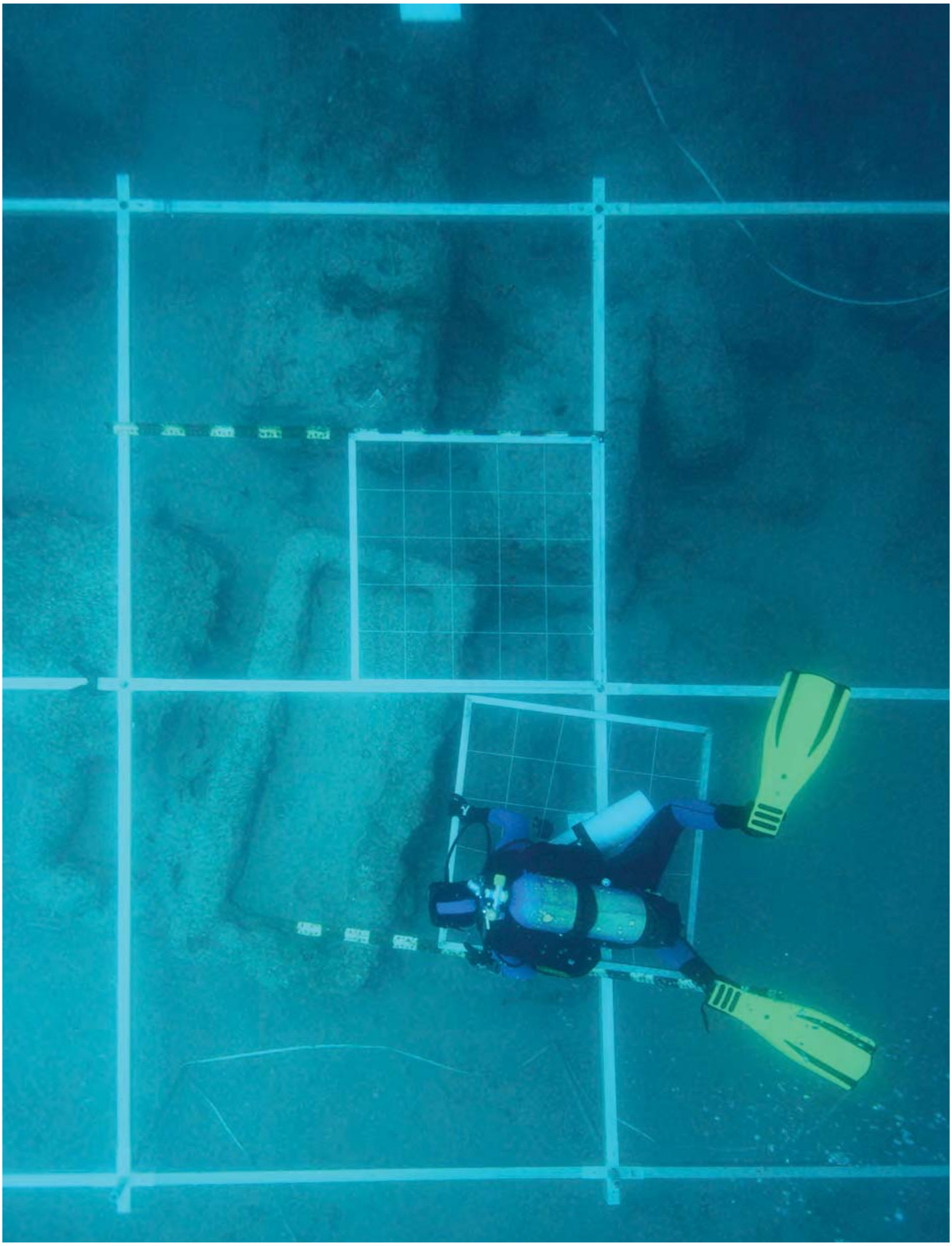
2 Annex to the 2001 Convention: The Rules Concerning Activities Directed at Underwater Cultural Heritage

In 1994, ICOMOS-ICUCH (the International Committee on Underwater Cultural Heritage), in consultation with other specialists started working on a document specifying standards by which activities directed at underwater cultural heritage would be measured. The resulting Charter was adopted by the General Assembly of ICOMOS at Sofia, Bulgaria in 1996. With few modifications resulting from the intense multilateral negotiations on the 2001 Convention, the ICOMOS Charter was incorporated as an Annex to the Convention. Considered by many as the heart and soul of the Convention, the Annex was unanimously adopted by all Member States, even by those countries which have no intention of ratifying the Convention.

The Annex to the Convention represents its archaeological substance and provides the key to the proper management of the archaeological resource. It provides practical rules for the treatment and research of underwater cultural heritage. The Annex aims not only to protect the underwater cultural heritage, but also to preserve all information contained therein. The main overriding principle of the Annex and of the 2001 Convention itself, is the protection of underwater cultural heritage through *in situ* preservation as the first option. If this is not possible, then proper archaeological research should be executed to preserve information *ex situ*. The Annex dissuades commercial exploitation of underwater cultural heritage and its irretrievable dispersal. It aims to minimize site disturbance and encourage non-intrusive and responsible public access. The Annex also encourages international cooperation to promote information sharing among relevant professionals.

The Annex contains thirty-six Rules on:

- *How a project should be designed*
- *Competence and qualifications required for persons undertaking interventions*
- *Planning and funding a project*
- *Documentation of a site and dissemination of information*
- *Methodologies on conservation and site management*



Research and documentation of a Roman period shipwreck with sarcophagi near Sutivan on the island of Brač in Croatia in 2009. © Department of Underwater Archaeology of Croatia

Unit Summary

The major achievements of the 2001 Convention are twofold. Firstly, the 2001 Convention has dramatically improved the protection of underwater cultural heritage by providing a framework for international cooperation among States Parties. This framework encourages the protection of underwater archaeological sites wherever they are located in the open seas. Secondly, the Rules of its Annex provide globally-accepted professional standards for activities directed at any underwater archaeological site.

Underwater cultural heritage is considered a significant part of humanity's shared heritage; therefore, it is essential to build the capacities of Member States so that they can appropriately implement the 2001 Convention and the Rules of its Annex. The knowledge gained from this training manual does not make one an expert on maritime archaeology, but it does create an awareness of other disciplines that need to be learnt if we are to sustainably manage and better protect our rich underwater cultural heritage over the long term.

Suggested Timetable

90 mins	Introduction to the Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) - *Threats to underwater cultural heritage* - *The making of the 2001 Convention* - *Overview of the 2001 Convention* - *Main principles* - *State Cooperation System* - *Advantages of ratifying the 2001 Convention* - *Rights and responsibilities of States Parties to the Convention*
	Break
120 mins	The Rules of the Annex to the Convention - *Rationale of each rule* - *Practical application(s)/actual cases of how each Rule is applied* - *Lessons learnt from past interventions/experience in the field*
	Break
60 mins	Wrap Up Session - *Summary of highlights of the presentations/discussions* - *Questions and answers*
15 mins	Concluding Remarks and Closure

Teaching Suggestions

It is recommended that trainers introduce students to the 2001 UNESCO Convention through a half-day lecture and discussions. Preferably, this introductory unit should be scheduled in the afternoon of the first day of the training course, following the opening ceremony and informal welcome activities.

Students are expected to have read about the Convention and its Annex from the online sources prior to the start of the Foundation Course. As the time allotted for the lecture is brief, it is suggested that during their powerpoint presentation, the trainer asks simple questions about the next slide before opening and explaining the contents of that slide. This would enable the trainer to gauge how much information about the Convention was absorbed by each student prior to the start of the course, their level of comprehension and general communication skills.

During the presentation and discussions on the Rules of the Annex, the trainer is encouraged to cite actual cases of activities directed at underwater cultural heritage to illustrate and explain each rule.

Due to the varying levels of English comprehension among students, it is useful for the trainer to include more explanatory text than is usual on the PowerPoint slides to facilitate better comprehension among the students.

UNESCO and its pool of international experts have previously generated information and illustrations on how the 2001 Convention and its Annex can be practically applied. Given this, there is no need to replicate available sources of information for this training course manual. Instead, it is recommended that trainers should refer students to online sources of information.

The 2001 Convention sets the tone of the entire training course and provides the rationale for the preferred procedures for the treatment of underwater cultural heritage. As such, students upon notification of their acceptance to take part in the Foundation Course are required to learn as much as possible about the 2001 Convention by studying the following:

- *Information brochure on the 2001 Convention: http://www.unesco.org/culture/underwater/infokit_en/ (Accessed March 2012).*
- *Official text of the 2001 Convention and the Rules of its Annex concerning Activities Directed at Underwater Cultural Heritage: http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/2001-convention/official-text/ (Accessed March 2012).*
- *The main principles of the 2001 Convention, particularly the legal issues and the framework for international cooperation in the protection of underwater cultural heritage, are very well articulated in the:*
- *Frequently Asked Questions (FAQs): http://www.unesco.org/culture/underwater/faq-en/ (Accessed March 2012).*

In each of the training units, trainers will make references to specific articles of the Convention or Rules of the Annex to justify or provide the rationale for what is being taught. Given this, students are required to download a hard copy of the text of the 2001 Convention and its Annex from the website and keep it with their training manual for constant reference throughout the Foundation Course.

Eighteen international experts on maritime archaeology collaborated in the preparation of the UNESCO Manual for Activities Directed at Underwater Cultural Heritage. The Manual is specially designed to help specialists and site managers understand the Rules contained in the Annex to the 2001 Convention and to facilitate their practical application. The Manual not only articulates the rationale behind each Rule, but also provides practical guidelines on how each Rule can be applied. As such, this Manual should be constantly consulted by students for guidance, not only during the Foundation Course, but also in the planning and implementation of activities directed at underwater cultural heritage.

UNESCO Manual for Activities Directed at Underwater Cultural Heritage (2011) is made accessible to the general public on the website at: www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/unesco-manual-for-activities-directed-at-underwater-cultural-heritage/unesco-manual (Accessed July 2012).

Suggested Reading: Full List

ICOMOS. 1996. *Charter on the Protection and Management of Underwater Cultural Heritage.* Sofia. http://www.international.icomos.org/charters/underwater_e.pdf (Accessed March 2012).

O'Keefe, P.J. 2002. *Shipwrecked Heritage: A Commentary on the UNESCO Convention on Underwater Cultural Heritage.* Leicester, Institute of Arts and Law.

Prott, L.V. (ed.). 2006. *Finishing the Interrupted Voyage: Papers of the UNESCO Asia-Pacific Workshop on the 2001 Convention on the Protection of the Underwater Cultural Heritage.* Leicester,UNESCO/Institute of Arts and Law.

UNESCO. 1995. *The 1954 Convention for the Protection of Cultural Property in the Event of Armed Conflict.* UNESCO Paris. http://www.unesco.org/new/en/culture/themes/movable-heritage-and-museums/armed-conflict-and-heritage (Accessed March 2012).

UNESCO. 1995. *The 1970 Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Cultural Property.*Paris, UNESCO. http://www.unesco.org/new/en/culture/themes/movable-heritage-and-museums/illicit-traffic-of-cultural-property/1970-convention (Accessed March 2012).

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UNESCO. 2011. *UNESCO Manual for Activities Directed at Underwater Cultural Heritage.* UNESCO Paris. http://www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/unesco-manual-for-activities-directed-at-underwater-cultural-heritage/unesco-manual (Accessed March 2012).

United Nations
Educational, Scientific and
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The Protection of the
Underwater Cultural Heritage

UNIT 2

Author Christopher J. Underwood

Back to Basics

Introduction to the Principles and Practice of Foreshore and Underwater Archaeology

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Cover photo: Students conducting a 3-dimensional survey practical exercise. © Martijn R. Manders

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UNIT 2

Contents

UNIT 2

Author Christopher J. Underwood

Back to Basics

Introduction to the Principles and Practice of Foreshore and Underwater Archaeology

Core Knowledge of the Unit

This unit introduces students to the basics of foreshore and underwater archaeology. During the initial training sessions in Thailand, the first two units of the Nautical Archaeology Society's (NAS) Training Programme were used as the first week of the foundation course. Although selected parts of the NAS Training programme form the components of the Back to Basics unit, they need not necessarily be considered as the only option (see *Additional Information 1*).

Upon completion of the Back to Basics unit, students will have an understanding of:

- *Scope of cultural heritage sites found underwater or on the foreshore*
- *Terms nautical, maritime and underwater archaeology*
- *Techniques used to date cultural heritage material*
- *Techniques that are used to survey underwater and foreshore cultural heritage sites*
- *Structure and components of a project design*
- *Factors that are considered in the planning of the safety and logistics of underwater and foreshore archaeological field work*
- *Techniques that are used for searching underwater sites*
- *Remote-sensing equipment that is used to carry out searches for underwater sites*
- *Techniques for fixing the geographic position of sites*

Introduction to the Unit

Due to the varying professional backgrounds and experience levels of students, this unit is used to provide a fundamental base of knowledge on a broad range of topics specifically relating to underwater cultural heritage and archaeology on the foreshore and underwater.

Having established a firm base of understanding, students will continue to acquire more detailed knowledge contained in later units of the foundation course. Students also get the opportunity to gain further practical field experience in surveying and recording skills (see Unit 12: *Practical Dive Session of the Foundation Course: The Mannok Shipwreck Site, Gulf of Thailand*).

ADDITIONAL INFORMATION

1 For more information about NAS and its Training Programme visit: http://www.nauticalarchaeologysociety.org/training/index.php

1 Introduction to the Principles and Practice of Foreshore and Underwater Archaeology

The following section outlines the topics covered during the NAS Introduction course.

1.1 The Scope of Foreshore and Underwater Archaeology

- Comparison between underwater archaeology and archaeology on land
- Definitions relating to the study of underwater archaeology
- Type of evidence found on underwater and coastal sites
- Potential of archaeological research on underwater sites
- Characteristics of underwater cultural heritage sites
- Identification of the various threats to the preservation and protection of underwater cultural heritage sites

Suggested Reading

Adams, J. 2002. Maritime Archaeology. *Encyclopedia of Historical Archaeology.* C. Orser (ed.). Oxford.

Bass, G. F. 1990. After the Diving is Over. *Underwater Archaeology: Proceedings of the Society of Historical Archaeology Conference.* Carrell, T.L. (ed.). Tucson, Arizona.

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 2-10.

Delgado, J. P. (ed.). 2001. *Encyclopedia of Underwater and Maritime Archaeology,* New Edition. London.

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Green, J. (ed.). 2004. *Maritime Archaeology: a Technical Handbook.* London.

McGrail, S. (ed.). 1984. *Aspects of Maritime Archaeology and Ethnology.* London.

Muckelroy, K. 1978. *Maritime Archaeology.* Cambridge University Press.

Renfrew, C. and Bahn P. 2004. Archaeology: the Key Concepts, Fourth Edition. Oxford.

Throckmorton, P. 1990. The World's Worst Investment, the Economics of Treasure Hunting with Real Life Comparisons. Carrell, T. L. (ed.). *Underwater Archaeology: Proceedings of the Society of Historical Archaeology Conference 1990.* Tucson, Arizona.

1.2 Underwater and on the Foreshore Site Types

- Watercraft
- Aircraft
- Ports and anchorages
- Coastal defences
- Dwellings
- Submerged landscapes
- Fish traps
- Sites in lakes, rivers and canals (including bridges)
- Caves and wells
- Individual finds (although not usually considered sites)

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 17-22.

Delgado, J. P. (ed.). 2001. *Encyclopedia of Underwater and Maritime Archaeology,* New Edition. London.

Muckleroy, K. 1978. Maritime Archaeology. Cambridge.

1.3 Dating Archaeological Material

- Stratigraphy
- Typology
- Radiocarbon
- Dendrochronology
- Historical association
- Thermoluminescence
- Palaeomagnetism
- Optical stimulated dating

Suggested Reading

Aitken, M. J. 1998. *An Introduction to Optical Dating*. Oxford, Oxford University Press.

Ashmore, P. 1999. Radiocarbon Dating: Avoiding Errors by Avoiding Mixed Samples. *Antiquity Journal,* Vol. 73, pp. 124–30.

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English Heritage. 2006. *Archaeomagnetic Dating: Guidelines on Producing and Interpreting Archaeomagnetic Dates*. English Heritage. http://www.english-heritage.org.uk/publications/archaeomagnetic-dating-guidelines (Accessed November 2011).

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English Heritage. 2008. *Luminescence Dating: Guidelines on Using Luminescence Dating in Archaeology*. English Heritage. http://www.english-heritage.org.uk/content/publications/docs/luminescencedating.pdf (Accessed November 2011).

Harris, E. C. 1989. Principles of Archaeology and Stratigraphy, Second Edition. London.

1.4 Introduction to 2-Dimensional Survey Techniques

- Radial
- Offsets
- Ties
- Drawing grid (planning frame)

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 114-127.

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Holt, P. 2003. An Assessment of Quality in Underwater Archaeology Surveys Using Tape Measurements. *International Journal of Nautical Archaeology*, Vol. 32.2, pp. 246-31. http://www.3hconsulting.com/publications.html (Accessed November 2011).

1.5 Practical Training Sessions

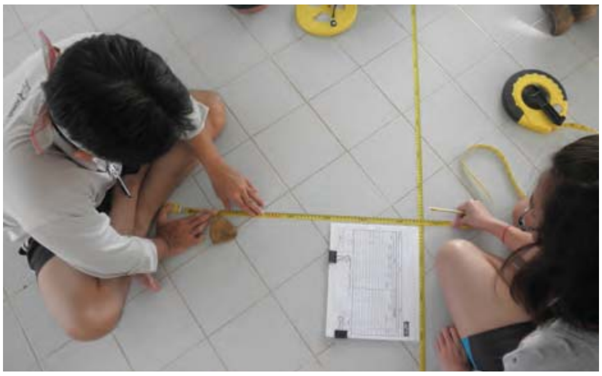
As the emphasis of the NAS Introduction Course is on the development of student's field skills, the introductory unit features both 'dry' (in the classroom) and 'wet' (in the swimming pool) practical training sessions.

1.5.1 Dry Practical Session

The aim of the dry practical session is to provide students with the opportunity of practising survey techniques without the complications of diving. Students will learn how to use a number of 2-dimensional site survey techniques including:

- Offsets
- Ties
- Drawing grid (planning frame)

A view of the general layout of the 'dry' 2-dimensional survey practical session at the centre in Chanthaburi. There are two baselines with one pair of surveyors working on each side. © Christopher J. Underwood



The surveyors are using the survey board to check the 90° offset during the 'dry' practical session. © Christopher J. Underwood

Recording a tie (trilateration using a baseline) during the 'dry' 2-dimensional survey practical session. A measurement is taken from a known point on the artefact to a convenient point on the baseline. A second tie is required to position the point on the artefact. © Christopher J. Underwood

BELOW: Participants being given a safety briefing before the underwater 2-dimensional survey practical session.
© Christopher J. Underwood

1.5.2 Swimming Pool Practical Session

Once students have gained a firm understanding of 2-dimensional (2-D) site survey techniques, they then test their knowledge underwater. Here, they practice in a swimming pool each of the techniques learned in the classroom including:

- Offsets
- Ties
- Drawing grid (planning frame)

1.5.3 Transferring the Results of the Dry 2-D Survey Practical Session to Paper

- Offsets
- Ties

1.5.4 Transferring the Results of the Swimming Pool 2-D Survey Practical Session to Paper

- Offsets
- Ties

1.6 Project Designs

This section provides students with an introduction to project design and understanding of:

- The types of archaeological projects that are undertaken
- The sources of information that can help in the formation of a project plan
- The phases of an archaeological project
- The importance of clear aims and objectives for a project
- Aspects that are included in a project plan with reference to Rule 10 of the Annex to the UNESCO Convention on the Protection of Underwater Cultural Heritage (Paris 2001)

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 34-37.

Elkin, D. et al. 2007. Archaeological Research on HMS *Swift*: a British Sloop-of-War Lost Off Patagonia, Southern Argentina, in 1770. *International Journal of Nautical Archaeology,* Vol. 36, pp. 32-58.

English Heritage. 2006. *Management of Research Projects in the Historic Environment: The MoRPHE Project Managers' Guide.*

English Heritage. 2005. *Management of Research Projects in the Historic Environment (MAP II).*

1.7 Area Search, Survey and Position Fixing

This section provides students with an understanding of topics related to area search, survey and position fixing.

1.7.1 Diver Search Techniques

- Jackstay
- Corridor
- Circular
- Snag-line
- Towed diver
- Diver propulsion vehicle
- Metal detectors

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 96-102.

1.7.2 Remote Sensing Search Equipment

- Magnetometer
- Side Scan sonar
- Sub-bottom sonar
- Multi beam sonar
- Single beam sonar
- Sector-scanning sonar
- Remotely operated vehicles (ROVs)

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 103-113.

Dean, M. 2006. Echoes of the Past: Geophysical Surveys in Scottish Waters and Beyond. *Going Over Old Ground – Perspectives on Archaeological Geophysical and Geochemical Survey in Scotland*. Oxford, BAR British Series 41, pp. 80-87

Fish, J. P. and Carr, H. A. 1990. *Sound Underwater Images: A Guide to the Generation and Interpretation of Side Scan Sonar Data*. Boston, MA.

Judd, P. and Brown, S. 2006. *Getting to Grips with GPS: Mastering the Skills of GPS Navigation and Digital Mapping*. Leicester.

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Papathedra, G., Geraga, M. and Ferentinos, G. 2005. The Navarino Naval Battle Site, Greece: an Integrated Remote-sensing Survey and a Rational Management Approach. *International Journal of Nautical Archaeology,* 34, pp. 95–109.

Quinn, R., Breen, C., Forsythe, W., Barton, K., Rooney, S. and O'Hara, D. 2002a. Integrated Geophysical Surveys of the French Frigate *La Surveillante* (1797) Bantry Bay, County Cork, Ireland. *Journal of Archaeological Science,* No.29, pp. 413-22.

Quinn, R., Breen, C., Forsythe, W., Barton, K., Rooney, S. and O'Hara, D. 2002b. Comparison of the Maritime Sites and Monuments Record with Side Scan Sonar and Diver Surveys: a Case Study from Rathlin Island, Ireland. *Geoarchaeology,* 17.5, pp. 441-51.

Quinn, R., Dean, M., Lawrence, M., Liscoe, S. and Boland, D. 2005. Backscatter Responses and Resolutions Considerations in Archaeological Side-scan Sonar Surveys: a Controlled Experiment. *International Journal of Science*, Vol. 32, pp. 1252-64.

1.7.3 Position Fixing Techniques

- Global Positioning System (GPS)
- Differential Global Positioning System (DGPS)
- Total station
- Bearings
- Transits

Suggested Reading

Ackroyd, N. and Lorimer. R. 1990. *Global Navigation: A GPS User's Guide.* London.

Betts, F. 1984. *Surveying for Archaeologists*. Durham.

Bowens, A. (ed.). 2009. Underwater Archaeology: *The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 83-95.

Boyce, J. L., Reinhardt, E. G., Raban, A. and Pozza, M. R., 2004. Marine Magnetic Survey of a Submerged Roman Harbour, Caesaria Maritima, Israel. *International Journal of Nautical Archaeology,* Vol 33, pp. 122-36.

English Heritage. 2003. *Where on Earth Are We?* English Heritage. http://amaxus.english-heritage.org.uk/upload/pdf/where_on_earth_are_we.pdf (Accessed November 2011).

1.8 Project Logistics and Safety

- The importance of safety and risk analysis on all archaeological sites
- The different roles that need to be filled on an archaeological project and why each is important
- The need to develop a recording system before starting work on a site
- Pre-prepared forms and how they can be used

Suggested Reading

Bowens, A. (ed.). 2009. Underwater Archaeology: *The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 38-44.

Underwood, J. C. 2011. Excavation Planning and Logistics (HMS *Swift* 1770). *Oxford Handbook for Maritime Archaeology.* USA, Oxford University Press.

1.9 Training Review

To complete the Back to Basics unit, a review of the main topics and themes that have been covered during the syllabus is presented.

Unit Summary

Although some of the foundation course participants have previous underwater archaeological experience and therefore are familiar with the information presented in this unit, others are either not familiar with it or still lack confidence. Those with limited prior knowledge are most likely to find that these modules provide a useful and thorough introduction to the theme of underwater archaeology. This unit also serves as a useful refresher of the fundamental principles and techniques applied in underwater archaeology, even for those with previous experience.

Suggested Timetable

Introduction to the Principles and Practice of Foreshore and Underwater Archaeology: Theory Sessions (Part 1)

90 mins	Scope of Underwater and Foreshore Archaeology
	Break
90 mins	Site Types and Dating Archaeological Material
	Break
90 mins	Introduction to 2-Dimensional Survey Techniques

Introduction to the Principles and Practice of Foreshore and Underwater Archaeology: Practical Sessions

60 mins	2-Dimensional Survey Practical (Dry)
	Break
60 mins	2-Dimensional Survey Practical (Dry)
	Break
240 mins	2-Dimensional Survey Practical (Wet) and Debrief (including the travel time to the pool)

Introduction to the Principles and Practice of Foreshore and Underwater Archaeology: Theory Sessions (Part 2)

90 mins	Project Designs
	Break
90 mins	Area Search, Survey and Positioning Fixing
	Break
90 mins	Project Safety and Logistics
30 mins	Concluding Remarks and Closure

Teaching Suggestions

2-Dimensional Site Survey Techniques

Student Objectives

- *Plan a survey*
- *Agree on a system of hand signals for communication*
- *Survey a minimum of four artefacts on one side only of the baseline using two survey techniques (e.g. offsets and ties)*
- *Use a drawing grid (planning frame) to record a cluster of objects. If there is time this exercise can also be practiced. The grid can either be used as part of the baseline exercise or set up independently*

How to Organise the Practical Sessions

For both the dry and wet practical sessions an artificial site is created using baselines, control points and artefacts. The number of tape measures and artefacts is dependent on the number of students. For example, if students work in pairs (one pair on each side of a baseline) a typical course of sixteen students will require four tape measures, a number of artefacts and using 4 to 5 metre long baselines.

Equipment Required for Each Baseline (Two Pairs of Surveyors)

- *1 tape measure to create a 4 to 5 metre baseline*
- *A hook or alternative method of attachment at each end of the baseline to create the control points*
- *2 non-slip mats (used in showers or baths) to be placed at either end of the baseline to help prevent the control points from moving and to protect the pool bottom from being damaged by the weights*
- *Divers weights or alternative weights to help maintain the straightness and tension of the baseline*
- *8 artefacts (4 metres each side of the baseline)*
- *4 (or more) objects to be placed under each drawing grid (planning frame)*

If the drawing grids are used it is practical to have two grids that can be shared between the groups. Pairs are required to coordinate with each other so that each pair has some time using a grid during the practical session.

Equipment Required for Each Pair of Participants

- *1 tape measure (10 metres)*
- *1 board for the printed A4 recording forms*
- *Recording forms for the survey tasks and drawing grid exercise*
- *Pencil and eraser*

ADDITIONAL INFORMATION

2 The diving technicians of the Thai Underwater Archaeology Division (UAD) organized and provided the logistical support for the practical sessions, as well as assistance for those students with limited prior diving experience.

Although 10-metre tapes are specified, the realistic maximum will be approximately 7 metres. The same measuring tapes will be used during the diving sessions.

For more information about setting up the pool tasks, see *Additional Information 2*.

Recording Forms

The printed forms required for the swimming pool survey exercise need to be waterproof. This can be achieved by printing them directly on to Mylar (plastic paper used by architects) which should have a minimum thickness of 300 microns. Alternatively, the printed forms can be laminated.

Briefing for the Practical Sessions

During the briefing for the practical sessions, trainers should instruct students to:

- *Work in pairs. Pairing can be the same for the dry and wet session depending on the diving ability of the students*
- *Plan the survey*
- *Draw a simple sketch of the site before starting the measured survey (this is particularly helpful for planning the survey and avoiding errors during the survey)*
- *Decide on a method of hand signals (it is good practice to use hand signals in the dry session before the diving session. Students can be asked not to talk to each other to simulate working underwater)*
- *Survey four objects using two of the selected survey methods. To enable a comparison of the relative positions of objects when they are plotted on paper, it is important that the same points on each of the objects are surveyed using the selected survey methods*
- *Circular objects can be surveyed to their centre point and a measurement of the object's dia-meter will provide the shape*
- *If an object has a length (such as a cannon) both ends of the object (as a minimum) need to be surveyed to fix its position relative to the baseline, resulting in a minimum of four measurements*
- *Sketch the cluster of objects under the drawing grid (planning frame)*

Depending on the availability of diving equipment or the size of the swimming pool it might be necessary to divide the students into two groups.

IT IS CRUCIAL THAT THERE IS AN EXTENSIVE SAFETY BRIEFING BEFORE THE SWIMMING POOL PRACTICAL SESSION.

Transferring the Results of the 2-D Survey Practical Sessions to Paper and Analysis: *What to Use*

Student Objectives

- *Understand how to transfer the survey results to paper to create a site plan*
- *Understand how a scale rule is used*
- *Understand the advantages and disadvantages of each survey method*
- *Understand the reasons for and characteristics of typical errors*
- *Understand the need to plan a survey*
- *Understand the need for an effective method of communicating underwater*

Equipment Required for Each Pair of Students

- *1 x drawing compass (15cm radius)*
- *1 x 90 degree set-square (15cm height/length)*
- *1 x metric scale rule*
- *1 x sheet of A3 paper or equivalent*
- *1 x pencil and eraser*

Briefing for the Task

During the briefing for the practical sessions, trainers should instruct students to:

- *Work in the same pairs as during the practical sessions.*
- *Use the recommended scale of 1:20*
- *Ensure that the length of the baseline should be drawn along one edge of the paper to avoid the transferred scale measurements not fitting on the paper*
- *Ensure that the results of the two selected techniques are transferred onto paper using one baseline resulting in two marks for each point that has been surveyed*

NB. Students may need more instruction on how to use the scale rule.

Analysis of the Results

It is very likely that students find that the two sets of survey points do not overlap. This is normal and illustrates the difficulty in achieving a perfect or right angle for the offset survey and the problems with acute or obtuse angles associated with ties. There will also be genuine errors.

The most common errors are:

- *Recording the wrong measurement*
- *Recording the right measurement but writing the result in the wrong column on the recording form*
- *Forgetting to record the whole number before the decimal point, for example, writing 0.154 instead of 3.154*
- *Placing the decimal point in the wrong position, for example, 1.540 instead of 1.054*
- *Reading numbers on the tape measure upside down: 6's look like 9's and 4's can look like 7's depending on the quality of the tape measure and underwater visibility*
- *Forgetting to take a measurement*

Training Review: *What to Use*

Trainers can compile a list of assessment questions relating to the core knowledge of each of the presentation which can be used as a basis for a question/answer followed by a discussion to clarify misunderstandings.

Suggest Reading: Full List

Adams, J. 2002. Maritime Archaeology. *Encyclopedia of Historical Archaeology*. C. Orser (ed.). Oxford, pp. 328-30.

Ackroyd, N. and Lorimer, R. 1990. *Global Navigation: A GPS User's Guide*. London.

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Bass, G. F. 1990. After the Diving is Over. *Underwater Archaeology: Proceedings of the Society of Historical Archaeology Conference*. Carrell, T.L (ed.). 1990. Tucson, Arizona.

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Cross, P. A. 1981. The Computation of Position at Sea. *Hydrographic Journal*. 20.7.

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Gamble, C. 2006. *Archaeology: the Basics,* New Edition. Oxford.

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The Protection of the
Underwater Cultural Heritage

UNIT 3

Author Martijn R. Manders

Management of Underwater Cultural Heritage

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UNIT 3

Contents

UNIT 3

Author Martijn R. Manders

Management of Underwater Cultural Heritage

Core Knowledge of the Unit

This unit introduces the basic elements of underwater cultural heritage management and provides guidance on how students can learn to facilitate the process.

Upon completion of the Management of Underwater Cultural Heritage unit, students will:

- *Have an understanding of mitigation in maritime and underwater archaeology*
- *Be familiar with different types of management plans*
- *Know how to identify stakeholders*
- *Know how to deal with identified stakeholders*
- *Have some insight on the ethics in the protection of underwater cultural heritage*

Introduction to the Unit

It is imperative that our underwater cultural heritage is carefully managed over time to ensure its protection. Sites provide us with an abundance of information regarding our shared history and the development of civilizations. Therefore, they cannot remain forever under the sea, ignored, forgotten or only observed. Having been assessed for their significance (see Unit 6: *Significance Assessment*), each site requires an appropriate plan of action, such as (limited) excavation, *in situ* preservation or alternatively removed from our archive of significant archaeological sites. The decisions and evaluations that are made, the people involved and their influence on the way underwater cultural heritage is treated, all play an important role in the overall management. This can be done at the local, regional, national and even international level.

1 What is Underwater Cultural Heritage?

In accordance with Article 1 of the UNESCO Convention on the Protection of Underwater Cultural Heritage (Paris 2001), 'underwater cultural heritage' means all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years such as:

(i) sites, structures, buildings, artefacts and human remains, together with their archaeological and natural context;

(ii) vessels, aircraft, other vehicles or any part thereof, their cargo or other contents, together with their archaeological and natural context; and

(iii) objects of prehistoric character.

(b) Pipelines and cables placed on the seabed shall not be considered as underwater cultural heritage.

(c) Installations other than pipelines and cables, placed on the seabed and still in use, shall not be considered as underwater cultural heritage.

For the purpose of the 2001 Convention, 100 years was adopted as the benchmark, though some countries may have their own minimum age of sites that they consider to be the heritage. For example, the Netherlands used to adhere to 50 years as a minimum age while the United Kingdom (UK) does not use a minimum age at all, opting to protect sites based on an assessment on their significance. In 2012, the Netherlands has followed the UK's practice to only assess on significance and to remove the minimum age.

Suggested Reading

Forrest, C. 2002. Defining 'Underwater Cultural Heritage'. *The International Journal of Nautical Archaeology,* Vol. 31. No.1, pp. 3-11.

2 What is Managing Underwater Cultural Heritage?

In simplified terms the management of underwater cultural heritage can be defined as the attempt to balance the protection of underwater archaeological sites with, for example, the availability of funds, human resources, time and also economic development pressures such as fishing. To be able to successfully manage sites several factors have to be taken into account. These can include different heritage resources (known, unknown and future), threats, influences from outside, ethics, site accessibility, documentation, reconciliation of conflicts of interests, the willingness to preserve our heritage, etc. Foremost management is about structuring all of the information available to us, prioritising the needs and importance of each site and making well founded decisions based on all factors.

3 Why Management?

In recent decades underwater cultural heritage has faced growing threats due to its increasing accessibility to the larger public and more extensive exploitation. Added to this, the natural conditions in and around a site can alter due to climate change or natural erosion.

With the beds of open seas, rivers and lakes becoming more accessible with modern diving equipment, the number of stakeholders who may have direct or indirect impacts on the underwater archaeological resource is increasing.

Some important things to consider in the management of underwater cultural heritage are:

- *It is a part of the overall land management which includes natural and cultural land and seascapes.*
- *Other parties may not consider the site significant or worthy of safeguarding.*
- *Underwater cultural heritage needs advocates to fight for its protection.*
- *It is our shared heritage and a part of national identity, a cultural source that we can appreciate and learn from.*
- *Legislation and policy guidelines are being developed, not only for the protection of underwater cultural heritage, but also for associated concerns such as the exploitation of the seabed.*
- *Underwater cultural heritage has to be considered in a broad context that goes beyond individual sites. It is important to remember that sites are not only also intrinsically connected with the environment, but also to each other.*

The preservation of underwater cultural heritage has to be approached in a proactive, rather than reactive way. A mission vision and a clear set of values need to be defined, alongside the development of strategic and financial plans for managing the resource as a whole assemblage, rather than just individual sites. In many countries underwater cultural heritage is still being managed on a day to day basis; if a site is discovered, it must be surveyed to collect relevant information and protective measures should be undertaken to mitigate risk to the site.

Heritage resources on land have been rather efficiently protected. With more and more underwater archaeological sites discovered each year, the need for urgent protection has now been realised for those sites on the seabed. With the increasing threats from on shore and off shore infrastructure development, commercial fishing and exploitation of marine resources, underwater archaeological sites must be protected and managed sustainably, not only for known resources, but also for the unknown and future resources (See Unit 4: *Underwater Archaeological Resources*). If the management of underwater cultural heritage is carefully planned in advance, time, money and human resources can be more effectively utilized.

ABOVE: A news heading reported, 'Treasure under the Sea! Treasure seekers find a ceramic hoard underwater and sell the artefacts at 1,000 Thai Baht (US$30) each.'
© UAD, Thailand

OPPOSITE AND RIGHT:
The management of the underwater cultural heritage considers many factors. It deals with single objects as well as complete sites, in different countries with different protective legislations. It also includes, for example, awareness raising, legislation, research and physical in situ *preservation.*
© UAD, Thailand

4 How is Underwater Cultural Heritage Managed?

4.1 Structuring Processes

Processes within the management of underwater cultural heritage need to be clearly defined. They can not only be done on a site level (such as management plans from MoSS or English Heritage, see *Additional Information*), but also on a regional, national (see Unit 4: *Underwater Archaeological Resources*) and international level (such as MACHU-GIS, see Unit 7: *Data Management in Maritime and Underwater Archaeology*).

4.1.1 Site Level

Underwater cultural heritage sites are usually found through extensive research and active searches by archaeologists or by others for commercial purposes. Individually, each of these sites has to be registered, surveyed, assessed their significance, potentially excavated or protected and monitored. There are various ways of undertaking these processes, but regardless of choice it is most important that it is done in a structured and consistent manner. For this reason detailed management plans on a site level are developed.

There are many existing guidelines on how to facilitate specific elements of the management process. The best known guidelines are provided in the Annex of the UNESCO Convention on the Protection of Underwater Cultural Heritage (Paris 2001), the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996), and for European citizens, The European Convention on the Protection of the Archaeological Heritage (Valletta 1992). Each of these conventions contains a detailed set of rules concerning activities directed at underwater cultural heritage.

ADDITIONAL INFORMATION

For more information on Monitoring, Visualizing and Safeguarding North European Shipwreck Sites (MoSS) see: www.mossproject.eu

English Heritage (EH) is officially known as the Historic Buildings and Monuments Commission for England. English Heritage is the Government's statutory adviser on the historic environment and is a non-departmental public body sponsored by the Department for Culture, Media and Sport. Their principal powers and responsibilities are laid out in the National Heritage Act (1983), which was amended by the National Heritage Act 2002 to include functions relating to underwater archaeology, and created maritime and underwater management function.

Suggested Reading

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- Tilburg, H. 2006. Japanese Midget Sub at Pearl Harbor: Collaborative Maritime Heritage Preservation. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I. (eds.). ICOMOS, p. 67.

4.1.2 Regional Level

An archaeological site *in situ* has a unique relationship with its environment which has to be taken into account when managing it. Managers have to consider a number of pertinent questions: what is the history of the area and can the site be connected to it? Are there more sites lying adjacent? How is the area presently used? Are the identified threats or the stakeholders typical for this region? Are the individuals or institutes on a regional level (e.g. provinces, states or municipalities) responsible for the management of underwater cultural heritage?

4.1.3 National Level

Managing underwater cultural heritage on a national level also presents a set of particular considerations. At this level one must take into account many aspects including the maritime history of a country, people who are involved (the stakeholders), the protective legislation, the responsible institution in the protection of the heritage and the establishment of an active central database.

These central databases contain detailed documentation for each site and are called the 'known resource'. Using the information available from the central database, one can visualize the unknown and future resources The unknown resource, for example, can provide information about what can be expected to be found when an area, such as the sea, river or lake bed is disturbed, while the future resource can help to develop future plans to ensure that over time there will be still be heritage left to protect (see Unit 4: *Underwater Archaeological Resources*).

National databases containing the known resource differ from country to country, which may prove problematic if it is necessary to compare sites from several possible origins (many countries do have underwater cultural heritage, usually shipwrecks, which have a verifiable link to other countries). Keeping these databases up to date in a consistent manner (e.g. by using thesauri) is most essential, although discrepancies can often easily be solved by using standard software and systems that are available on the market or at fellow institutes.

At the national, regional and international levels, the management of underwater cultural heritage can even be structured to a higher level. Databases with information of not only the archaeological resources, but also the geology, the sedimentology, the history etc., can be combined in a Geographic Information System (see Unit 6: *Geographical Information Systems (GIS) in Underwater Archaeology*). The information collected from these combined data sets often provides more than the sum of the individual data sets, thus generating new data and a broader understanding.

It is also possible to think also of structuring underwater cultural heritage on a scientific level by deve-loping national research agendas. These documents describe what is already known and what kind of information is lacking about underwater cultural heritage from certain periods or regions. A national research agenda can help not only to structure research, but also to help prioritize what is really important to preserve and whether to investigate or not. Documents such as these are not static and have to be updated constantly to remain a valuable source of insight. Within infrastructure projects they play an integral role in the chain that starts with the design of a spatial development and finishes with its implementation. Within underwater cultural heritage management it ensures that our knowledge is enhanced and that the care of the heritage continues to be improved.

Suggested Reading

- Bazelmans, J.G.A. 2006. To What End? For What Purpose? The National Archaeological Research Agenda (NOaA) and Quality Management in Dutch Archaeology. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* Vol. 46. Heeringen, R.M. and Lauwerier, R.C.G.M (eds.). Proceedings of the National Service for Archaeological Heritage in the Netherlands, pp. 53-67.
- English Heritage 2005. *English Heritage Research Agenda: An Introduction to English Heritage's Research Themes and Programmes 2005-2010.*

4.1.4 International Level

Managing underwater cultural heritage at the international level can be a complex task. Shipwrecks (that constitute a large component of underwater cultural heritage), are almost by definition relics of international history, having crossed many borders during their voyages for reasons of trade, war, culture and religion. Some management plans that are used on individual site level are used in several countries, making it possible to compare multiple sites.

On a legislative level, some international laws and regulations make it possible to implement the same policy over several countries. Examples are the European Convention on the Protection of the Archaeological Heritage (Valletta 1992), also known as the Treaty of Valletta, and the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001).

Ultimately the extent to which our underwater cultural heritage is managed depends on the sum total of willingness, budget, legislation, knowledge and time. With effort, each of these elements can be improved as long as awareness is created. To successfully raise awareness it is necessary to be able to correctly identify all the possible stakeholders and know how to reach and influence them.

Suggested Reading

Coroneos, C. 2006. The Four Commandments: The Response of Hong Kong SAR to the Impact of Seabed Development on Underwater Cultural Heritage. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I (eds.). ICOMOS, pp. 46-49.

Harrison, R. (ed.). 1994. *Manual of Heritage Management*. Oxford, Butterworth & Heinemann.

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Nutley, D. 2006. Protected Zones and Partnerships: Their Application and Importance to Underwater Cultural Heritage Management. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I (eds.). ICOMOS, pp. 32-35.

Prott, L. V. 2006. Finishing the Interrupted Voyage. *Papers of the UNESCO Asia-Pacific Workshop on the 2001 Convention on the Protection of the Underwater Cultural Heritage*. Bangkok, UNESCO.

4.2 Dare to Select

The fact that some underwater cultural heritage is so rich carries with it both advantages and disadvantages. How can we ensure that the available budgets will be used in the right way? Time and money does not always allow for all that we would ideally set out to achieve. It is therefore imperative that we select and prioritise what can be done and discard what cannot be accomplished. Given this, assessments and management plans can be our most valuable tools.

The process of selecting and prioritizing is subjective, but as the formats that are used to measure the quality and importance of sites make the process transparent, they are much more readily accepted by others.

Although it is common practice to leave archaeological sites underwater unattended, it has proven to be extremely difficult for an archaeologist to openly declare their intention to 'abandon' a shipwreck, leaving it to nature (or by other means) to deteriorate and vanish. The same is true for sites that are being protected by law through, for example, designation.

There are many delicate issues to consider when managing underwater cultural heritage and deciding what is important to preserve. Should we only focus on old sites or begin to take into consideration the more recent ones such as these two fishing vessels? (Fishing vessels left behind on a shore on the Isle of Mull, Scotland). © Martijn R. Manders

Another difficult issue is that of *in situ* preservation versus excavation (see Unit 9: *In Situ Preservation*). There are many national and international regulations such as the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001), which promote the protection of sites *in situ* as being the first option for managers to consider. There is nothing wrong with this approach considering its many advantages. However, the *in situ* preservation is only one part of overall management plan and it may not be possible or desirable in some cases. Archaeological knowledge is derived principally from scientific investigation of the archaeological resource, using a whole range of techniques from non-destructive research to full excavations.

Archaeology is the systematic study of past human life and culture by the recovery and examination of remaining material evidence, such as graves, buildings, tools and pottery. It is important to understand this history to be able to determine what is and is not important, and as source orientation and identification in the present. Therefore, it is necessary to be careful with this source, but not to be too afraid to use it.

Suggested Reading

Bernier, A. 2006. To Dig or Not to Dig? The Example of the Shipwreck of the *Elizabeth and Mary*. *Heritage at Risk Special Edition.* Grenier, R. Nutley, D. and Cochran, I. (eds.). ICOMOS, pp. 64-67.

4.3 Mitigation

Mitigation is another important element of archaeological resource management. Again this is a broad term and is essentially all about avoiding unnecessary risks by implementing a series of simple, proactive interventions taken prior to the impact of a disaster to minimize its effects, and by doing so protect cultural heritage. Hazards, such as earthquakes, cannot be reduced, but the risk from such a hazard can be mitigated, for example, by constructing earthquake resistant buildings or shelves that prevent objects from sliding off (i.e. by reducing their vulnerability). For underwater cultural heritage, mitigation measures can be employed on the excavated or unexcavated resource; undertaken *in situ* (e.g. underwater) or *ex situ* (as a planning measure).

There are many ways to mitigate when managing cultural heritage. Some measures are more effective than others and may have to be built into preservation measures or the design of the development project (See Unit 5: *Desk-based Assessment* and Unit 6: *Significance Assessment*). The implication of such measures can be seen on site or at a higher (e.g. national and international) level.

Structural mitigation methods have a more a permanent character. Some are operational in nature and include the use of work flows, processes and quality norms for people involved in the business, while others are strategic. Legislation, for example, is very important and is often focused on making the archaeological resources resistant against disasters.

Less structural mitigation methods are usually the ones executed on a smaller scale, such as negotiation and implementation on a project and site level. Here choices have to be made about avoidance, the protection of heritage *in situ* or the excavation of a site. It is important to remember that although a method may be sustainable for one site, it may not be applicable for the overall archaeological resource management.

When mitigation is first carried out on archaeological sites, the aim should be to avoid all adverse impacts. If this is not possible, then the next best thing is to minimize these impacts as much as possible and only in the event that this cannot be achieved, should compensation be mitigated for those unavoidable impacts.

Suggested Reading

Maarleveld, T. J. 2000. Mitigation. *Background Materials on the Protection of the Underwater Cultural Heritage,* Vol. 2. Prott, L. V., Edouard, P. and Rochelle, R. H (eds.). UNESCO, pp. 299-305.

5 Ethics

Ethics are the norms and values that both bring and bind a group (community) together, distinguishing the group from others. After a period of time the ethics of a group can be implicit and unspoken, however, this does not mean it does not exist.

As a community grows larger, the norms and values have to be made explicit so that each member can know who belongs to the group and who does not. This process can be initiated and implemented by elder group members on the basis of what has been learned in the past, or it can be a democratic process where the whole group decides on what is good or what is bad.

Communities within the field of underwater cultural heritage work in a similar way. Their ethics, norms and values might look more or less the same but can differ, often as a result of socio-economic factors. When different groups have to work together it is not only important to identify the business side of the deal, but also to spend some time on the ethical similarities and differences. Only when the ethics of both groups remain unviolated can cooperation be possible. This is especially relevant in the field of underwater cultural heritage, given the multiple stakeholders involved. Archaeologists themselves also have to play different roles. An archaeologist working for a commercial archaeological company has different corporate norms and values to keep in mind than the archaeologist working for the government. These corporate or government ethics can even differ from that of the archaeologist's own personal ethics, in which case it is not appropriate to force them to take on that particular job.

A general ethical code for underwater archaeologists is included in the Annex of the 2001 UNESCO Convention. All countries which participated during the negotiation of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) agreed upon a code of good practice which

LEFT: Windmill farms built at sea may disturb large areas of the seabed. (Wind farms in the North Sea, Netherlands). © Martijn R. Manders

BELOW: Looting does not only have a negative impact on sites, but also sends out misleading messages that cultural heritage does not belong to all of us and can be sold to the highest bidder. (Earthen jars confiscated from looters in Thailand). © UAD, Thailand

had been adapted from the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia, 1996). Although it has been accepted as a code of good practice by many countries, professional underwater archaeologists' organizations should also adopt the Annex as part of their ethical code.

Suggested Reading

Coroneos, C. 2006. The Ethics and Values of Maritime Archaeology, Maritime Archaeology: Australian Approaches. *The Springer Series in Underwater Archaeology.* Staniforth, M and Nash, M (eds.), pp. 111-122.

Elia, R. J. 1999. The Ethics of Collaboration: Archaeologists and the Whydah Project. Background *Materials on the Protection of the Underwater Cultural Heritage*. Prott, L. V. and Ieng, S (eds.). UNESCO/Nautical Archaeology Society, pp. 107-119.

ICOMOS. 1996. *ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage.* Sofia.

Ransley, J. 2007. Rigorous Reasoning, Reflexive Research and the Space for 'Alternative Archaeologies'. Questions for Maritime Archaeological Heritage Management. *International Journal of Nautical Archaeology,* Vol. 36. No. 2, pp. 221-237.

UNESCO. 2001. *Annex of the UNESCO Convention on the Protection of Underwater Cultural Heritage.* Paris.

TOP: Transporters, ship owners, captains and crews are often stakeholders in the management of underwater cultural heritage. © Martijn R Manders

MIDDLE: Yacht owners or those sailing for pleasure are also potential stakeholders. © Martijn R. Manders

ABOVE LEFT: There are several stakeholders involved with the protection and management of underwater cultural heritage. Local fishermen are knowledgeable about their area and can |also tell us where to find shipwrecks. (Chanthaburi, Thailand). © Martijn R. Manders

ABOVE RIGHT: The crew from a large fishing vessel in Rayong, Gulf of Thailand. © Martijn R. Manders

Recreational divers visit underwater sites out of curiosity, interest and enjoyment. © Martijn R. Manders

6 Stakeholders

As there are many individuals and organisations involved both directly and indirectly in the management of underwater cultural heritage, one of the most successful methods to safeguard sites is to make sure that stakeholders (or at least the most important ones) are heard and that they are encouraged to become active partners. Ultimately if only archaeologists think the underwater cultural heritage is worth protecting, they may be fighting a losing battle, as there is always likely to be other things regarded by other stakeholders as more essential. This is what makes creating awareness among scientists (or scholars), policy makers and the general public so crucial. Archaeologists also have to consider the broader picture and realise that they are not protecting underwater cultural heritage only for themselves, but for others and for future generations.

6.1 Identifying Stakeholders

Anybody involved (either directly or indirectly) in the management of underwater cultural heritage is a stakeholder. Since each stakeholder can either be a friend or an opponent, it is important to accurately identify all those involved in the project. By gaining an insight into their needs, vision, values, culture and ethics, it becomes possible to approach each in the appropriate manner with which to successfully negotiate, influence and involve them.

6.2 Involving Stakeholders

Managers should always try to involve the different stakeholders to both aid understanding and to make it easier to develop solutions for the protection of underwater cultural heritage. It is important to keep in mind that a group is formed and bound together because of its common ethics and sustained cooperation is only possible when each party can maintain their own. If not, then there is no other option than for people to move from one group (with one set of ethics), to another group with a (slightly) different set of ethics. This by its very nature is not cooperation in its truest sense as it is asking the individuals of one group to give up the thing that binds them by convincing them they are 'wrong' and requesting that they choose the 'right' group.

Suggested Reading

- MACHU Project Team. 2008. How MACHU helps European Citizens, Planners, Policy Officers and Scientists. *MACHU Report* 1. Amersfoort, pp. 8-10.
- Taylor, K. 2006. *Cultural Mapping: Engaging with Communities.* Asian Approaches to Conservation Research Conference Proceedings 3-5 October 2006, pp. 152-161.

6.3 Addressing the Stakeholders

All stakeholder groups have to be addressed in a manner that fits their own unique language, goals and ethics, as each group will play a particular role in the process and may want different outcomes.

For example:

Fishermen

Fishermen use the seas for economic gain and seldom do they only fish for their own consumption. There are many different types of fisherman. The lone fisherman with a single line is not likely to be a big threat to underwater cultural heritage, however, fishing trawlers may present a very real danger. Primarily, fishermen are not interested in the archaeological value of shipwrecks, but wrecks are considered important as they are often the places where fish gather en masse. In this context, fishermen may very well have a vested interest in protecting these areas. Also, as people who depend on the sea for their livelihood they have an intrinsic historical connection to it and may value maritime heritage more than most.

Conversely, what has also been experienced is that archaeological objects caught in fisherman's nets are being sold for financial gain, creating some interest in 'fishing' for artefacts. In some sites old nets are being used purposely to catch cultural objects which leads to significant site disturbance. This raises a number of questions. How can these stakeholders be made aware of the archaeological value of the place and the objects? Can they become partners in the protection of underwater cultural heritage? And, if so, how?

Raising awareness is one of the most important tools that can be used to engage the fishing community as a partner in the protection of sites. Using the fishing communities shared history and common ancestries can often be a powerful route of communication coupled with a reminder on how shipwrecks can serve as breeding places for fish. When wrecks are destroyed there is usually a marked effect on the biodiversity in an area leading to a decline in economic potential for the fisherman. By cooperating with these communities it is possible to find balanced solutions that not only protect sites, but also protect the livelihoods of the fishermen.

By physically protecting sites, nets do not get entangled or damaged and it is sometimes possible for the site to be used to cultivate mussels and oysters. There is also the potential for opening up wreck sites to the public (recreational divers) thus providing the local fishing community with an additional role (and revenue stream) in the protection of the site and guiding the visitors.

Policy makers

Policy makers are vital for the protection of our underwater cultural heritage as they are the ones who can formulate appropriate policies and protective legislation, which are essential components of heritage management. Policy makers can create these components if they are influenced to do so.

However, they must know how to strike a balance between budgets, politics and output. How can they be made aware of the importance of underwater cultural heritage?

In this case raising awareness can be facilitated by developing detailed overviews of the overall resources (known, unknown and future). Indicative maps can be created that combine all the information about the resources with planned infrastructural projects and reveal not only the threats, but also the possibilities for protection.

Policy makers and politicians are also very concerned with international cooperation and legislation, so it is essential that they are fully informed in this regard.

For more information see also Unit 17: *Public Archaeology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology.*

Suggested Reading

- McMullen, P.H. 2011. Underwater Cultural Heritage, an Assessment of Risks from Commercial Fishing. *Seafish Report*. CR 643.

6.4 Negotiating

When all stakeholders are known, their ethics understood and there is a clear picture of what they are fighting for, then there is a basis for negotiating with them for the purpose of protecting underwater cultural heritage. It is by knowing how to approach various differing groups while keeping a clear sight of their goals, that site managers can have a stronger position in the negotiations.

Unit Summary

The management of underwater cultural heritage is a complex process that cannot be facilitated by archaeologists alone. Cooperation among concerned stakeholders is therefore essential.

Inevitable choices have to be made on each site; some will be selected to be preserved *in situ*, some to be excavated and some will be left unattended. Assessments can be made and plans managed on a local, regional, national and even international level.

It is not only the archaeologist who is involved; it may also be the fishermen, the coastal community or recreational divers and some (or all) of these groups may not agree with the archaeologist's point of view. However, the better the aims and ethics of each group of stakeholders are understood, the greater the chance that they will cooperate with one another, leading to a fruitful negotiation.

The different stakeholders may have other reasons to be involved in cultural heritage, but the goals may be the same. It is therefore important to identify all stakeholders, to negotiate with and involve each of these groups in the management and protection of underwater cultural heritage. The involvement of all concerned parties has to be well-managed in order to ensure that the right sites are preserved, researched and appreciated.

Suggested Timetable

30 mins	Introduction to the Management of Underwater Cultural Heritage *- What is Underwater Cultural Heritage?* *- What is Managing Underwater Cultural Heritage?* *- Why Management?*
60 mins	How do we Manage Underwater Cultural Heritage? *- Structuring Processes* *- Creating Overview* *- Mitigation* *- Management Plans* *- Dare to Select*
	Break
90 mins	Ethics
	Break
90 mins	Stakeholders *- Identifying Stakeholders* *- Involving Stakeholders* *- Addressing the Stakeholders* *- Negotiating with Stakeholders* *- Creating Awareness*
	Break
90 mins	Role Play
30 mins	Concluding Remarks and Closure

Teaching Suggestions

Throughout this unit students are provided with a short overview of the different elements that play a role in the management of underwater cultural heritage. Discussions can help deepen the student's understanding and although it is not possible to cover all the aspects and views surrounding heritage management, a few topics that are useful to discuss are listed below.

4.1.1 Site Level

Students should be made familiar with the Annex of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) and the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996).

In particular it is important to explain Rule 10 and Rule 25 of the UNESCO Convention. The ICOMOS Charter is almost identical to the Annex of the UNESCO Convention, however, it is important to highlight Rule 2 and Rule 10 of the ICOMOC Charter.

A comparison of the management plans is covered in Unit 6: *Significance Assessment*, but it is worth introducing students to this topic during this earlier unit.

6.1 Identifying Stakeholders

Students should be asked to name some universal stakeholders in underwater cultural heritage. Stakeholders can be: archaeologists, policy makers, politicians, fisherman, dredgers, looters, sports divers, tourists, environmentalists, etc.

Once the participants have completed this small exercise the trainer should introduce an example site, such as the Bay of Chanthaburi, and ask students to identify the stakeholders that they would expect to find there.

Students should also try to identify whether or not the mentioned stakeholders are partners in the protection of underwater cultural heritage. Trainers should remember to emphasize to the students that stakeholders can be a partner, but may also be against the site manager's points of view. It is important to mention to students that even though some stakeholders are not partners, they can be convinced to be advocates for site protection in the future.

6.2 Involving Stakeholders

After covering this topic, it may be useful for trainers to have the students name a few stakeholders and discuss what kind of role those stakeholders play in the management of underwater cultural heritage. It is important for the participants to consider what they think archaeologists or policymakers would want to gain from a relationship with these groups.

6.3 Addressing the Stakeholders

Trainers should provide students with two examples of stakeholders and discuss how these groups should be involved and addressed during potential negotiations.

6.4 Negotiating

One of the most effective ways to facilitate an understanding of negotiation is to use a role play exercise. A role play can be a perfect tool for students to practice identifying the needs of different stakeholders and improve their negotiation skills. Some examples of role play exercises that have been specially developed for this unit are described in the 'Practical Sessions' section below.

Practical Sessions

A role play is the most effective way to place both the trainer and students in different situations and in the role of different types of stakeholders. This practical training technique is also flexible both in terms of difficulty and time. A role play can last anywhere from 10 minutes to a full day, depending on how the exercise is facilitated.

For this unit we have developed a role play that lasts approximately half a day.

Role Play Exercise 1

Background: a small coastal town has been a traditional fishing centre for centuries. It is an idyllic place, where fishing boats and a handful of dive operators leave from the old harbour daily to visit spectacular dive spots where three shipwrecks are also found.

The town is a bit sleepy and to stimulate the economy the city council has decided to do a feasibility study on a potential extension of the harbour. An extension would allow for the use of large fishing trawlers and means that the harbour can also be used as a cargo terminal for the cargo ships that may then supply the inner land beyond this coastal town.

The community is primarily divided into these stakeholder groups:

- *The local small scale fishermen*
- *The harbour front inhabitants*
- *The city council*
- *The dive operators*
- *The (national) cultural heritage office*
- *Environmentalists*
- *Developers/construction company*

The trainer should divide the students into the stakeholder groups above and provide each with material depicting the area. Each of the groups should be supplied with different information, which will provide their unique tool for negotiation.

Role plays provide students with an opportunity to look at things from different perspectives. Understanding the viewpoint of stakeholders leads to more effective management of underwater cultural heritage. (Foundation Course 3, Chanthaburi Thailand). © of Martijn R. Manders

Role Play Exercise 2

Another role play for the management of underwater cultural heritage has been developed by Flatman & Young (2008) and is called 'Seascapes'. Although most of the material is based on European experiences, the majority of them can be applied to the Asian Region as well.

There is a teacher and student handbook available to accompany the exercise that can be easily obtained. It is recommended that students work on three of the cases, with each lasting approximately 15 minutes, to keep the group stimulated and focused on the outcomes.

The first section of the exercises requires students to create a series of case studies, inspired by real world examples. Each case study has to include the possible management options for maritime archaeological sites, particularly those discovered, managed or investigated as a result of commercial activities such as fishing, dredging, aggregates or hydrocarbon extraction.

The students are then required to package these case studies in the form of user-friendly 'trading cards' (plus supporting documentation). The 'trading cards' describe each of the various stakeholders involved in these archaeological sites and provide the basis for a role play exploration of the different management strategies that exist for each.

Teacher and student handbooks

Flatman, J. 2006. *Seascapes: a Maritime Archaeology Role Play.* Staff Handbook. UCL Institute of Archaeology.

Flatman, J. 2006. *Seascapes: a Maritime Archaeology Role Play.* Student Handbook. UCL Institute of Archaeology.

Suggested Reading: Full List

Bazelmans, J.G.A. 2006. To What End? For What Purpose? The National Archaeological Research Agenda (NOaA) and Quality Management in Dutch Archaeology. *Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek,* Vol. 46. Heeringen, R.M. and Lauwerier, R.C.G.M (eds.). Proceedings of the National Service for Archaeological Heritage in the Netherlands, pp. 53-67.

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Forrest, C. 2002. Defining 'Underwater Cultural Heritage'. The International Journal of Nautical Archaeology, Vol. 31. No.1, pp. 3-11.

Forrest, C. and Gribble, J. 2006. Perspectives from the Southern Hemisphere –Australia and South Africa in Joint Nautical Archaeology Policy Committee. *The UNESCO Convention for the Protection of the Underwater Cultural Heritage*. Proceedings of the Burlington House Seminar, October 2005. Nautical Archaeology Society, Portsmouth, pp. 30-35.

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MACHU Project Team. 2008. How MACHU helps European Citizens, Planners, Policy officers and Scientists. *MACHU Report* 1. Amersfoort, pp. 8-10.

McMullen, P.H. 2011. Underwater Cultural Heritage, an Assessment of Risks from Commercial Fishing. *Seafish Report*. CR 643.

Nutley, D. 2006. Protected Zones and Partnerships: Their Application and Importance to Underwater Cultural Heritage Management. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I (eds.). ICOMOS, pp. 32-35.

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The Protection of the
Underwater Cultural Heritage

UNIT 4

Author Martijn R. Manders

Underwater Archaeological Resources

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Cover photo: Oceans, rivers and lakes contain a rich legacy of cultural heritage, but as it is not widely visible it is often unappreciated. It is the responsibility of cultural heritage managers to make all stakeholders aware of the value of this resource. © Martijn R. Manders

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UNIT 4

Contents

UNIT 4

Author Martijn R. Manders

Underwater Archaeological Resources

Core Knowledge of the Unit

This unit introduces students to the concept of archaeological resources. It explains how to determine and measure each of the main resource types and understand what uses they have when managing underwater cultural heritage.

Upon completion of Underwater Archaeological Resources unit, students will:

- *Understand what is meant by the term 'archaeological resource'*
- *Have knowledge of the different types of resources*
- *Be able to determine known, unknown and future resources*
- *Understand the practical uses of archaeological resources*

Introduction to the Unit

What is 'archaeological resource'?

One definition for archaeological resource has been provided by the USA Archaeological Protection Act of 1979 (ARPA):

> *Any material remains of past human life or activities which are of archaeological interest. (...) Non-fossilized and fossilized paleontological specimens, or any portion or piece thereof, shall not be considered archaeological resources, (...) unless found in an archaeological context. No item shall be treated as an archaeological resource, (...) unless such item is at least 100 years old.*

An alternative definition from the *British Columbia Archeological Resource Management Handbook* states:

> *Archaeological resources consist of the physical remains of past human activity. The scientific study of these remains, through the methods and techniques employed in the discipline of archaeology, is essential to the understanding and appreciation of prehistoric and historic cultural development in British Columbia. These resources may be of regional, provincial, national or international significance. (...) These resources are often very susceptible to disturbance and are non-renewable and finite in number.*

In general, the archaeological resource can be thought of as the sum total of material remains left behind by humans in the past.

As illustrated by these two definitions, the detailed definition of archaeological resource can vary from country to country and is often influenced by science, politics and legislation. As a result it is often important to set out the appropriate scope or the limits of a planned activity, such as inventory and assessment, before undertaking the activity. By doing so, it develops an understanding of where your responsibilities lie as a country or as a cultural heritage manager.

ADDITIONAL INFORMATION

Resource Definition 1 Source: USA Archaeological Resources Protection Act of 1979.

Resource Definition 2 Source: www.tsa.gov.bc.ca/archaeology/docs/resource_management_handbook/index.htm (Accessed Nov 2011).

The definition and therefore also the content of the archaeological resource is dependent on what is considered to be part of it, and what is of value. The value or significance of archaeological resources is discussed further in a separate unit (see Unit 6: *Significance Assessment*); how it is defined is important to understand this unit.

The scope of archaeological resources is broad and it possible to divide archaeological resource into many different categories. One can, for example, talk about the resources of finds, discrete sites, dispersed sites, war graves, landscapes, etc. or they can be clustered in terms of different environments such as terrestrial, coastal, river, lake and marine. All these definitions and clusters can lead to different considerations, demands and constraints on resource management.

The archaeological resource is a product of man, created by social processes and led by the need to create things that can be controlled and managed. We will therefore limit the scope and focus of this unit on archaeological resources in the context of underwater cultural heritage management and categorize them into the known, the unknown and the future resources.

1 Archaeological Resource: Static or Dynamic?

Is the archaeological resource something static that can be tightly defined or is the resource a dynamic one? To what extent the archaeological resource is dynamic depends a little on its definition and the effort given to protect underwater cultural heritage, but in general it is acknowledged that the quantity and quality of the resource constantly change.

The quantity and quality are not only subject to definitions, but also to influences on the resource over time, such as mechanical, biological, chemical and human deterioration processes (see Unit 9: *In Situ Preservation*). Activities that generate future archaeological resources like, for example, building new houses or dredging new channels, can also cause the destruction of older parts of the resource. This is a normal phenomenon that has always existed. In these cases, the deterioration process is occurring quickly, on a very large scale and causes the 'old' archaeological resource to shrink rapidly.

2 Different Resources

To be able to create an accurate overview of this dynamic archaeological resource, it is important to constantly update information databases and to divide the resources into specific groups that can be managed. During this foundation course, the focus will be on three main archaeological resources: the known archaeological resource, the unknown archaeological resource and the future archaeological resource, which will be explained in detail later. However, one can distinguish additional categories of resources, such as the original resource, the extant resource, the lost resource, the recovered resource and the predicted resource.

Original resource: the cumulative total of anthropogenic remains that found their way into the soil, including the remains of built or dug structures. The original resource provides us with the most direct reflection of all human activity in the past. The actual size of the original resource can only be estimated, as many archaeological remains have been lost over time. The estimate will generally be less precise, as the age of the site becomes older.

Extant resource: consists of the known and unknown archaeological remains still present in the soil, *in situ* or otherwise (for example, reburied). It is in fact synonymous with buried history or subsurface archaeology. It is particularly important because this is the part of the resource from which information about the past can be derived. It is also the part that can be preserved and managed *in situ*.

Lost resource: is the part of the original resource that has been destroyed as a result of various post-depositional biotic, abiotic and anthropogenic processes, either before or after it was documented.

Recovered resource: consists of that part of the resource that has been lost *in situ* due to archaeological research. The resource recovered during an investigation is by definition smaller than the resource that was present at the location prior to the work. The recovered resource usually consists of reports, photos, drawings, etc.

Predicted resource: comprises of both the unknown resource *in situ* and the undocumented lost resource. Predictive models can be used to gain some idea of the predicted resource. The predicted resource is unlikely to correspond exactly with the extant resource as the models are simply too inaccurate. We often do not know of all the variables that played a role in the choice to use a specified area or the degradation of the sites in a certain area. The ultimate goal is to obtain a picture of the predicted resource that approximates the unknown source as accurately as possible.

The archaeological resources: extant, lost and recovered resources in comparison to the original resources. © Martijn R. Manders

The underwater archaeological resource can be partly seen as something particular and unique (e.g. sunken ships) or in some cases it can be considered as part of a larger resource; a combined underwater and terrestrial resource which would include, for example, prehistoric sites.

The maritime archaeological resource is a combination of both underwater and terrestrial sites, consisting not only of shipwrecks, but also harbours, ship yards, quays, jetties and beacons.

Suggested Reading

Deeben, J. H. C., Groenewoudt, B. J., Hallewas, D. P., Rooijen, C. A. M. van and Zoetbrood, P. A. M. 2006. In Search of the Archaeological Resource. Heeringen, R. M. Van and R. C. G. M. Lauwerier (eds.). *Proceedings of the National Service for Archaeological Heritage in the Netherlands*, Vol. 46, pp. 113-126.

Keith, D. H. 2006. Going, Going – Gone! *Background Materials on the Protection of the Underwater Cultural Heritage,* Vol. 2. Prott, L. V., Edouard, P. and Rochelle R. H. (eds.). UNESCO, pp. 265-278.

3 What is *not* Part of the Archaeological Resource?

Once the archaeological resource is defined, some of the remains may not be part of it, which makes these definitions very important. For example, if it has been defined that the known archaeological resource consists of sites older than 100 years old, then everything younger than that is considered to not to be a part of it. Since the age limit can be very strict, a 90 year old vessel cannot be considered a part of the archaeological resource and is therefore considered of low archaeological value. In 10 years, however, the vessel is 100 years old. Will it then suddenly become significant, because of its age? Age limits are usually made for management reasons, but in order to not be forced to review our resources every year, defining the future archaeological resource can be an option.

4 Why is it so Important to Determine These Resources?

Determining resources is one of the most basic management tools we have at our disposal. If countries are dedicated to protecting and managing their underwater cultural heritage, then it is important to first create an overview of what is most important to preserve. This essential component of planning enables budget, human resources and time to be used more effectively in both the short and long term.

Once determined, information on the resources should be recorded in a central database that can be accessed by all. This vast collection of data allows for the creation of a comprehensive summary that enables setting of priorities or which resources should be protected or not. These overviews can even be utilised as an important tool to advocate legislation among policy makers for the protection of underwater cultural heritage.

The size and the speed, in which the soil, sea and riverbeds are being disturbed by large infrastructural development, demand both quick overviews and accurate predictions of where archaeological sites are to be found. Once this information has been collected, it can be used in negotiations to preserve and protect the archaeological heritage.

The archaeological resource exists within a natural environment that is constantly in use. This also means that there is a constant pressure on the resource (directly or indirectly) due to infrastructure projects and climate change. As a result, in many countries archaeological research is undertaken alongside these infrastructure projects. The European Convention on the Protection of the Archaeological Heritage (Valletta 1992) provides an example. In projects such as these, there is a delicate balance between different interests, such as the growth of a town or harbour versus the protection of the archaeological heritage. All stakeholders have their own political or economic interest that have to be carefully negotiated. It is therefore extremely important to have a good overview of what the archaeological resource in a certain area is, so that it can be thoroughly discussed during the negotiation process. By defining the resources, we can clearly illustrate the underwater cultural heritage, thus making it easier for other stakeholders to understand what and why it needs to be protected.

Lastly, by knowing the archaeological resources, scientists are given an insight of those they can use for future research.

For more information on the importance of determining resources, see Unit 3: *Management of Underwater Cultural Heritage*.

5 Who Determines What the Archaeological Resource is?

In many countries, it is either an accredited individual archaeologist or the competent authority involved with the management of underwater cultural heritage, who determines what constitutes the archaeological resource.

Until recently in the Netherlands, anything that was older than 50 years and of cultural historical significance was protected under the Dutch Monuments law and therefore a part of the cultural heritage resource. In 2012, this approach was altered to conform with the United Kingdom's practice of assessing each site for its own significance.

All resources have to be defined according to the definitions of archaeology. By using these definitions, we can determine whether something is in fact 'archaeological' or if it should be defined in different terms, such as 'built heritage'.

The cultural and historical significance and the age of the object are usually determined by a senior archaeologist. Significance can also be determined by other experts. If a community thinks a site is of value because it is linked to their own local history, then its significance cannot be denied. (See Unit 6: *Significance Assessment)*.

6 What is the Known Archaeological Resource?

Known archaeological resource: this comprises of all the archaeological sites that are known to us.

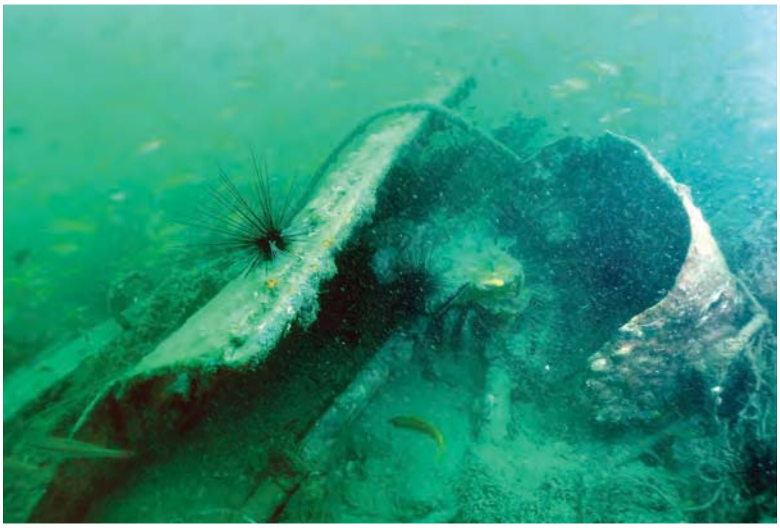
Known archaeological resource can be a subject of debate, as what is 'known' about a site is not clearly defined before it can be categorized as such. Has a site been assessed and deemed significant or is it only necessary to know a fragment of crucial data about it such as its position? Does the existence of a wreck constitute a known resource? Is it the material that the wreck is made of? Or is that not even important? Some of the shipwreck databases also include shipwrecks that are known to have been sunk in a certain area, but these exact positions are not known. Is this also a known resource? All countries use different methods to assess the known resource, yet regardless of the criteria they use, the most important factor is to measure the resources consistently in the same way.

In general, the known archaeological resource consists of all archaeological sites that are known, registered and still existing in the soil.

The known archaeological resource consists of defined sites. Yet, is it always possible to define where a site starts and where it ends? Can a ship barricade be considered as one site? Or does it consist of several individual shipwreck sites? The same can be said about prehistoric sites on the seabed. Is the area where the stone artefacts were found considered as the site? Or does it spread far beyond that limited location?

ABOVE: The Bankachai II shipwreck is a Thai Junk from the sixteenth century that was excavated by the Underwater Archaeology Division (UAD), Fine Arts Department of Thailand. © UAD, Thailand

BELOW: The early twentieth century shipwreck of Mannok Island has been used as the diving location during foundation courses and is also part of the known resource. © UAD, Thailand



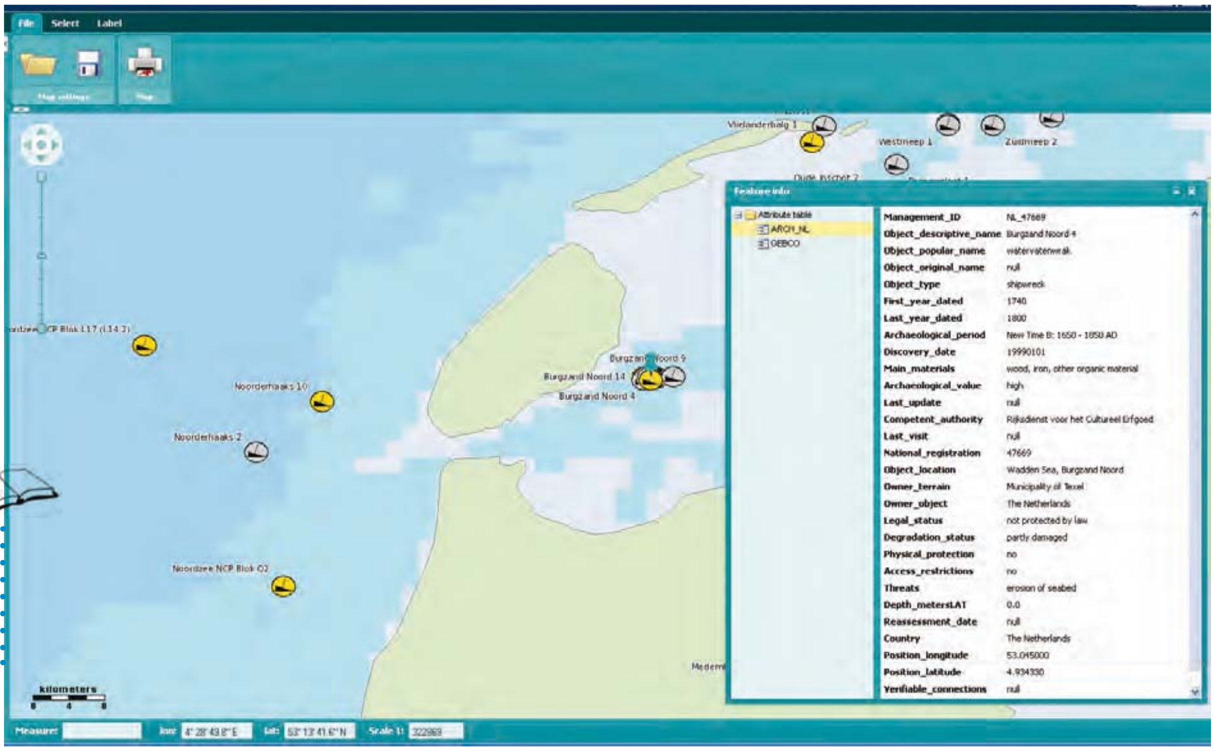
All these indicate that there is a strong interaction between the known and the unknown archaeological resources. The location of what has been found may be known and with this information, combined with other data, such as that on seabed morphology, we can gain an understanding of what can be expected to be found in the vicinity.

6.1 Uses of the Known Archaeological Resource

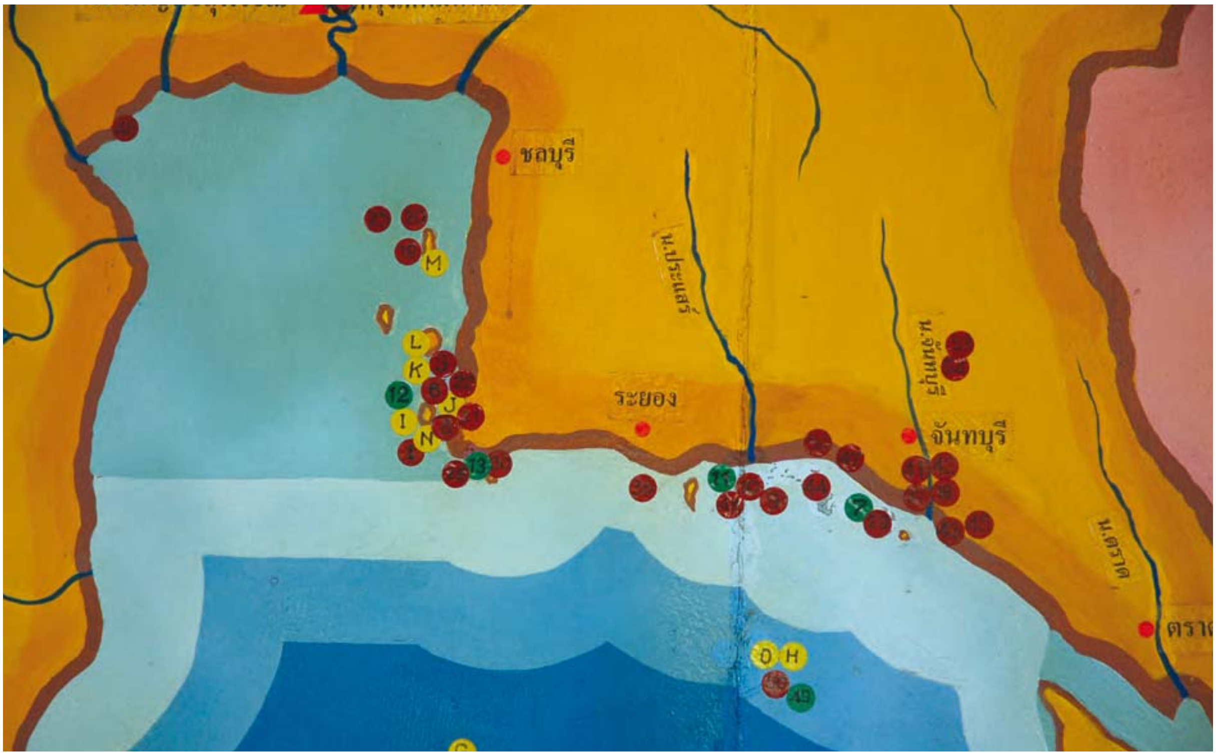
A database that contains the known archaeological resource is an orderly archive for archaeologists, which enables them to easily locate sites that would be useful to investigate and answer their research questions. When structured in a certain way, the database can provide a wealth of information from which to create an overview.

A database that contains the known underwater archaeological resource is also highly important for policy-makers because it reveals the richness of this heritage that cannot be observed by all, due to its location. In combination with other information, such as spatial planning data derived from a Geographic Information System (GIS) (see Unit 8: *Geographical Information Systems (GIS) in Underwater Archaeology*), we can determine possible threats and their impacts on underwater cultural heritage. The known resource can then be protected either through planning (infrastructure projects) or by protective legislation.

The known archaeological resource is also used to address the public and to create popular awareness. It provides us with information for public consumption, encouraging dialogue between different interest groups and stakeholders.



The known maritime and underwater resources can be easily registered in a database or a Geographical Information System (GIS). Here, Dutch shipwrecks are registered in the MACHU GIS. © RCE



The known resources can also be easily plotted onto a physical map. Here, the located sites in the Gulf of Thailand as plotted by the UAD. © UAD, Thailand

6.2 Examples of Databases and GIS on the Known Archaeological Resource

- *ARCHIS, Archaeological database of the Netherlands*
- *MACHU (Managing Cultural Heritage Underwater): www.machuproject.eu*
- *Avocational databases, such as NAS Adopt-a-Wreck*
- *The United Kingdom Hydrographic Office (UKHO): http://www.ukho.gov.uk/Pages/Home.aspx*
- *National Monument Record (UK)*
- *Databases/GIS in Asia*

Suggested Reading

Hootsen, H. 2008. Building the GIS System. *MACHU Report.* No. 1, Amersfoort, pp. 39-40.

Marasco, E. and Peerayot S. 2006. Geographic Information Systems and Heritage Management: Computerized Management of Ancient Sites. *Asian Approaches to Conservation.* Research Conference Proceedings 3/5 October 2006, pp. 134-143.

7 What is the Unknown Archaeological Resource?

The unknown archaeological resource: the precise definition is dependent on that used for the known resource. Everything that may be excluded in the known resource can be added to the unknown, even if its existence has yet to be confirmed.

Usually, the unknown archaeological resource refers to archaeological remains whose location, nature, age and quality have not yet been determined. The scale and quality of this part of the resource can only be estimated, mainly on the basis of what is known about the known resource. The unknown resource is a predictive and indicative one; essentially, it is an educated guess of what may be present in a certain area.

7.1 How to Measure the Unknown Archaeological Resource

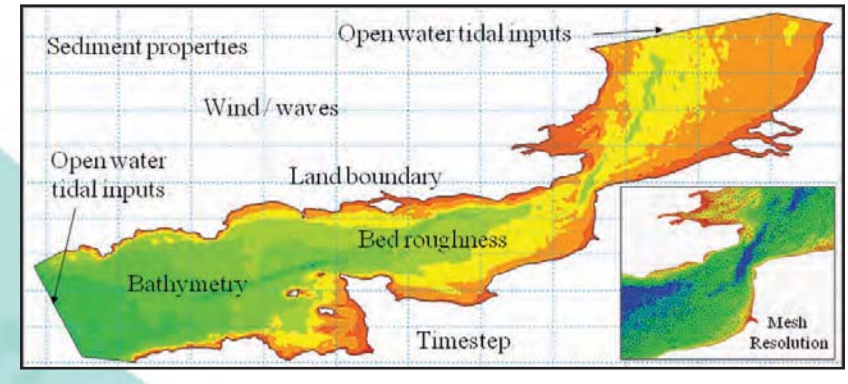
If a known site is defined as a site that has been assessed, then the first and simplest method to get an indication of the unknown resource is to compare the amount of the known archaeological resource with the number of positions known.

Moreover, the unknown resource is that which can be expected to be found. To estimate this it is crucial to have an insight into what can be expected to be found in a certain area from various local stakeholders.

Usually, fishing communities can usually provide a lot of information on where shipwrecks or other obstacles are located. These are places where they fish or where their nets are caught. In some instances, they may even have dragged or recovered artefacts from their nets.

Harbour authorities also hold a great deal of information about their harbour, the entrance and routes to it. They may also be able to provide geophysical data of the seabed.

Recreational divers and dive schools would be familiar with the diving site. Shipwrecks are most attractive to divers, who may know their locations that are not known to competent authorities.



More advanced methods for indicating the unknown resource include the use of predictive modelling. Here the sedimentation-erosion patterns in the Southern North Sea Basin are being predicted. Using hind-casts (what has happened) and forecasts (what will happen) can give us clues on what is still left under the soil and what will be in danger of deterioration within a given period of time. © MACHU Project

The unknown resources can be predicted by combining a variety of indirect evidence from an area such as historical, geological and climatological information. Here, an Indicative Map of Archaeological Value (IKAW) is developed according to the same principles in the Netherlands. © RCE

Furthermore, the unknown resource is also the prediction of the possible resource in an area. This can be measured using a variety of measurement tools such as:

Geological data: understanding how the coastline has evolved provides information on the possibility that ships have sunk in certain areas, as in cases where prehistoric sites are found. Geological data can help to determine the age of certain sea, river or lakebed sediments, allowing us to predict where possible sites can be located. It can also determine the type of sea, river or lakebed which can help us estimate the quality of the expected sites.

Geophysical data: can detect sites on the seabed by providing an indication that something is lying at a specific spot, but with no clear idea of what it is. Multibeam sonar and single beam sonar can be used to calculate the seabed change over time, by measuring the depth of the seabed. With this data, one can determine whether a specific area has been eroded or sedimentary.

Sometimes models (see MACHU project: www.machuproject.eu) are used to calculate past and future changes in the seabed. With this information we cannot only predict the unknown resource that remains in the seabed, but also what the future will eventually bring for these resources.

Lastly, it can be useful to consider historical information to predict the unknown source. How did the area develop? How was it used? Was it a busy sea route? Or has it always been a very shallow area? Did it silt up after a period of time? By examining available information from these perspectives, it is possible to predict the potential value of an area for underwater cultural heritage.

ABOVE: The geology can be used to predict the presence and condition of UCH in a certain area.
© Geological Survey of Thailand

RIGHT: Historical information, such as this map, can tell us whether certain areas where part of important trading routes or if waterways have changed over time.
Courtesy Martijn R. Manders' collection

7.2 Uses of the Unknown Archaeological Resource

It is very important to have obtained an educated idea of what can be expected from each category of resource. The speed with which infrastructural development is intruding into our marine environment (such as those in spatial planning) requires that an overview of the present resources be provided as an input to development plans for appropriate management of archaeological resources within the scope of infrastructure projects.

Having an insight into the unknown archaeological resource can provide an important tool in planning research agendas (see Unit 3: *Management of Underwater Cultural Heritage*) and can also be used to influence policy makers.

7.3 Examples of Databases, GIS and Research of the Unknown Resource

- *The MACHU project: www.machuproject.eu*
- *Prehistoric sites in the Southern North Sea Basin*
- *Indicative Maps Archaeological Value (the Netherlands)*
- *Examples from Asia: e.g. predicting location of Hominin Sites in Africa and Asia.*

Suggested Reading

Collins, M. Holmes, K. and Brown, K.R. 2005. *Predicting the Location of Hominin Sites in Africa and Asia.* http://ads.ahds.ac.uk/catalogue/specColl/hominids_ahrb_2003/index.cfm (Accessed Feb 2012).

Coroneos, C. 2006. The Four Commandments: The Response of Hong Kong SAR to the Impact of Seabed Development on Underwater Cultural Heritage. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I (eds.). ICOMOS, pp. 46-49.

Dix, J. and Lambkin, D. 2008. Modelling Sediment Mobility to Support the Management of Submerged Archaeological sites. *MACHU Report*. No. 1, Amersfoort, pp. 40-41.

8 What is the Future Archaeological Resource?

Future archaeological resource: comprises of those sites that are not yet part of archaeological heritage due to several reasons (such as age, political choices or lack of interest), but may be of interest in the future.

In many countries sites have to be older than 100 years to be protected under heritage or archaeology law, as provided in the UNESCO Convention on the Protection of Underwater Cultural Heritage (Paris 2001).

Although future archaeological resources may not be of immediate interest, an understanding of what constitute this category is useful, particularly when the future protection for some of these sites is required.

The *Titanic* provides an interesting example. Despite its popularity, the shipwreck reaches its 100 years threshold only in 2012, which is the UNESCO age limit. Other examples are the First and Second World War shipwrecks. Until 1989, the Second World War wrecks were not considered as archaeological heritage in the Netherlands. That year, the first wrecks reached 50 years of submersion, the minimum age set by the Netherlands for a monument. It also has to be of cultural and historical significance, but that cannot be denied for warships of the period. Almost nothing was known about these sites and they were usually sidelined with little or no law enforcement done to protect them. As a result, many of the First World War and the Second World War wrecks have suffered extensive looting for both commercial and private gain. These days it will be hard to find a well preserved *Vorpostenboot* (a German ship used to guard the Dutch and Belgian Coasts), whereas in the 80s and early 90s there were plenty in existence. The Asian waters are full of sites related to the Second World War and other conflicts from the late nineteenth and the first half of the twentieth Century. In some countries, these sites are considered to be an important part of the country's underwater cultural heritage, while in others, their significance is marginal.

One argument to exclude the First and Second World War objects as part of archaeological heritage has been the claim that much is already known about them. We know how they were built and where, what they were doing and where they sank or crashed. This justification sounds logical in an era of extensive media. Moreover, there are photos, films, written resources, collective memories, etc. Indeed, ships, planes and tanks were built in series and the drawings still exist, so what can archaeology possibly add to this?

First of all, objects found tell us something not only about the objects themselves, but also about the area where they were found. This narrative forms an integral part of the history of that place. Secondly, although originally built in series, ships, for example, have their own individual history. Custom repairs and changes in design were made specifically for the purposes. Often times, the archaeological resource is the only evidence for this. Thirdly, archaeological research can tell us in much more detailed account of how a ship sank or how a plane crashed. Fourthly, the objects consist of not only the ship, the plane or the tank, but also of its content; the cargo, personal belongings etc. that are found on board. Extensive archaeological research can reveal much about how a specific object has been used and by whom.

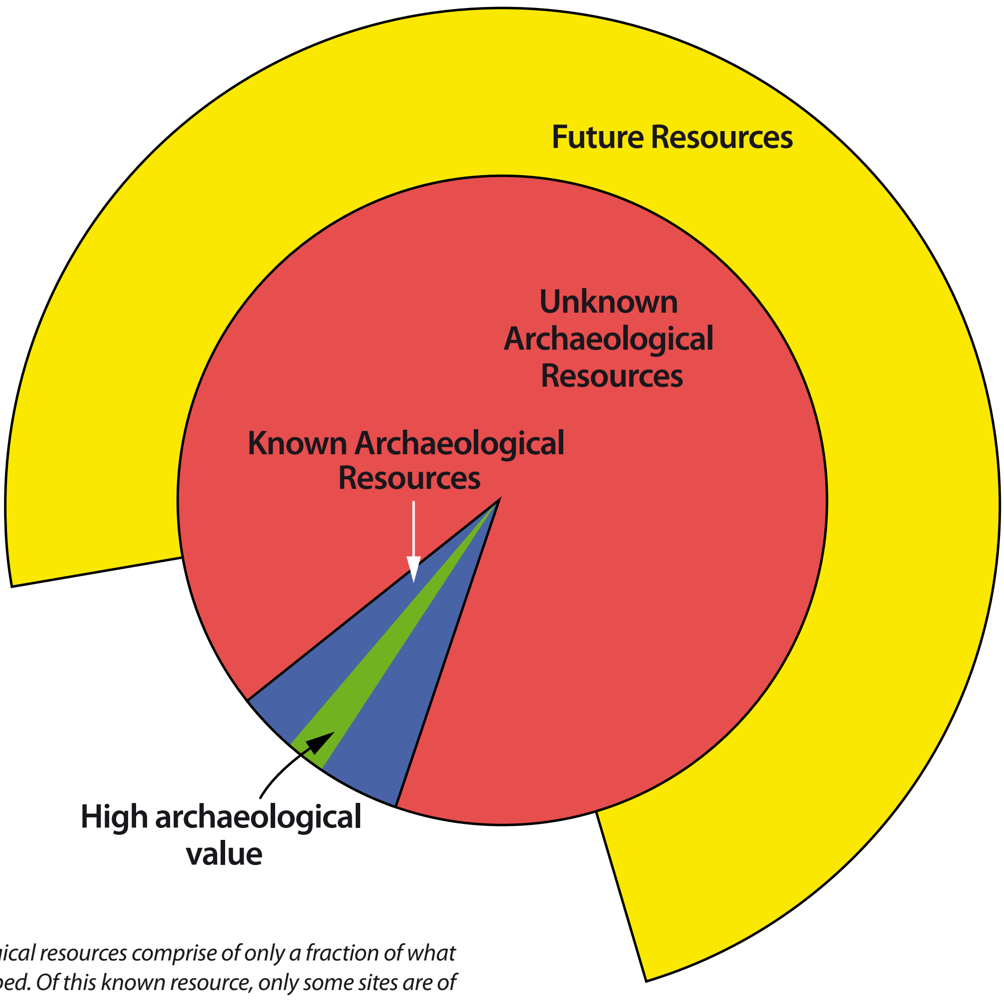
Should sites less than 100 years old be considered as underwater cultural heritage resources? German warship Hipper *sinking the British destroyer HMS* Glowworm *during the battle of Norway in the Second World War. Picture taken from Heinz Bongartz: Seemacht Deutschland, Zweiter Band 1944. Courtesy Martijn R. Manders' collection*

Suggested Reading

- Gribble, J. 2006. The Sad Case of the SS *Maori*. *Heritage at Risk Special Edition*. Grenier, R. Nutley, D. and Cochran, I. (eds.). ICOMOS, pp. 41-44.
- Jeffery, B. 2004. World War II Underwater Cultural Heritage Sites in Truk Lagoon: Considering a Case for World Heritage Listing. *The International Journal of Nautical Archaeology*, Vol. 33.1, pp. 106-121.
- Muthucumarana, R. 2010. SS *Conch*: A Wreck with a Reputation. *Maritime Lanka* 2, pp. 35-40.
- Wessex Archaeology. 2008. Aircraft Crash Sites at Sea. *A Scoping Study*. Archaeological Desk-based Assessment.

8.1 Uses of the Future Archaeological Resource

As its name suggests, the future archaeological resource can help us to prepare for the near future. It is mainly a management tool that can help create awareness not only among archaeologists, but also policy makers and general public. Since age restricts the definition of archaeological resources, sites of less than 100 years are not well managed. By building our knowledge of this resource, we are better equipped to safeguard underwater cultural heritage and minimise its damage or total loss.



The known archaeological resources comprise of only a fraction of what still remains in the seabed. Of this known resource, only some sites are of high archaeological value and it is important to identify them. Older sites are usually more deteriorated, lie deeper under the sediment and are less visible than younger sites. Therefore, we must also determine the value and use of new and future archaeological resources. These resources are highly visible, often under threat and the focus of much debate.
© Martijn R. Manders

Unit Summary

In general, the archaeological resource can be described as the sum total of material remains left behind by humans in the past. It is possible to divide this broad resource into many categories, however, the most important are the known, unknown and future resources. These three categories of archaeological resources must be well understood to enable underwater cultural heritage to be well managed.

The definition of each category depends to some extent on what is agreed among concerned stakeholders. How do we define, for example, what a known resource is? Is it defined only after a site has been assessed or is it only necessary to have a fragment of information such as the exact location of a wreck? In contrast, the unknown archaeological resource is something which is there, but we have no information about its position or its quality. In this case, we have to identify the resource by taking an educated guess. Having knowledge about it is crucial for long term management strategies.

Heritage is defined by the legal frameworks of each country. Often times, the age of a site determines whether a site can be considered a heritage resource or not. Some time in the future, a site will be acceptable as part of the heritage. This requires that these 'new' sites also deserve protection and appropriate management to prevent their irrepairable damage once they are classified by law as protected cultural heritage sites in the future.

Suggested Timetable

15 mins	Introduction Dividing Archaeological Resource into Sub-groups
75 mins	What is the Known Archaeological Resource? - *Definition* - *Uses* - *Discussions*
	Break
90 mins	What is the Unknown Archaeological Resource? - *Definition* - *How to measure* - *Uses* - *Discussions*
	Break
90 mins	What is the Future Archaeological Resource? - *Definition* - *Uses* - *Discussions*
	Break
75 mins	Practical Session: Defining Different Archaeological Resources of a Chosen Area
15 mins	Concluding Remarks and Closure

Teaching Suggestions

This unit introduces students to the concept of archaeological resources, how each major type of resource can be determined and measured, and how they are used in the management of underwater cultural heritage. Teaching suggestions designed to enhance the student's knowledge of some of the topics in the unit are listed below.

6 What is the Known Archaeological Resource?

Recommended questions for discussion are:

- *Is the term 'known resource' used in Asian countries?*
- *If it is used in Asian countries, what does it mean?*
- *Is an excavated site also part of the known resource? Or are these only the in situ sites?*
- *Does the known resource consist only of archaeologically assessed sites?*
- *Does the known resource comprise of sites whose the exact positions are known?*
- *What if we cannot determine the extent of the site? Can we then consider it to be known or unknown resource?*
- *Is the known resource registered in a database?*
- *Is the database available for everyone to use?*
- *Who is responsible for it?*
- *Who contributes to it?*

7.1 How to Measure the Unknown Archaeological Resource

When covering this topic, it may be useful for trainers to illustrate the teaching material with examples of underwater prehistoric sites such as those found in the Palk Strait/Gulf of Mannar (Sri Lanka), Torres Strait (Australia), Dwarka (India), Denmark and the North Sea Basin.

7.2 Uses of the Unknown Archaeological Resource

Recommended questions for discussion are:

- *Is the term 'unknown resource' used in the Asian countries?*
- *If yes, what does it mean?*
- *Is the unknown resource registered in a database?*
- *Is the database available for everyone to use?*
- *Who is responsible for it?*
- *Who contributes to it?*

8.1 Uses of the Future Archaeological Resource

Recommended questions for discussion are:

- *Does the student's country of origin deal with the future resource?*
- *If yes, then how do they deal with it?*
- *If no, then why not and what is the normal procedure when sites such as the Second World War shipwrecks are found?*
- *Can the students come up with examples of future archaeological resources?*
- *Do the students think it is worth putting time, money, people and effort into this archaeological resource?*

Practical Session

It is important that the students are provided with the practical task of defining different archaeological resources in a chosen area. Trainers should provide students with a range of information including:

- *A selected area*
- *Basic information about the sites that are known in that area (or the possibility to access the data quickly)*
- *History of the area and its surroundings*
- *If possible information on the seabed (side scan sonar, multibeam, aerial photography, satellite images (Google Earth), sediment type, etc.)*

It is recommended that students have two hours to interpret the information provided and using the knowledge they gained during the training, define the known, unknown and future underwater cultural heritage resources. The conclusions of the practical sessions can be discussed in a plenary session.

In early foundation courses, the central area of Chanthaburi was chosen for analysis. Students were given 1 to 2 hours to explore the centre, the harbour and the fishing village.

The regional field training centre in Chanthaburi is situated in a maritime environment. As a practical test, students are asked to survey the area and determine the known, unknown and future maritime resources. © Martijn R. Manders

Suggested Reading: Full List

Collins, M., Holmes, K. and Brown, K.R. 2005. *Predicting the Location of Hominin Sites in Africa and Asia.* http://ads.ahds.ac.uk/catalogue/specColl/hominids_ahrb_2003/index.cfm (Accessed Feb 2012).

Coroneos, C. 2006. The Four Commandments: The Response of Hong Kong SAR to the Impact of Seabed Development on Underwater Cultural Heritage. *Heritage at Risk Special Edition.* Grenier, R. Nutley, D. and Cochran, I (eds.). ICOMOS, pp. 46-49.

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The Protection of the
Underwater Cultural Heritage

UNIT 5

Authors Hans K. Van Tilburg and Mark Staniforth

Desk-based Assessment

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UNIT 5

Contents

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Desk-based Assessment

Core Knowledge of the Unit

The Desk-based Assessment unit clarifies the role that document or archival based surveys play in the management of underwater cultural heritage resources, and provides students with guidance on completing and presenting these critical assessments. As a management tool, desk-based assessments are particularly focused on mitigating human impacts to heritage resources.

Familiarity with desk-based assessments is vital to the preservation of the underwater cultural heritage, as these types of reports are an essential tool in the resource management kit.

Upon completion of the Desk-based Assessment unit, students will:

- *Describe the main components of a desk-based assessment report*
- *Discuss various impact types and the need for an assessment report*
- *Be familiar with a broad range of potential underwater cultural heritage resources*
- *Be familiar with a broad range of source material related to underwater cultural heritage*
- *Be able to prioritize primary and secondary information*
- *Be able to provide a summary of recommendations necessary for the preservation management of the underwater cultural heritage resource*

Introduction to the Unit

Desk-based assessment reports are aimed at a comprehensive understanding of underwater cultural heritage resources within a specific survey area, in order to mitigate or avoid impacts from ocean development projects of various kinds. These assessments may include information from field surveys and may also recommend (but do not necessarily require) that further field surveys be undertaken. Essentially, desk-based assessments provide the most comprehensive overview of underwater cultural heritage resources drawn from existing information sources for management purposes.

The process of creating a desk-based assessment report is in some ways similar to the background historical and archival research accomplished in support of a wide range of underwater cultural heritage projects. The assessment, however, focuses on the broad potential of underwater cultural heritage resources within a potential impact area, rather than any single resource or resource type, and directly addresses management issues related to resource preservation and human impacts.

Desk-based assessments are important tools in understanding and protecting underwater cultural heritage and managing change. Although reports based on desk-based assessments increasingly form part of the planning process and are often included in conservation management plans and environmental assessments, many maritime archaeologists have little or no training in researching, compiling and presenting them.

Desk-based assessment reports are comprised of specific elements which lead to and support a set of recommendations for the preservation of underwater cultural heritage resources.

These elements are:

- *Report introduction*
- *Identification of the survey area*
- *Existing preservation legislation*
- *Methods and sources*
- *Baseline conditions*
- *Significance evaluation*
- *Potential impacts*
- *Recommended mitigation actions*

1 Report Introduction

At a minimum, the introduction of the desk-based assessment report needs to communicate to the reader the time frame of the report's production, the agencies or programs involved, the general area surveyed and (perhaps most importantly) the reason the assessment is being produced. What agency or action promoted the need for the assessment? The introduction needs to do all this in a clear and succinct manner.

2 Identification of the Survey Area

A general description of the survey area must be included as part of the assessment report. The general description features a number of parametres, including water depth (range), bottom type, water temperature, winds, even storm patterns and frequency. These are all factors which affect the status of underwater cultural heritage resource and site formation processes. Past and present human uses of the marine environment within the survey area must also be considered (e.g. fishing, diving and salvage), as changes in them may have consequences for underwater cultural heritage.

In addition to a general description, the exact boundaries of the area being considered for the assessment need to be clearly represented in both written (text) and graphic (map or chart) formats. Remember, these boundaries will often represent broad areas of potential project impacts, rather than boundaries defining the spatial limits of any single archaeological site. Written descriptions generally include a table featuring specific latitude and longitude waypoints, defining the exact boundaries of the project area. Maps should be the most current editions available. Geographic Information Systems (see Unit 8: *Geographical Information Systems (GIS) in Underwater Archaeology*) provide a powerful tool with which to portray bounded marine areas, subsequently overlain with underwater cultural heritage resource sites, potential impact sites and zones of protective legislation.

3 Existing Preservation Legislation

Underwater cultural heritage legislation is comprised of any legal preservation mandates and guidelines that are aimed specifically at underwater cultural heritage resource within the survey area. Compared with existing mandates for the protection of natural resources, cultural resource preservation measures may be relatively unknown, even to programmes and agencies responsible for the protection of cultural resources.

Nations which have adopted and ratified the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) have, within its Annex, appropriate guidelines for documenting and protecting underwater cultural heritage resource. In addition, nations may have defined laws protecting historic properties and/or archaeological sites within their territorial waters. It is often the case that laws which protect historic properties on land are, in fact, applicable to submerged bottomlands (and underwater cultural heritage), though marine areas may not be specifically mentioned.

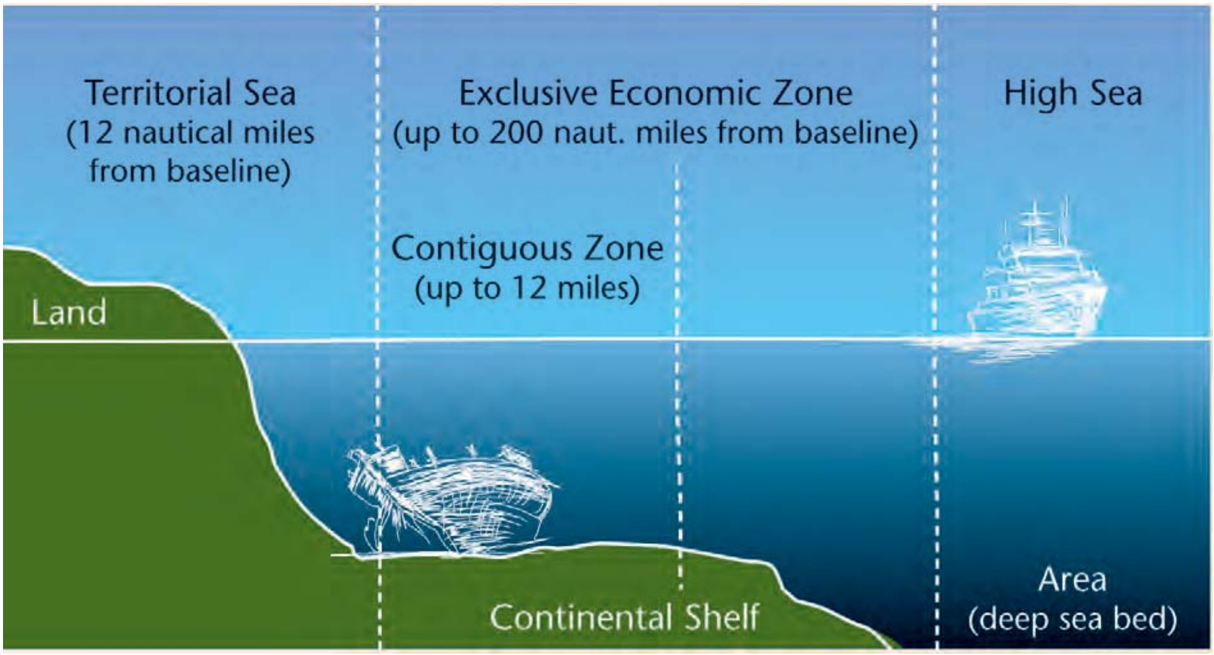
Shipwreck sites, particularly more modern resources such as those associated with the First World War, may include materials like ordnance or fuel oil which represent potential threats to the marine environment. Therefore, environmental protection laws which may not at first seem applicable to the underwater cultural heritage may also need to be considered. For instance, laws requiring the protection of marine mammal habitat can have ramifications for any activity which might damage Second World War era shipwrecks (potentially releasing trapped fuel oil). Resource managers need to think broadly when considering the various mandates which influence the protection of underwater cultural heritage.

Preservation mandates are often limited in terms of geographical scope. In other words, legal protections for the underwater cultural heritage often depend on how far the site may be from the shoreline. Coastal zones established by the United Nations Law of the Sea (UNCLOS 1987) reflect changing levels of ownership and changing levels of protective management. The location of the survey area in relation to these internationally recognized marine zones (e.g. internal, territorial, contiguous, exclusive economic, continental shelf and area zones) is probably the single most important criterion for the consideration of resource preservation.

Resource managers need to consider:

- *Underwater cultural heritage legislation*
- *Any other cultural heritage legislation*
- *Any environmental legislation*
- *Other administrative rules and regulations*

Coastal zones as defined by UNCLOS



© UNESCO/C. Lund

The application of cultural heritage preservation laws is complex. Examples of specific underwater cultural heritage protective legislation include:

- *Convention on the Protection of the Underwater Cultural Heritage 2001 (UNESCO)*
- *Antiquities Act 1976 (Malaysia)*
- *Historic Shipwrecks Act 1976 (Australia)*
- *Movable Cultural Property Act 1986 (Australia)*
- *Antiquities Ordnance 1940 (Sri Lanka)*
- *Cultural Property Act 1988 (Sri Lanka)*
- *Abandoned Shipwreck Act 1987 (United States)*
- *Sunken Military Craft Act 2004 (United States)*
- *Ancient Monuments and Archaeological Sites and Remains Act 1958 (India)*
- *Underwater Cultural Relics Preservation Statute of the PRC 1989 (China)*

It is up to the cultural resource manager to understand the various underwater cultural heritage legal protections applicable to the identified survey area, as well as the agencies responsible for implementing those protections. A clear summary of these mandates needs to be included in the desk-based assessment in order to build a solid foundation of support for the pending protective recommendations.

Suggested Reading

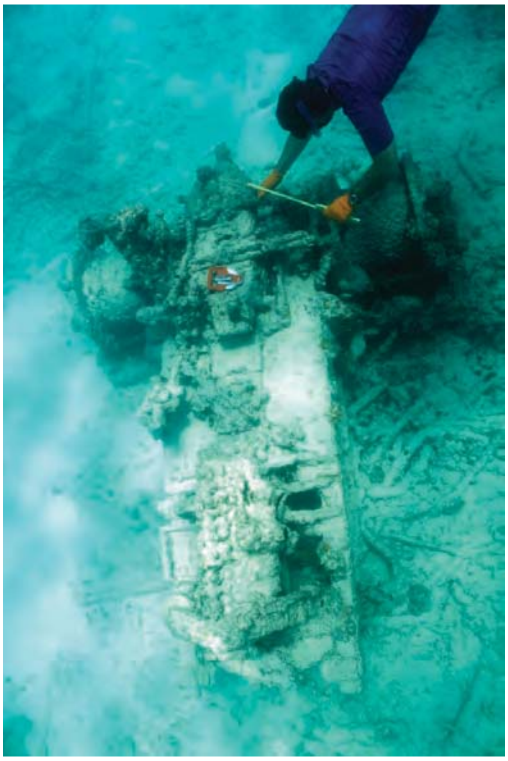
Bowens, A. (ed.). 2009. International and National Laws Relating to Archaeology Under Water. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Portsmouth, NAS, pp. 45-52.

Maarleveld, T. J. 2000. Archaeological Heritage Management: Cultural and Legislative Perspective. *Background Materials on the Protection of the Underwater Cultural Heritage 2.* Paris, UNESCO, pp. 204-217.

4 Methods and Sources

The desk-based assessment creates a snapshot of underwater cultural heritage resources within a defined area, allowing for the evaluation of potential impacts from proposed human activities and the discussion of possible mitigation efforts. It is not, therefore, initially focused on a single site or single type of heritage resource. The effort to gather all data pertinent to the baseline status of the underwater cultural heritage must initially cast a broad net and consider a number of potential types of submerged resources.

Shipwrecks are only one type of resource. The UNESCO 2001 Convention defines underwater cultural heritage resource as including: ‘all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years’. Local mandates may recognize 50 years as potentially historic. This means that a wide range of historic and prehistoric submerged sites, structures, buildings, human remains, vessels and aircraft, along with their cargo or other contents, can be considered as underwater cultural heritage. Methods for finding information on such a wide range of resources must, therefore, consider a wide range of sources (see Unit 4: *Underwater Archaeological Resources*).



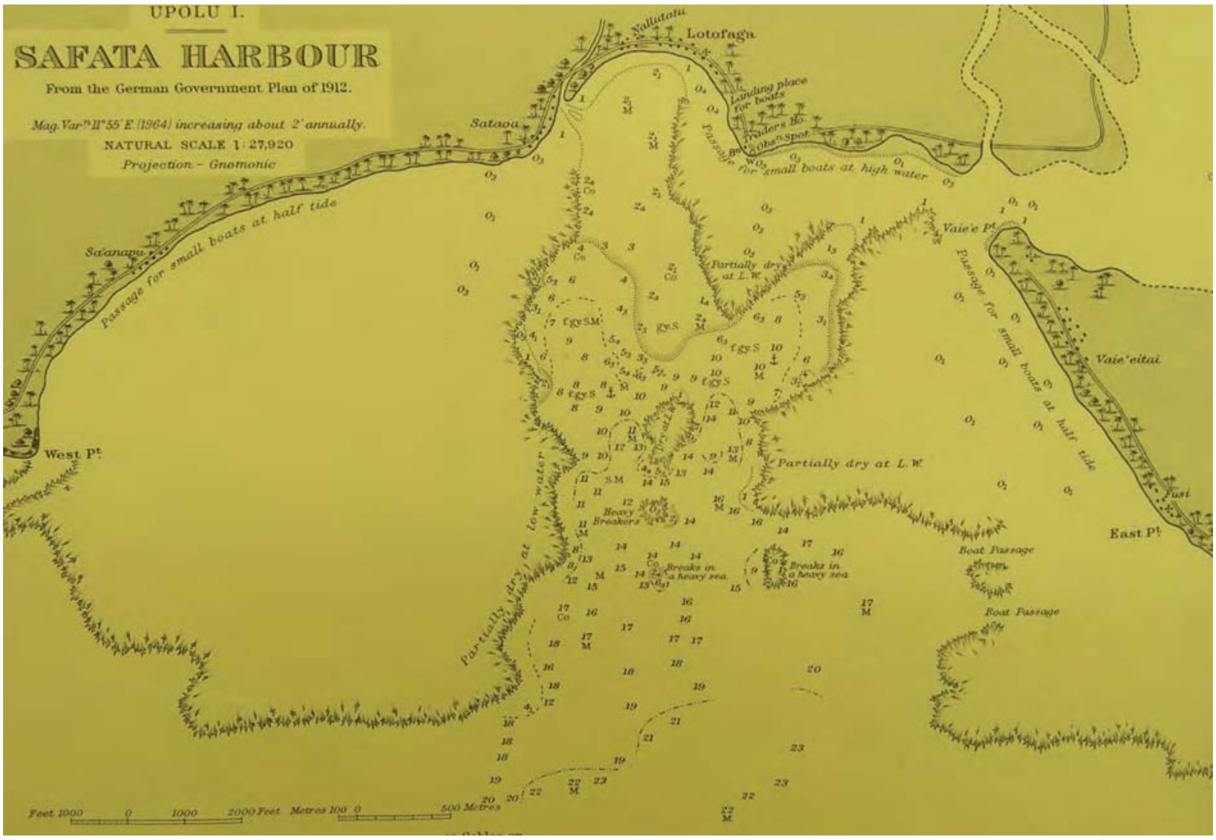
ABOVE: A Second World War era naval aircraft identified as an American SB2C Helldiver. © NOAA Sanctuaries

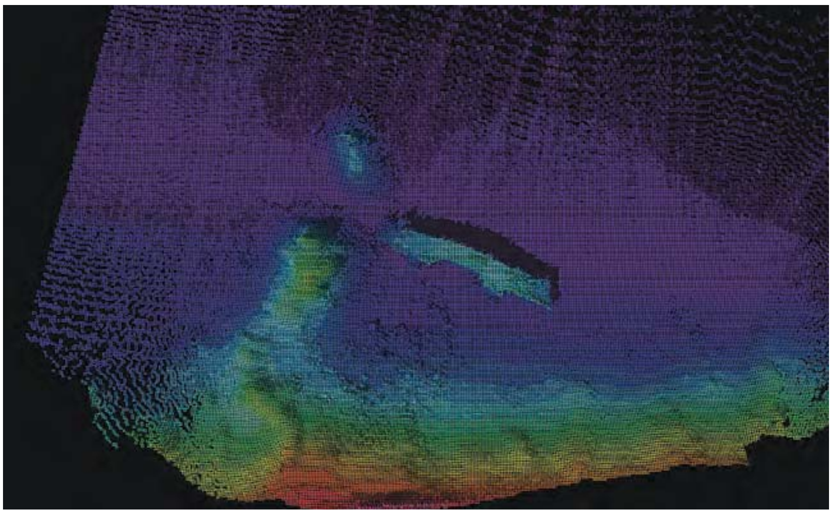
FAR RIGHT: Scotch boiler of the SS Maui; *shipwrecks are probably the most familiar type of underwater cultural heritage. © University of Hawaii Marine Option Program*

RIGHT: Steam powered winch; vessel landing sites and the remains of historic piers feature cargo handling equipment and the accumulated artefacts that result from decades of human use. © University of Hawaii Marine Option Program/J. Coney

Types of sources that provide information on underwater cultural heritage include:

- *Literature - local journals, gazetteers, books*
- *Maps - historical, survey and geological maps*
- *Charts - historical and current charts*
- *Aerial photographs*
- *Sites and monuments data*
- *Wrecks data (public and private wreck site databases)*
- *Geophysical and geotechnical data*
- *Related marine sciences (opportunistic discoveries)*
- *Newspapers*
- *Satellite imagery*
- *Naval/wartime records*
- *Hydrographic survey*
- *Visual information from the local people*





ABOVE: Historic chart of Safata Harbor, Samoa, showing landing locations, anchorages and passages through the reef.
© British Admiralty

LEFT: High-resolution multibeam image of the USS Chehalis, *sunk in Pago Pago harbor.*
© NOAA CREI

It is important to note that during this initial data collection, the assessment of significance (see Unit 6: *Significance Assessment*) is not a top priority, for the resource manager must seek to first understand the range of potential resources within the survey area in a comprehensive fashion, without bias.

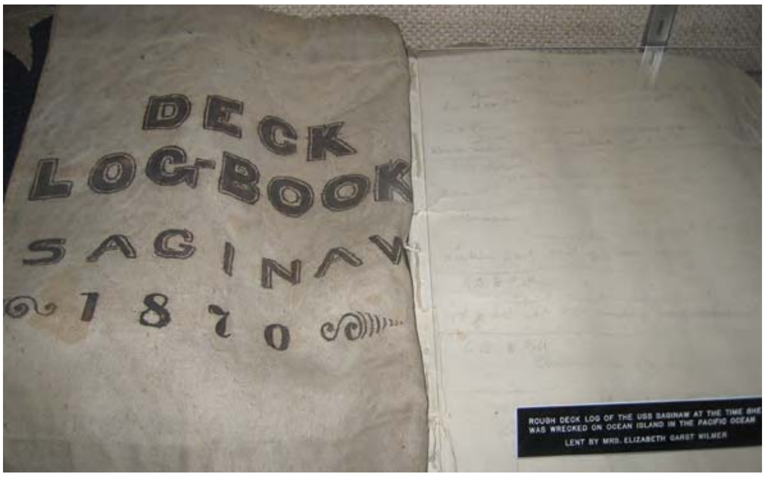
Sometimes information comes from seemingly unlikely sources. For instance, fishermen often know locations of wrecks, which some refer to as 'hang sites' where nets become entangled or where fish are known to gather. Clearly, maritime archaeologists are not the only ones who find wrecks. Often when marine biologists or geologists conduct surveys, they come across cultural heritage resources, but (unfortunately) fail to record them as it's not the focus of their studies. Cultural resource managers should strive to create good working relationships with other marine scientists working in the area so that this information is captured and shared.

The consideration of multiple information sources brings with it the challenge of dealing with both 'good' and 'bad' data. Simply put, some sources are more trustworthy than others. One way to sort the reliable information from the questionable information is to focus on primacy. What is primary data? What is secondary data?

Primary sources, such as ship logbooks, crew rosters, historic charts and first hand eye witness testimony (oral or written history) are generally created at or very close to the time and place of the particular incident, such as a shipwreck or plane crash. Secondary sources, such as books or articles based on other books, articles or popular diving guides, are generally created long after and are distant from the time and place of the event. Primary sources are considered more original and less subject to error and exaggeration.

Definition of primary sources: an artefact, a document, a recording or other source of information that was created at the time; a source of direct personal knowledge; often useful in determining location of underwater cultural heritage.

Definition of secondary sources: a document or recording based on original information created elsewhere or later time; often involves analysis or evaluation; often useful in the interpretation of underwater cultural heritage resources.



Primary sources such as ship's log books can assist in the interpretation of the underwater cultural heritage. © NOAA Sanctuaries

Judging data, however, is not an exact science. The distinction between primary and secondary sources can be somewhat subjective and contextual. In other words, 'primary' and 'secondary' are relative terms and sources are usually judged primary or secondary in relation to specific historical contexts and time frames. There can be poor primary sources, such as information which reflects historic cultural bias and there can be excellent secondary sources, more objective treatments written later, but based on strong primary data.

Resources managers should use this 'time and place' rule carefully, remaining aware of the many social and cultural changes that have occurred over time, including changes in how we record and evaluate information and how we perceive one another. Professionalism and experience must come into play when weighting the value of a wide variety of sources. As difficult as it may be, it will be important to note within the desk-based assessment report whether your information is based predominantly on primary or secondary data. Primary source material should be emphasized in the assessment report, whereas secondary material may or may not be critical enough to be specifically noted as such in the text. In any case, all references should be listed in the report bibliography.

The following questions may help in the determination of primary or secondary information:

- *When was the document written? Where was it written?*
- *How close is this to the particular event in question?*
- *What kind of document is it and who was the intended audience? Official? Private?*
- *Is there potential for cross-cultural bias in the document?*
- *How authoritative was the creator of the document?*
- *Would they really have known about the subject?*
- *Why was this document created in the first place? Was there any ulterior motive?*

In order to use information most effectively in the desk-based assessment, sources must be carefully identified. This is done by systematically citing each source, in other words, providing clear information on each important source, so that the reader could (if so desired) locate that source on their own initiative. Researchers should be in the habit of recording provenance information not just for artefacts, but for documentary material as well. This includes proper bibliographic citations for books and articles, legal citations for preservation mandates, archive location information, photographs, etc. Often specific archives have a preferred format for citations from their collections. All references should be listed in the desk-based assessment report bibliography.

There are different citation styles appropriate to the nature of the specific publication and audience. For instance, UNESCO related documents produced in the Asia-Pacific region may rely on the *UNESCO Bangkok Style Guide for English Language* (February 2007). See http://www.unescobkk.org/index.php?id=publication_procedures (Accessed November 2011).

The important thing is to be consistent and thorough when it comes to citing your critical references.

Suggested Reading

Bowens, A. (ed.). 2009. Historical Research. Underwater Archaeology: *The NAS Guide to Principles and Practice,* Second Edition. Portsmouth, NAS, pp. 65-70.

Manders, M. 2004. Safeguarding a Site: The Master Management Plan. *MOSS Newsletter*. March 2004, pp. 16-19.

Viduka, A. 2006. Managing Threats to Underwater Cultural Heritage Sites: the *Yongala* as a Case Study. *Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts,* pp. 61-63.

5 Baseline Conditions

One important objective of the desk-based assessment is to provide a description of underwater cultural heritage resources. These can be as they are known to exist (confirmed on the bottom or known archaeological resources), or as they are suspected to exist (reported lost on the bottom or unknown archaeological resources), within the survey area, prior to the commencement of projects which may have an impact on them. Shipwrecks usually gain the most public attention, but are only one category of underwater cultural heritage.

ABOVE: A shallow wreck site in a high energy environment; the broken hardware and equipment of the 55 metre long wooden sailing schooner Churchill, *lost at an atoll in 1917. © NOAA Sanctuaries*

BELOW: A more intact wooden shipwreck in deep water (200+ metres), likely the Japanese-built fishing sampan Daikoko Maru, *lost in Hawaii in 1929. © University of Hawaii, Hawaii Undersea Research Lab (HURL)*

Sections related to baseline conditions typically include a description of the underlying geology and environment and landscape history, and a brief historical background to the study area. This material leads directly into a discussion of the nature of underwater cultural heritage resources. Information on various underwater cultural resources must be compiled from a wide range of sources and reflect an attempt to be objective, rather than favour one single type of heritage resource over another. In addition, the baseline condition section should assess the state of preservation of heritage resources within the survey area (see Unit 4: *Underwater Archaeological Resources)*. This can include a description of site formation processes.

Information from the sources will vary widely in terms of accuracy and reliability. Dealing with everything from geo referenced side scan and magnetometer data to unconfirmed rumours will be challenging. Furthermore, resources managers should remain aware that the standard survey tools of underwater archaeology, particularly the magnetometer, may be biased towards representing a greater proportion of historic shipwreck remains relative to pre-iron age sites. Detecting lithic artefacts like stone structures, tools or such things as pre-iron age wooden fishing weirs, is much more difficult. Remote sensing tools like side scan sonar and magnetometer have proven to be much more useful in some environments, such as broad flat sediment bottoms of river deltas, than others, such as the spur and groove coralline topography of oceanic atolls. Existing survey data is not always representative of the actual resource base.

There may be a patterned distribution of underwater cultural heritage resources within the survey area, reflecting past human seafaring behaviour, such as fishing activities or regular trade and communication routes.

In the case of submerged palaeo-shorelines, potential archaeological remains may be clustered in areas where ecosystem resources converge, such as estuaries where rivers and open shorelines meet. Understanding submerged palaeo-landscapes and palaeo-shorelines (and hence possible prehistoric

Kaloko-Honokohau National Historic Park, Hawaii; sites like stone fish ponds and fish traps provide evidence of ancient aquaculture systems. © Hans K. Van Tilburg habitation sites) benefits from collaboration with geographers and oceanographers. The retreat of the glaciers during the last ice age (approximately 10,000 BP) raised the ocean levels, in some places by as much as 100 metres. The potential now exists for submerged habitation sites in many places of the world.

Just as prehistoric habitation sites may reflect a pattern in the use of the environment, historic activities on the coasts and seas may be patterned as well. For example, in Hawaii during the Second World War, many naval aircraft were lost in the sea immediately upon takeoff (when the aircraft failed to maintain sufficient power). As a result, submerged aircraft can often be found in a line extending directly from the runway of the naval air station to the ocean. In the days of sail, harbours and coastal anchorages, particularly those with narrow passages through the barrier reef, claimed many wooden vessels, simply because this was where the ships had to come closest to shoreline hazards. Steam propulsion opened parts of the coast which were previously unavailable to sail and early steam landings saw the same kind of cumulative grouping over time. Finally, so called 'ship traps' can occur where maritime trade routes converge with prevailing winds and currents upon a lee shore (or some other land obstruction).

Simply put, the distribution of many types of underwater cultural heritage is neither random nor uniform, but patterned. Areas that have a high probability of underwater cultural heritage due to prehistoric or historic uses should be called out in the desk-based assessment report.

In order to present a clear picture of underwater cultural heritage resources within the survey area, the cultural resource manager must grapple with a wide variety of known and potential properties which range from fixed (precise) or general (vague) locations. A graphic summary of submerged resources often involves the production of some form of map. This raises two immediate issues which must be considered when mapping known and reported losses. How can unconfirmed but reported losses be represented graphically for an audience? And how can the position of confirmed (located) resources which may be sensitive to potential threats be protected? Fixed points on a chart easily pinpoint the location of known

Steam ship routes around the Island of Maui, Hawaii; detail from a Post Route Map for the Territory of Hawaii, Samoan Islands, and the Island of Guam, 1908. © US Post Office Department sites, but there is no single or best depiction for reported but unconfirmed losses. Various sizes of shaded circles, diametres representative of inaccuracy in location, provide one method to accomplish this. Lists of vessel losses within delineated zones on the map are another (see Unit 4: *Underwater Archaeological Resources* and Unit 8: *Geographical Information Systems (GIS) in Underwater Archaeology*).

When reports include sensitive information like the specific locations of shipwrecks or the nature of the cargo, consideration must be given to the potential for negative impacts if the information is publically distributed. Sometimes there are specific preservation mandates which allow for this protection. For instance, in the United States agencies are allowed by the National Historic Preservation Act to protect sensitive information like the location or character of the property or ownership when it is clearly determined that public disclosure may:

1. *Cause a significant invasion of privacy;*
2. *Risk harm to the historic resource; or*
3. *Impede the use of a traditional religious site by practitioners.*

Suggested Reading

Muche, F. J. 1998. Site Location Factors. *Maritime Archaeology: a Reader of Substantive and Theoretical Contributions.* New York, Plenum Press, pp. 253-255.

Ruppe, R J. 1998. Sea Level Change as a Variable in Colonial American Archaeology. *Maritime Archaeology: a Reader of Substantive and Theoretical Contributions.* New York, Plenum Press, pp. 247-252.

6 Significance Evaluation

From contemporary debris to prehistoric artefacts and from single anchors to complete shipwrecks, there are many traces of past human behaviour in the sea. The question of assigning relevance or significance to artefacts and sites, of deciding what is worthy of consideration and preservation and what is not, is so central to the management and protection of the underwater cultural heritage that it is taken up in its own chapter (see Unit 6: *Significance Assessment).*

7 Potential Impacts

Many places of the shallow ocean shelf are dynamic in nature and snapshot images of the seafloor do not always capture the changing currents, scouring effects and sedimentation rates due to natural ocean processes. But beyond these background changes, human activities usually present much more immediate impacts to heritage resources. The Potential Impacts component lists the agencies or programs involved in the proposed actions and agencies or programs responsible for addressing underwater cultural heritage mitigation efforts.

Types of ocean development which have the potential to greatly affect the underwater cultural heritage include:

- *Bottom dredging*
- *Trawling*
- *Wharf/port/marina development*
- *Offshore wind farms*
- *Oil and gas development*
- *Sub-sea cables and pipelines*
- *Wave power (in early stages of development)*
- *Outfalls (sewerage)*
- *Spoils (dredge materials) dumping*

These types of projects can have direct and immediate impacts to the heritage resource. Furthermore, when projects introduce changes to the pre-existing ocean environment (changing current pattern sediment transport or water quality criteria), they may also have indirect consequences for heritage resources. Simply releasing the position of a previously unknown wreck site to the public may have both direct and indirect impacts. Recreational diving activity may have numerous impacts such as intentional site disturbance, excavation, looting, inadvertent anchor damage, etc. Direct and indirect effects from human activities on the ocean must be recognized in relation to the identified known and potential underwater cultural heritage resources. The potential impacts component provides a risk assessment, for the identified underwater cultural heritage resources from these potential threats (see Unit 3: *Management of Underwater Cultural Heritage* and Unit 9: *In Situ Preservation*).

Suggested Reading

Negueruela, I. 2000. Managing Our Maritime Heritage: The Case of the National Maritime Archaeological Museum and National Centre for Underwater Research, Cartegena, Spain. *Background Materials on the Protection of the Underwater Cultural Heritage 2*. Paris, UNESCO, pp. 280-297.

Sundaresh, A.S. Guar. and Nair, R.R. 1997. Our Threatened Archaeological Heritage: A Case Study from the Tamil Nadu Coast. *Current Science,* Vol. 73. No. 7, pp. 593-598.

Offshore oil platform; risers, platform jackets, subsea pipelines and wellheads all potentially impact underwater cultural heritage resources. © NOAA Sanctuaries

8 Recommended Mitigation Actions

The desk-based assessment is designed to characterize baseline archaeological information, in order that negative impacts to the resource can be avoided or mitigated to the greatest extent possible. Impacts to the resource provide the motivation for conducting specific investigation and/or excavation of confirmed cultural heritage sites, or the implementation of remote sensing or diver surveys of areas of potentially significant cultural heritage resources.

Avoidance zones can include designated areas where project impacts are prohibited, limiting all types of ocean bottom disturbances (dredging, dumping, anchoring, etc.) for the protection of underwater cultural heritage resources. Avoidance may be the cheapest option for the heritage resource agency (as it does not require further investigation, excavation, etc.) and in many cases consists of exclusionary zones around identified wreck sites. Project planners may then simply shift the impact area to avoid impacts. Avoidance zones must be large enough to cover the main wreck site and associated debris. Multiple zones may be delineated when there is no clear debris trail between sites. Avoidance zones may be based on side scan, magnetometer, or field diving data, and/or on desk-based inventory data. For larger areas or more numerous resources, shifting the project area may be prohibitively costly from the project planner's perspective.

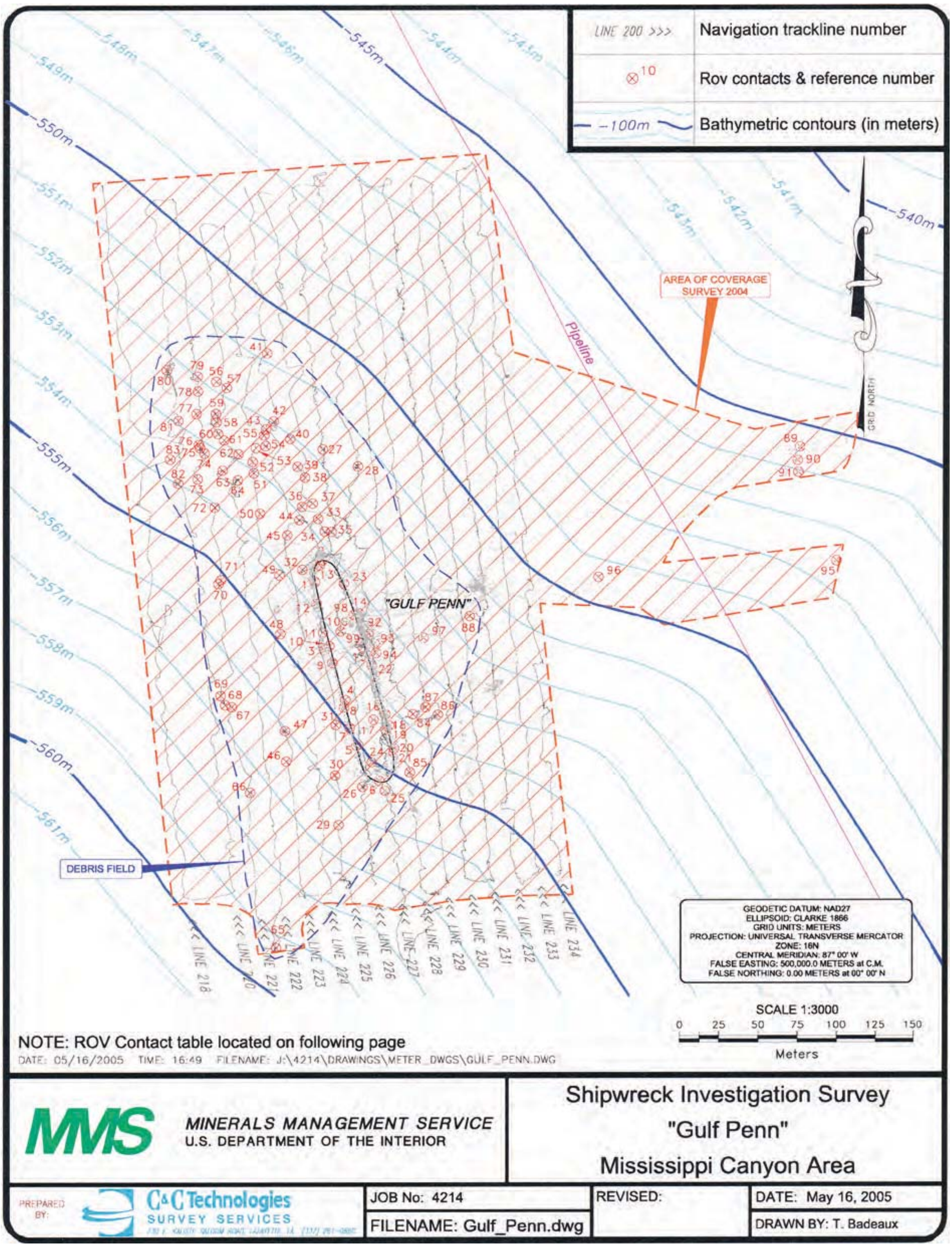
Recommendations can include:

- ***Avoidance***
  - *Sites placed within Construction Exclusion Zones*
  - *Cheapest option for the heritage resource*
  - *Will be restrictive for the developer*
- ***Clarification***
  - *Further survey in order to clarify the position, nature and extent of sites*
  - *May involve geophysical, Remotely Operated Vehicle (ROV) and diver survey*
- ***Offsetting impacts through full investigation***
  - *Diver recording of wreck sites to an appropriate level*
  - *Excavation or excavation/recovery*
- ***Offsetting through compensatory works***
  - *Palaeo-environmental assessment and analysis*
  - *Staged approach to borehole analysis*
- ***Site Monitoring***

Where impacts may adversely affect the underwater cultural heritage, but either the boundaries, character, or exact position of the heritage may not be known, the 'clarification' recommendation can be made for side scan and magnetometer surveys, to locate the resource site. Remote sensing would then be followed by 'ground truthing' the side scan or magnetometer target using Remotely Operated Vehicles (ROVs) or diver surveys, clarifying the site boundaries and site identification. Ideally site clarification surveys will be able to provide position/resolution data to within one square metre. The cost for the clarification process would be included in the project plans. Clarification simply provides additional information for a more accurate subsequent recommendation (avoidance, investigation and compensatory works).

Unlike surveys to clarify the nature and position of underwater cultural heritage resource, the 'full site investigation' recommendation focuses on the more intensive excavation, documentation and possible recovery of an individual site. This option is chosen where significant underwater cultural heritage resources are located and avoidance zones are not an option. Expenses are much higher for the full excavation and documentation of the site, and even more so if the decision is made to recover the artefacts and conserve the material. Recovery of underwater cultural heritage prior to development projects which have no other mitigation option is sometimes called 'salvage' or 'rescue' archaeology.

BELOW: Remote Operated Vehicle (ROV) survey used to delineate debris field of wreck site, the boundary of a potential avoidance zone. © US Department of Interior



Small boat fitted out for side scan sonar survey.
© NOAA Sanctuaries

Mitigation through compensatory works is an option in the case of unavoidable negative impacts to significant underwater cultural heritage sites. Projects may mitigate impacts to one site or type of heritage resource by supporting survey and preservation actions for another site or type of resource. Mitigation in this sense is beneficial to the overall cultural landscape (for more on mitigation see Unit 3: *Management of Underwater Cultural Heritage*).

Site monitoring during active projects can play a critical role once projects are underway. Here the term 'site monitoring' is used in direct association with active development projects, rather than monitoring associated with changes due to the natural environment. The archaeological monitor remains on site during the project development providing guidance and assuring that the avoidance zones are observed, or that further artefacts which might be revealed by dredging are accounted for as indications of possible underwater cultural heritage resources. The process or plan for handling accidental finds during project development must be defined prior to commencement. Checklists can be created identifying what types of finds trigger which actions, assisting the on-site monitor in decision-making. Site monitoring should be a project requirement when there is any potential for accidental finds.

Suggested Reading

Nutley, D. Underwater Cultural Heritage Management. *Maritime Archaeology in Australia: A Reader.* Blackwood SA: Southern Archaeology, pp. 268-276.

Maarleveld, T. J. 2000. Mitigation. *Background Materials on the Protection of the Underwater Cultural Heritage 2.* Paris, UNESCO, pp. 300-305.

Unit Summary

Desk-based assessment reports are aimed at a comprehensive understanding of underwater cultural heritage resources within a specific survey area in order to mitigate or avoid impacts from ocean development projects of various kinds.

The main components of the desk-based assessment report are:

- *Report introduction*
- *Identification of the survey area*
- *Existing preservation legislation*
- *Methods and sources*
- *Baseline conditions*
- *Significance evaluation*
- *Potential impacts*
- *Recommended mitigation actions*

Changes, both natural and man-made, will happen. The challenge is how we handle changes. The goal of the desk-based assessment is not to simply stop development projects which may impact heritage resources, but rather to mitigate impacts in favour of the protection and preservation of the underwater cultural heritage. The desk-based assessment report is the central document in this effort.

Suggested Timetable

10 mins	Desk-based Assessments Introduction
80 mins	- *Report Introduction* - *Identification of the Survey Area* - *Existing Preservation Legislation* - *Methods and Sources*
	Break
70 mins	- *Baseline Conditions* - *Significance Evaluation* - *Potential Impacts* - *Recommended Mitigation Actions* - *References*
20 mins	Concluding Remarks and Closure

Teaching Suggestions

The Desk-based Assessment unit clarifies the role that document or archival based surveys play in the management of underwater cultural heritage resources, and provides students with guidance on completing and presenting these critical assessments. Some teaching suggestions to enhance the student's knowledge of some of the topics covered during this unit have been selected.

3 Existing Preservation Legislation

The trainer should ask the students to provide examples of underwater cultural heritage preservation laws from their own countries. These laws will be specific to individual nations and students are already likely to be familiar with them. Are these examples familiar to non-marine resource managers?

4 Methods and Sources

Recommended questions for discussion are:

- *What other sources are unique to the students' regions?*
- *What are the advantages and disadvantages of using obscure types of information?*
- *Should the resource manager offer money for heritage information (ethical debate)?*

8 Recommended Mitigation Actions

If students have access to information regarding their course training site, the trainer could utilize the master plan template from Appendix E: Management Plan for the Mannok Shipwreck Site and task the students with selecting and describing site assessment factors.

Suggested Reading: Full List

Bowens, Amanda (ed.). 2009. International and National Laws Relating to Archaeology Under Water. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Portsmouth, NAS, pp. 45-52.

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Maarleveld, T. J. 2000. Archaeological heritage management: Cultural and Legislative Perspective. *Background Materials on the Protection of the Underwater Cultural Heritage* 2. Paris, UNESCO, pp. 204-217.

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Manders, M. 2004. Safeguarding a Site: The Master Management Plan. *MOSS Newsletter.* March 2004, pp. 16-19.

Muche, F. J. 1998. Site Location Factors. *Maritime Archaeology: a Reader of Substantive and Theoretical Contributions.* New York, Plenum Press, pp. 253-255.

Negueruela, I. 2000. Managing Our Maritime Heritage: The Case of the National Maritime Archaeological Museum and National Centre for Underwater Research, Cartegena, Spain. B*ackground Materials on the Protection of the Underwater Cultural Heritage 2.* Paris, UNESCO, pp. 280-297.

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Ruppe, R J. 1998. Sea Level Change as a Variable in Colonial American Archaeology. *Maritime Archaeology: a Reader of Substantive and Theoretical Contributions*. New York, Plenum Press, pp. 247-252.

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Viduka, A. 2006. Managing Threats to Underwater Cultural Heritage Sites: the Yongala as a Case Study. *Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts,* pp. 61-63.

United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 6

Authors Martijn R. Manders, Hans K. Van Tilburg and Mark Staniforth

Significance Assessment

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UNIT 6

Contents

UNIT 6

Authors Martijn R. Manders, Hans K. Van Tilburg and Mark. Staniforth

Significance Assessment

Core Knowledge of the Unit

This unit introduces the concept of significance in the management of underwater cultural heritage. Students are provided with an understanding of the importance of significance assessments and the role they play in the management process.

Upon completion of the Significance Assessment unit, students will:

- *Know what significance in underwater cultural heritage management means*
- *Have a basic understanding of how to assess the significance of underwater cultural heritage sites*
- *Understand the difficulties and sensibilities in adding value to underwater cultural heritage sites*
- *Understand why significance assessment is needed*
- *Understand the intrinsic value of underwater cultural heritage*
- *Understand the significance of change*
- *Have a basic understanding of Cultural Impact Assessments (CIA), Archaeological Impact Assessments (AIA) and Conservation Management Plans (CMP)*

Introduction to the Unit

The UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) broadly defines the heritage resource as, '... all traces of human existence having a cultural, historical or archaeological character which have been partially or totally under water, periodically or continuously, for at least 100 years ...'. This in itself is a clear statement on significance. The realities and limitations of managing underwater cultural heritage, however, mean that some heritage sites must still be treated as more significant than others. As a result, a closer examination of the concept of significance is required.

What is Significance?

A simple internet search can provide us with many descriptions on what significance and other words related to significance mean.

- **Significance:** *the quality of being significant or important or valued or meaningful or of consequence.*
- **Importance:** *the quality of being recognised as important and worthy of note.*
- **Meaningfulness:** *the quality of having great value, importance or significance.*
- **Consequence:** *having important effects, values or influence.*

Source: www.thefreedictionary.com

Although we can easily find a definition of what significance means, it is less clear how it should be interpreted in the context of cultural heritage. To understand cultural significance we need to look at the Burra Charter (1999). The Burra Charter provides guidance for the conservation, preservation and management of places of cultural significance and is based on the knowledge and experience of the members of the International Council on Monuments (ICOMOS) in Australia. According to the Burra Charter, cultural significance refers to the aesthetic, historic, scientific (including archaeological), social or spiritual value for past, present or future generations. Cultural significance is embodied in the heritage place (or site) itself, its fabric, setting, use, associations, meanings, records, related places and objects.

1 Significance Assessment

Ultimately cultural heritage depends on the importance (or significance) that a society places on them and it is this value that has always been the reason underlying heritage conservation. It is self-evident that no society makes an effort to conserve what it does not value.

It is necessary to gain a detailed understanding of the nature and extent of the significance that a heritage place has to a society in order to protect, preserve and conserve the values of that place. This requires an assessment, which if not undertaken could potentially lead to decisions being made that diminish or destroy important aspects of the site. The process of determining the values of a heritage place is known as the assessment of cultural significance.

The assessment of cultural significance has two interrelated and interdependent elements. The first element is the determination of that which makes a place significant and, therefore, the type (or types) of significance that it manifests. The second is the determination of the degree of significance that this heritage place has for society.

Cultural significance relates to value, but exactly what kind of value can be difficult to define, especially when it is used in this context. Value can be considered in terms of not only the economic value of a site, but also its aesthetic and historical values and its overall uniqueness or relevance. Value also refers to an ethical quality; the significance by virtue of material and inner standards that a society often accords to certain objects, places and stories associated with its ancestral past.

Although it depends greatly on who is using the definition of significance and for what purpose, it ideally should be a balanced combination of all the values mentioned above.

A site can yield a lot of information about the past. However, when a site is not visible or when the techniques that are available for use are not yet good enough to retrieve the data and consequently the information, the site might have less significance for understanding the past at this moment in time. Alternatively, a site with a high social significance (e.g. because it is highly visible in the landscape) might be considered to have great significance, although its intrinsic value to understand the past is not very high.

The significance of a site can also be modified or added to. Its importance can be increased by communicating the significance to more people through the media or archaeological publications.

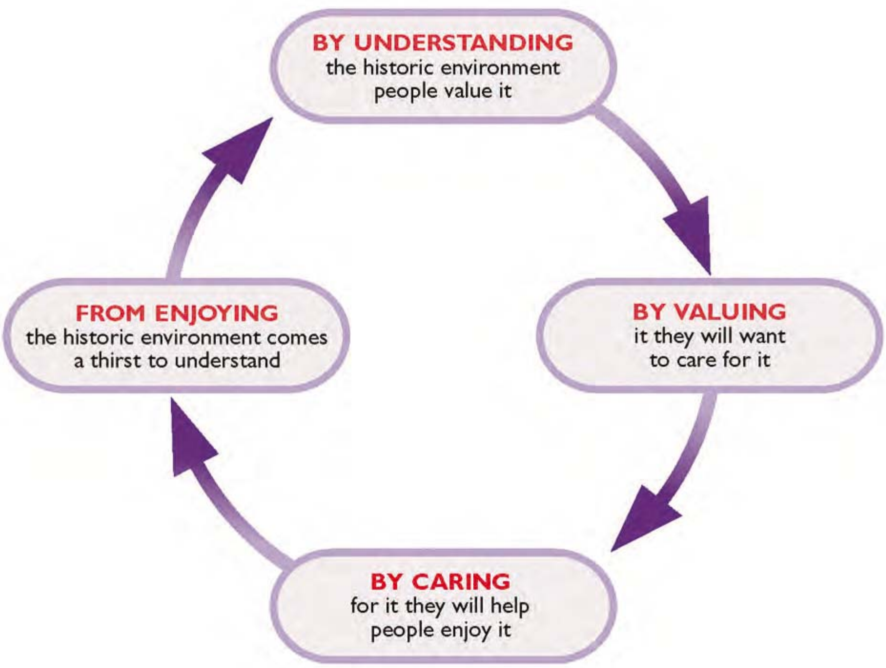
English Heritage has coined this process the 'Heritage Cycle'. They believe that if people understand the history of heritage places, they value them; by valuing the heritage places they will want to care for them; by caring for heritage places, people will enjoy them and through this enjoyment comes a thirst to understand more.

This process of creating value and significance happens every day. Archaeologists are not the only stakeholders to play an integral role. Heritage managers need to also be aware that through their daily management of underwater cultural heritage, sites that are included (and listed or protected) become more important and, therefore, increase their intrinsic value.

Suggested Reading

Bazelmans, J.G.A. 2006. Value and Values in Archaeology and Archaeological Heritage Management. *A Revolution in the Archaeological System*. Heeringen, R.M. Van and Lauwerier R.C.G.M. (eds.). Proceedings of the National Service for Archaeological Heritage in the Netherlands, Vol. 46, pp.13-25.

English Heritage. 2008. *SHAPE 2008: A Strategic Framework for Historic Environment Activities & Programmes in English Heritage.*



The Heritage Cycle developed by English Heritage. © English Heritage

2 Difficulties and Sensibilities in Adding Value to Cultural Heritage

Assessing sites and defining the significance can be highly subjective and may also raise many questions from other groups. It is, therefore, important to be transparent and involve the crucial stakeholders in the process.

Often the value or significance of a site is determined by comparing it against others. To do this both a site's quality (how significant a site is) and its quantity (how many other sites of this type exist) have to be considered. But what if the number of sites that have been evaluated is just a very small percentage of the total and each one is so different that they cannot be compared with each other? Is it still possible for significance to be assessed?

For underwater archaeology this scenario presents a very real problem. Most countries do not have more than a few hundred weighted (valued) underwater sites. This implicitly means that most sites that are weighted against these few and will be regarded as being of high value due to, for example, its uniqueness. When the quantity becomes better understood through the process of inventory, it is possible to compare the values of sites and prioritize on the basis of scientific quality.

Cultural, Political and Other Social Differences

The historical significance of a European East Indiaman, for example, might be considered high in Europe or Australia (where they are rarely found), but less significant in the former colonies where they are more abundant. The same applies for Chinese shipwrecks that have travelled all over Asia and beyond. Their significance for China is obvious and embraced accordingly, however, it is more difficult to weigh their significance for the coastal state in which they are located. This issue is especially interesting in the field of 'shared heritage' because it touches on the heart of the concept of mutuality. Can we determine whether the significance of a site is the same for both countries? Are the sites assessed on the basis of the same concepts of significance?

FAR LEFT: This anchor belongs to a seventeenth century Dutch Admiralty ship, The Utrecht, *which sank just off the coast of Brazil. Although highly salvaged, it is still considered to be of high archaeological importance, due to the fact that still little is known about the construction of Dutch ships active in the tropics using a three layered shell planking. © A. Lima*

LEFT: This sea plane, a Catalina PBY5 was found just off the coast of Biak, Indonesia. It may either be a Dutch plane from the Royal Netherlands East Indies Army (KNIL) or one from the United States. Its origin will help determine its value for either country. © Ministry of Maritime Affairs and Fisheries

The quality and quantity of a site's significance is usually measured against other known sites in the area. This can be different in various parts in the world, for example, shipwrecks in the Baltic Sea (between Sweden, Poland, Germany, Denmark, the Baltic States, Russia and Finland) can be preserved in such a state that they can hardly be referred to as wrecks, but more as virtually complete sunken ships. This state of preservation is rare and it is clear to all that these wrecks are very well-preserved. In the Netherlands, well-preserved shipwrecks are those that can be completely reconstructed, in other words; if at least half of the ship (starboard or portside) is preserved. In the tropical seas, like those in most of the Asian countries, the state of preservation is much lower due to a variety of factors including warmer waters, the coarse sediment, lower sedimentation rates and the enormous impact of biological deterioration (See Unit 9: *In Situ Protection*). Therefore, shipwrecks such as the *Avondster* (Galle Bay) and the Quanzhou ship (Houzhou) may be referred to as being very well-preserved; a large part of the *Avondster*'s wooden hull is still present as well as the starboard side until the first deck, while the Quanzhou ship is preserved to the waterline.

The memory value of a wreck is very different depending on your perspective. Something which is of local historical value might not be of very much significance on a national or international level and vice versa. The collective memory will usually be less on a wider scale; in villages (local) people, tradition, land and memory are very much connected to each other, while on a national and international scale, the binding factors are less. It also reduces further depending on the age of the site being assessed. The collective memory of the Second World War is still great, so wrecks from this period such as HMS *Vampire* (1942) that sank off Batticaloa, Sri Lanka, retain a high value. This memory value is lessened when medieval or Ming dynasty shipwrecks, such as the Royal Nanhai wreck (1490) are considered.

The aesthetic value of a heritage place is a difficult and highly subjective value to ascertain. How can we determine what, for example, is beautiful? As a result, the aesthetic value has to be considered in a practical sense. Sites can be assessed according to how suitable they are for exhibition viewing purposes or whether they could even be used as an underwater heritage trail. Factors to take into consideration might include water visibility and how often a site is visited by recreational divers, etc.

ABOVE RIGHT: If a shipwreck is considered to be well-preserved it may also depend on where it is located. Sunken ships in the Baltic, such as this Dutch seventeenth century flute ship in Swedish water, are almost in perfect condition. © Ghostwreck-Project

RIGHT: The seventeenth century wreck of the Dutch East Indiaman Avondster *is less well-preserved than the ships in the Baltic, but in comparison to many other wrecks in tropical waters, it is extremely well-preserved. © Maritime Archaeology Unit, Sri Lanka*

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WEEKENDER

The second destruction of the HMS Aboukir

HERITAGE MATTERS

DR EDWARD HARRIS

'Underwater Cultural Heritage encompasses all traces of human existence that lie or were lying under water and have a cultural or historical character. Recognising the urgent need to preserve and protect such heritage, UNESCO elaborated in 2001 the Convention on the Protection of the Underwater Cultural Heritage. — UNESCO website 2011

The continuing global recession and the sharp increase in the value of precious and semi-precious metals represents a worldwide threat to heritage sites, both on land and under the seas and oceans.

The looting of archaeological sites on land will undoubtedly continue apace, as rich and poor alike take part in the finding and marketing of artefacts, particularly from prehistoric contexts in arenas such as South America and West Africa.

The poor take part by looting for a few pennies for their survival bank, the rich by buying illicit works of art, banking on such objects as inflation-proof in times when the real banks pay practically no interest on deposits, yet lend your money out at high rates.

Due to the high price of gold and silver, antiquities and precious objects, such as family silver and heirlooms, stand to be stolen and melted down to satisfy the lust for a quite buck.

With "send us your gold and silver and we'll send you cash" operations proliferating, Bermuda may not be immune from the latest criminal assaults on objects of cultural heritage.

Under the sea, the race to find and ransack the next shipwreck with bullion of some sort or another aboard appears also to be on the increase, as unfortunately, contrary to the behest of UNESCO, anything goes in the free-for-all underwater world of 'international waters', the emphasis being on short term cash returns versus the long term preservation and economic value for tourism use of cultural finds from under the sea.

Salvage of shipwrecks for less valuable metals, such as copper and bronze, seems also to be a returning fashion, much as it was in Bermuda in earlier decades when there was at least one outfit here that purchased such 'scrap' materials for shipping overseas.

That is perhaps why bronze propellers are now missing from historic and picturesque shipwrecks in local waters, to say nothing of 'disappeared' portholes and other features of metal on those carcases of the misfortunes of others.

Nearer to Britain, where we sent hundreds of our young men in the two World Wars, some of whom died on the soils of The Netherlands or nearby, Dutch salvage operators are enacting the second destruction of HMS *Aboukir*, the war grave site (many would say, sacred) of over 500 men, including William Edmund Smith, the first Bermudian to give his life in the First World War.

War graves on land are considered to be sacred territory and the Commonwealth War Graves Commission and respective governments place great emphasis on the maintenance and preservation of such sites in honour of those who gave their lives for our future freedoms.

Underwater sites, being undercover (not to say underworld) as it were, are perhaps less well monitored, as exemplified by the ripping apart of HMS *Aboukir* in recent months, for the extraction of industrial metals.

The sacredness of the site in the sands off the Dutch coast relates to the first few weeks of the Great War (1914—18), the start of which for the British Commonwealth began on fourth of that month in the late summer of 1914, as immortalised in the title and content of Barbara Tuchman's classic book, The Guns of August, being a history of the first month of the conflict.

When the guns fell silent four years later at the eleventh hour of the eleventh day of the eleventh month in 1918 (commemorated as Remembrance Day, 11 November annually), some 35 million people were dead or wounded, including some six million allied troops of which 80 were Bermudians of the Bermuda Volunteer Rifle Corps, the Bermuda Militia Artillery and other services: nearly all the Bermudians were volunteers.

Of our 22 year old man off the Dutch coast, it is likely he enlisted in the Royal Navy, being: "SMITH, William Edmund, L/1874, 1st class cook, R.N., lost on HMS *Aboukir* 1914, September 22, a coloured man, believed to have been the first Bermudian to lose his life in this war, son of William Felix Smith and his wife Emma Jane, née Douglas, of Harmon's Hill, Somerset, baptised 1893, June 4, at St James Church, Sandys. Mrs Smith received a letter signed by Mr Winston Churchill, conveying the sympathy of the King and Queen."

The designation L/1874 may indicate that William Smith may have enrolled here first in one of the local forces before the War.

Termed the 'Live Bait Squadron' because of their age, HMS *Aboukir*, HMS *Cressy*, and HMS *Hogue* of the Seventh Cruiser Squadron were on patrol in the early morning of Tuesday, 22 September 1914, when *U-9*, a German submarine commanded by Lt Otto Weddigen fired a torpedo at *Aboukir*, which sank in 20 minutes with the loss of 527 men, including the Bermudian Smith.

Stopping to pick up survivors (thinking the *Aboukir* struck a mine), the *Cressy* and *Hogue* were then sent to the bottom as well; in all, 1459 men were lost in the 90-minute attack.

While it is no consolation, the fact is that the 'incident established the U-boat as a major weapon in the conduct of naval warfare'.

A number of naval associations have lodged objections to the desecration of these war sites by the Dutch salvage companies.

Archaeologists, such as one Andy Brockman, are also firing salvos across Dutch bows: "In case you have not seen today's Times [27 September 2011], the violation of the three ships has been condemned by the Ministry of Defence, and the Dutch cultural agency.

On a practical level, the ships alleged to be carrying out the raids have been identified as the MS *Bernica* and MS *Bela* based in Scheveningen.

However, the Dutch Coastguard are quoted as being unable to act in spite of the vessels being seen on site by a Dutch aircraft and wreckage being found on the salvage ships by Dutch Police.

The UK Ministry of Defence is quoted as making efforts with the Dutch authorities to prevent 'inappropriate activity'."

Not only are sites like that of HMS *Aboukir*, *Cressy* and *Hogue* cultural heritage, but they are the sites of serious social heritage.

In this instance, the *Aboukir* is the last tangible remains relating to the lost of Bermudian William Edmund Smith, aside from the Aboukir Monument at Southsea near Portsmouth, for in the nature of things, descendants here have little or nothing in the way of material mementos of their ancestor, not even a photograph.

As we approach Remembrance Day 2011, the *Aboukir* affair and other recent underwater salvage work again raises the question as to what price we place as a world community on underwater cultural heritage, especially as much pertains to the grave sites of mariners and others.

Many otherwise enlightened lands have yet, after a decade, to ratify the UNESCO Convention on the Protection of the Underwater Cultural Heritage, and we, being a Dependent Territory of the United Kingdom, fall into that category.

On Remembrance Day, spare a thought for William Edmund Smith, who, if he was trapped in HMS *Aboukir* when he met his Maker, has probably been rolled over in his grave (after 97 years of peace) by those seeking a fast Euro at the expense of others who gave their all to defend and liberate Holland from German domination in the two World Wars.

Edward Cecil Harris, MBE, JP, PHD, FSA is Executive Director of the National Museum at Dockyard. Comments may be made to director@bmm.bm or 704-5480.

HMS *Aboukir*, a Cressy Class cruiser, launched in 1900, pictured about 1905.

The HMS Aboukir Monument on the shore of the English Channel at Southsea, near Portsmouth.

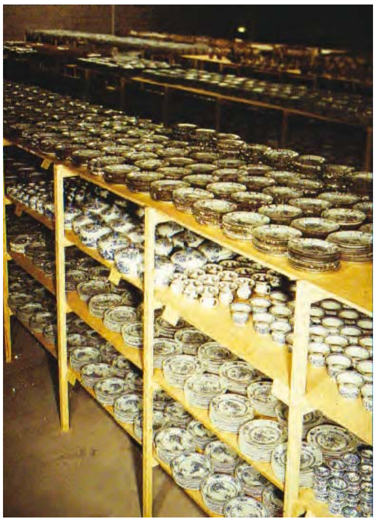
A commemorative card for a member of the losing side, perhaps William Smith's mother received one.

The commemorative card for the winning side, featuring the commander of the Kaiser's submarine *U-9*.

Ships from the First and Second World War still raise strong memories, therefore their 'memory value' is very high. This article from the Royal Gazette, (22 October 2011) deals with the destruction of three First World War wrecks for their scrap metal value. © Royal Gazette

It is not usual to determine a site in terms of its economic value, at least in terms of measuring the dollar value of material, such as ceramics, from the site. This is because archaeologists would like to have a clear distinction between the archaeological and historical significance and the economic value. Archaeologists will often rate a site on significance according to specific research questions and other factors, such as how representative it is. In cultural heritage management, however, economy is an important factor. The economic value does not have to be expressed in the value of the objects from a site, it could also be expressed, for example, in the value it has for tourism. From this perspective, it could be a very powerful tool to use when addressing crucial stakeholders, such as politicians. For management reasons it might be useful to complete a cost benefit analysis which makes clear that in some way an economic value is going to be assessed. This will influence the choice that has to be made in infrastructure (or development) projects to remove (e.g. by excavations) or to protect sites *in situ*.

In practice, the assessment of sites on the basis of values (such as archaeological importance) and its political or economic value will overlap and influence each other; something of high archaeological value will have a high political and economic value and vice versa.



A site that has been salvaged for its economic value is the eighteenth Century Dutch East India Company ship, the Geldermalsen, *found in Indonesian waters. Its cargo of mainly porcelain was sold at Christie's in 1986 for approximately 15 million Euros. © RCE*

Suggested Reading

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3 Different Kinds of Heritage

Another aspect that has to be taken into consideration is the fact that there is not just one cultural heritage. Over recent decades, heritage has been increasingly divided into sub-categories, such as World Heritage, Mutual Heritage, Intangible Heritage, Underwater Cultural Heritage, Vernacular Heritage, and so on. The significance of sites can be specified within these different heritage sub-categories. In addition, international, national, regional and local settings for heritage can also be distinguished. All these categories, sub-categories and settings are important to consider before determining the value of the place.

Suggested Reading

- Palmer, R (ed.). 2008. The Rural Vernacular Habitat, a Heritage on our Landscape. *Futuropa: For a New Vision of Landscape and Territory*. No.1/2008. Council of Europe.

4 Why is it Necessary to Assess Significance?

Limited resources means that not everything can be researched. Budgets, staff and time have to be carefully utilized and it is necessary to know what the known resources of cultural heritage are, so that sites can be assessed and prioritized. Significance also has to be measured in order to facilitate this prioritization process. Determining the significance of a site can be highly subjective, but by developing standards and using widely accepted methods, this process can be made as objective as possible or at least comparable. A transparent approach also opens up the process for discussion and improvement.

Underwater cultural heritage management, like all heritage management, is driven mainly by significance. Although it is just one step, it affects and dominates all choices that are made in the management process. Virtually all management decisions depend on the assessment of significance, as it is the determining factor for what is nominated for the register. It helps determine the kinds of research questions that are being asked and leads to choices about what is preserved (*in situ*) and what is destroyed for research programmes (excavations to gain information) and development projects. Overall, significance determines how sites are categorized, how they are managed, how impacts are mitigated and the choice of whether a site is considered heritage at all.

Interestingly in archaeology, significance is used for more than just assessing the value of a site; it is also an analytical tool for making interpretations of the past on a larger scale, such as reconstructing past societies or as a way to question our archaeological modes of enquiry. In short, significance allows us to reflect and question why material heritage is studied in the first place. In determining the significance of sites it is always necessary to reflect on the work that has been done, so that we can compare one site to another and consider if a study has any significance for the understanding of the past.

5 Different Methods of Assessing Significance

As has been illustrated, there are several ways to describe significance in relation to cultural heritage. Several articles have been published on the philosophy and the methods used to assess the significance of maritime archaeological sites. Many of these articles provide a strong foundation from which to base the development of local significance assessments.

There are two major aspects of significance to be distinguished; the intrinsic value and its relation to managing change.

The intrinsic value of a site is considered to be a large variety of values that cover the significance for scientific (or academic), cultural, social, economic, educative, amenity, community and personal use.

ADDITIONAL INFORMATION

1 Several criteria can be used to determine the intrinsic value of a site. The Australian Antarctic Data Centre provides additional information and insight on each of these. See www.aad.gov.au

The significance in relation to managing change relates to understanding how changes arise and what the implications are in altering the intrinsic value considerations. In order to judge this, there are well established conservation principles for heritage management. The issue here is how the significance of change is predicted, judged and managed once a key understanding of the intrinsic values are established (see *Additional Information 1*).

Suggested Reading

Staniforth, M. 2001. Assessing the Significance of Twentieth Century Underwater Cultural Heritage. Conference Proceedings: *20th Century Heritage: Our Recent Cultural Legacy*. D. S. Jones. (ed.). The University of Adelaide and the ICOMOS Secretariat, pp. 145-149.

Westerdahl, C. 1994. Maritime Cultures and Ship Types: Brief Comments on the Significance of Maritime Archaeology. *The International Journal of Nautical Archaeology*. 23.4, pp. 265-270.

5.1 Intrinsic Value

This aspect of significance needs to cover a wide range of values in terms of scientific/academic, cultural, social, economic, educative, amenity, community and personal use. All or any such values can also be seen in terms of importance, sensitivity and potential.

Importance can be seen as reflecting the scale at which values operate. These are often considered in terms of international, national, regional and local, but may actually be more culturally determined or of practical output (e.g. degree of social or educative engagement).

Sensitivity is a different aspect of importance and can be seen as having more to do with not only how strongly values are felt, but also how vulnerable they are to being lost or altered physically. Here, it is important to consider how easily detrimental consequences may arise if the heritage becomes devalued or overlooked. The number of people affected may increase the level of sensitivity regardless of the importance of the heritage

Potential is an important issue primarily because so little is known about most sites, that much of the assessment of the criteria used for determining significance, such as the physical state of a site, nature of the artefacts, and the importance of a site, usually remains incomplete. There is always more that can be done to reveal further intrinsic value and gain more public benefit.

Several criteria can be used to determine the intrinsic value of a site:

1. **The potential to yield important information about the past** which is not available through other means. It displays archaeological significance, including scientific or research significance.

2. **Historical significance:** It has to be considered whether a place has significant heritage value because of its special association with the life or works of a person (or group of persons), for its importance or events in cultural history or for its association with people, events, places and themes. Historically significant objects range from those associated with famous people and important events, to objects of daily life used by more ordinary people. They include objects that are typical of particular activities, industries or ways of living. Historically significant objects may be mass produced, unique, precious or handmade.

3. **Scientific, research or technical significance:** It has to be considered whether a place is representative of the period in terms of scientific, research or technical significance. A site or an object may have research significance if it has major potential for further scientific examination or study. Archaeological artefacts and collections may have research significance if they are provenanced and were recovered from a documented context or if they represent aspects of history that are not well reflected in other sources.

4. **Aesthetic significance:** A site may have significant heritage value because of the place's importance in exhibiting particular aesthetic characteristics valued by a community or cultural group. This is particularly evident for underwater cultural heritage sites which can be considered places of great visual beauty by divers.

5. **Social or spiritual significance.** A site may have outstanding heritage value to a nation because of its strong association with a particular community or cultural group for social, cultural or spiritual reasons. Shipwrecks can also be grave sites of special memorial significance.

6. **Experience Significance:** The visibility of a site within a landscape and its strong association to memory value can create a unique mood or character that enhances a site's significance.

7. **Economic Significance:** A site can be of economic significance either in the present day or future. This significance can be both a blessing and a curse. A blessing because it often has a higher significance in the eyes of crucial stakeholders (such as politicians) and is, therefore, more likely to be preserved, and a curse because a shipwreck with a cargo of high economic value is much more likely to be looted.

Not all of these criteria are always used. The most common in cultural heritage are historical significance, archaeological (scientific) significance and experiential significance.

Additional comparative criteria are then used to evaluate the degree of significance further:

1. **Provenance:** derived from the French *provenir*, 'to come from'. Provenance refers to the origin or the source of something, or the history of the ownership or location of an object or site. The primary purpose of provenance is to confirm the time, place and, if appropriate, the person responsible for the creation, production or discovery of the object or site. Comparative techniques, such as expert opinions, written and verbal records and the results of various kinds of scientific tests, are often used to help establish provenance.

   Provenance also refers to the chain of ownership and context of use, of an object or site. Knowing this history enables a more precise assessment. Provenance is central to establishing historic and scientific significance. An object or site may be significant because its provenance; a documented history of its existence, ownership and use, gives it a context in society at large or in the natural world, or in the more personal world of a known individual. Provenance has very particular meaning in some collection areas. Archaeological material should ideally be provenanced to a particular site and to an exact stratum and location within that site. Archaeological material removed from a site without having had its provenance recorded has little value unless it has other significance, such as aesthetic. Even then, an object whose archaeological provenance is unknown is diminished in value in the same way as an artwork of doubtful provenance.

2. **Representativeness:** something that serves as an example or type for others of the same classification. One could give a high significance to a shipwreck and protect it because it serves as an example for a typical kind of ship.

3. **Rarity/uniqueness:** something that is rare or scarce. Being the only one of its kind, without an equal or equivalent; unparalleled. Rarity usually scores high in significance. One could debate whether this is correct or not, but since the amount of assessed sites (and specifically shipwrecks) is still relatively small, rarity/uniqueness is a category where most sites will score highly.

3. **Condition**: completeness or intactness and integrity. An object may be significant because it is unusually complete or sound, original condition. Objects with these characteristics are said to have integrity. Changes and adaptations made in the working life of an object or site do not necessarily diminish significance, and in fact, are also recognised as an integral part of itself and its history. This can be measured when, for example, the range of materials being preserved is examined. When the amount of structure of a shipwreck that remains is considered, if, for example, the inventory is preserved, cargo, personal belongings, etc., we have to assess on what is well-preserved, and what is not can be subjective. What is well-preserved? Is it when it still looks like a ship with the mast still standing, such as those wrecks that are found in the Baltic Sea? Or is it well-preserved if it is possible to reconstruct the whole ship, even though the wreck itself is completely scattered on the seabed?

4. **Interpretive potential:** archaeological objects, collections and sites may be significant for their capacity to interpret and demonstrate aspects of experience, historical themes, people and activities.

In the hands of a skilled museum worker, most objects have potential to tell their story and their significance is best described in reference to one or more of the primary criteria. However, there are some circumstances where interpretive potential is a major attribute of an object or collection, or may indeed be the only criterion for which the object is significant. To some extent, interpretive potential represents the value or utility the object has for a museum as a focus for interpretive and educational programmes. It may also be significant for its links to particular themes, histories or ways of seeing the collection. Some objects may have very limited significance under the primary criteria, but they still may have some degree of significance for museums because of their ability to interpret and illustrate particular themes, people or ideas. This is the case for many humble, unprovenanced social history objects, where the object stands for or is used as a link to, wider themes or issues. Interpretive potential can be particularly important where certain aspects of history and experience are not well represented in museum collections. Some people's lives are not materially rich or well expressed in the material culture record. In museums, their lives or experience may be interpreted though generic objects that have interpretive potential, but are otherwise of limited significance.

5.2 Managing Change

This aspect of significance has to do with understanding how changes arise and what are the implications are in altering or affecting the intrinsic value considerations. In order to judge this there are well established conservation principles for heritage management. Here, the issue is how the significance of change is predicted, judged and managed once the key understanding of intrinsic values are established. This issue embraces consideration of 'types of change' which can be considered in terms of the dynamics, process, outcomes and significance of change. These can again be considered in terms of magnitude of change, alteration of value, risks and opportunities, sustainability, significance of effects, regulation and management, and indicators and monitoring.

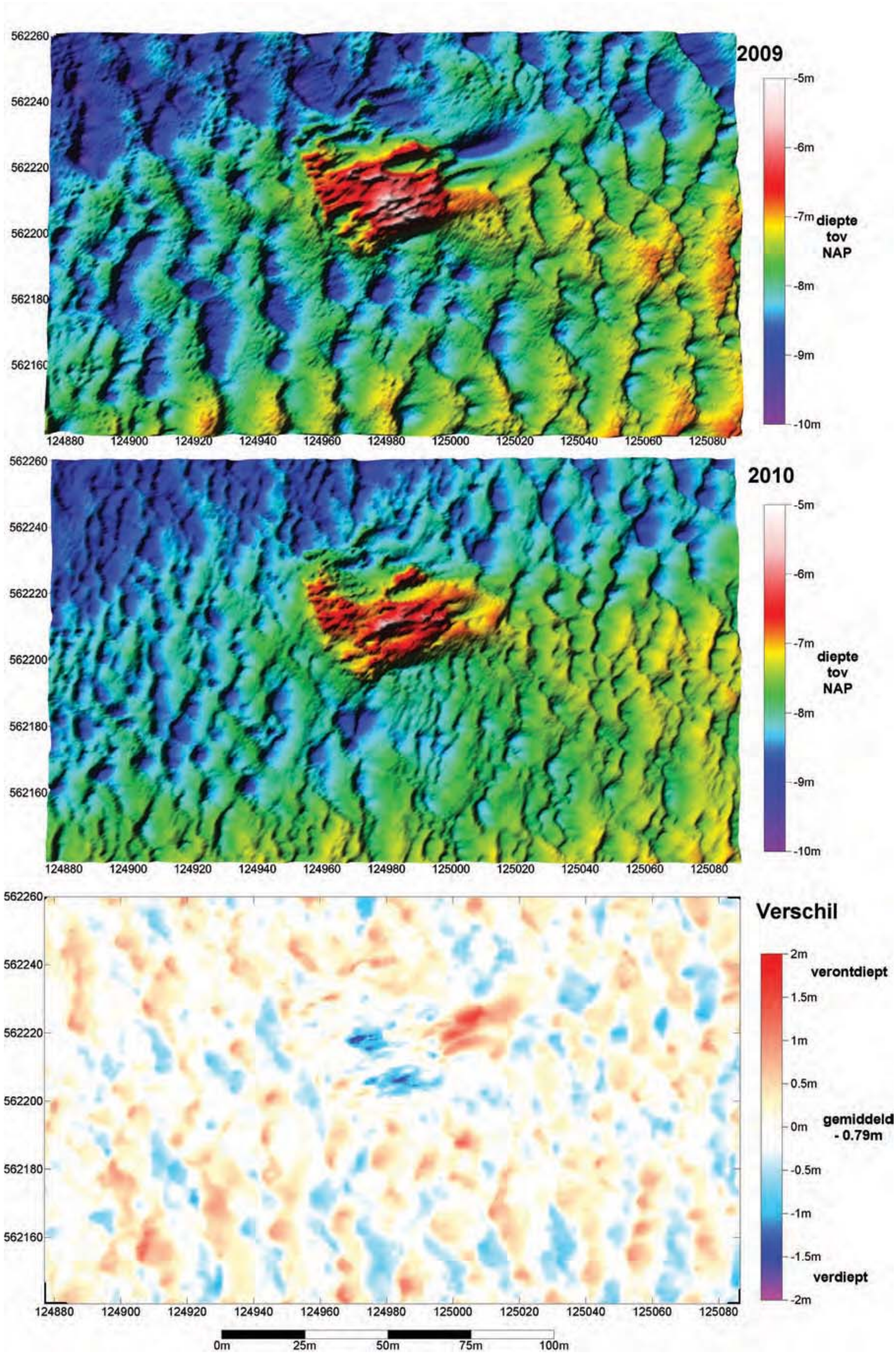
5.2.1 Types of Change

Dynamics of change: can be seen as changes that are beneficial, neutral or adverse and permanent or temporary in nature. This may also embrace whether changes are reversible or irreversible.

Process of change: can be considered in terms of sources of change. Activities, processes and physical alterations to the environment can all give rise to a range of ways in which effects can occur. These effects may be direct, indirect, synergistic (i.e. how different factors interact to create a different kind of change) or cumulative.

Outcomes of change: can be seen in terms of what intrinsic values are altered and from which outcomes may affect physical materials, settings, surroundings and perceptual, cultural and socio-economic issues (education, amenity and economic aspects).

This wreck has been destroyed by dredging. It is a form of sudden change to the environment which can be mitigated. See Unit 5: Desk-based Assessment. *© RCE*



The physical changes on a site can be monitored with multibeam recording. Here two recordings from different years (2009 and 2010) done on the BZN 10 wreck in the Netherlands. The lowest picture are the differences in depth between the two years. (c) RWS/RCE/Periplus Archeomare

Significance of change: cannot be determined without understanding both the intrinsic values and the types of change which may occur, including uncertainties that may exist, such as:

The magnitude of change: *is best thought of in terms of how far the intrinsic values of heritage may be altered and in particular how the special attributes that give it its value may either be enhanced or diminished. This will include how much both physical and perceptual aspects will be altered by the various ways that changes arise. There is also a distinction to be made between how much change will happen, where it is starting from and where it will end up (see limits of acceptable change).*

Risk and opportunity prediction: *is normally considered in terms of weighing up the seriousness of a hazard against the likelihood of it occurring. A similar concept can be applied to change in cultural heritage, where either the intrinsic values of a place or asset are not fully understood, or the magnitude of change cannot easily be predicted. The change may be either beneficial or adverse, so the uncertainty may be expressed either as a risk or an opportunity.*

Uncertainty and predictability: *are related considerations, as uncertainty is a simple acknowledgement that not everything is known to the level that is desirable. Predictability reflects a more quantitative approach to defining levels of uncertainty, usually based on the sampling parameters of studies undertaken to characterize the nature of the heritage asset (e.g. by non-intrusive survey or physical evaluation) and/or the scale of changes likely to occur. In the case of underwater cultural heritage these might, for example, include a prediction of increased levels of damage to a shipwreck as a result of more frequent visitation by recreational divers.*

Significance of effects: *is a balance between the importance of the cultural heritage in question and how much it will be changed for better or worse. Thresholds of significance are highly variable, but can be related to how far the effects of change support and enhance or are contrary to, specific cultural heritage objectives, policies or standards. This also encompasses external changes that may be contained in a variety of international, national, regional and local conventions, laws, policies, and programmes, codes of practice, design briefs, etc., which help to define standards against which significance can be judged.*

Sustainability of change: *seeks to weigh up the balance between the social, economic and environmental needs of society, which extend beyond the limits of how significance is measured in relation to heritage or environmental assessments. The way in which cultural heritage significance is judged may alter when these values are weighed up against other non-heritage environmental, social or economic needs.*

Limits of acceptable change: *there are various ways of looking at this, but often policies and legislation will indicate that significant change (as determined from considerations such as those outlined above) goes beyond a threshold of what is acceptable. In the public realm this may be defined by legislation and policy, but for some situations ethics, professional standards or technical considerations may define the limits of acceptable change. Public and legal opinion may also set the boundaries of what is acceptable and what is not.*

Regulation and management: *is a highly relevant topic related to significance both because regulatory bodies do much to define standards (e.g. significant criteria) and because they will often help define what is or is not acceptable. By doing so, they ensure the application of measures to avoid, reduce, offset or reverse negative effects and promote beneficial ones.*

Indicators and monitoring: *are further aspects of considering the significance of change because the actual changes that happen as a result of implementation, very often differ from what was expected. This is especially true in archaeology where unexpected new discoveries are often made that alter the parameters under which the original assessment was created. Monitoring is, therefore, not only a means of checking if assessments were right, but also modifying actions to account for new conditions. Indicators can be useful as a way to collect broad data on particular points of critical interest that enable us to construct a broad picture. Monitoring in its fullest sense also means collating information in such a way that it can aid us to make better judgements of significance in the first place.*

As has been illustrated, significance can mean a range of things and is in many ways subjective. When it has to be assessed, several different values have to be taken into account and weighed against each other. As a result it is crucial that when making an assessment, we do so in a structured and consistent manner.

5.3 Archaeological Impact Assessments (AIA) and Conservation Management Plans (CMP)

Resource management and understanding change have been explained in some detail, but to this point the topic of significance has been addressed in something of a vacuum; significance has been discussed as an important value, mainly for its own right. It is imperative, therefore, that we now apply the assessment of significance directly to 'real world' practical management scenarios. Resource managers rarely have the luxury of investigating underwater cultural heritage sites purely for archaeological or academic purposes. Site values are typically determined in response to the direct potential impacts they face from commercial development projects. Defining significance plays a major pragmatic role in two critical resource management tools: the Archaeological Impact Assessment and the Conservation Management Plan.

Impact assessments are designed:

- *To ensure that environmental and other considerations are explicitly addressed and incorporated into the development decision making process*
- *To anticipate and avoid, minimize or offset the adverse significant biophysical, social and other relevant effects of development proposals*
- *To protect the productivity and capacity of natural systems and the ecological processes which maintain their functions*
- *To promote development that is sustainable and optimizes resource use and management opportunities*

5.3.1 Impact Assessments

Definition: A particular type of evaluation that aims to determine whether, and to what extent, a programme causes changes in the desired direction among a target population or in an environment (Rossi and Freeman 1993). All assessments should be conducted in accordance with internationally agreed measures and activities.

Impact assessments are often designed to mitigate a wide range of adverse environmental and other impacts that can result from large and medium scale development projects.

All impact assessments, whether these are environmental (EIA), archaeological (AIA) or cultural (CIA), are executed in either the manner specified below or in a way that is fundamentally the same. See *Additional Information 2*.

ADDITIONAL INFORMATION

2 A brief outline of the sections required in an Archaeological Impact Assessment report was adapted from: Cameron, E. and Van den Bergh, J. 2003. *The CHIA System in Hong Kong 1997-2003 and Beyond*. Paper presented at 4th Annual KAPI Conference, Manila, Philippines, 23-25 October 2003.

A detailed overview of Archaeological Impact Assessment guidelines can also be found at: www.for.gov.bc.ca/archaeology/docs/impact_assessment_guidelines/preface.htm (Accessed Feb 2012).

Suggested Reading

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5.3.2 Environmental Impact Assessments (EIA)

Definition: studies undertaken in order to assess the effect on a specified environment when a new factor is introduced, which may upset the current ecological balance.

EIA guidelines: the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made. General Environmental Assessment guidelines are provided by the Asian Development Bank.

Principles of EIA best practice: a process of identifying, predicting, evaluating and communicating the probable effects of a current or proposed development policy or action, on the cultural life, institutions and resources of communities. The findings and conclusions are then integrated into the planning and decision making process, with a view to mitigating adverse impacts and enhancing positive outcomes. (See International Association for Impact Assessment: www.iaia.org).

The International Finance Corporation Performance Standard 8 is also a useful document that aims to protect irreplaceable cultural heritage and to guide clients on preserving cultural heritage in the course of their business operations. (See International Finance Corporation Performance Standard 8 on Cultural Heritage: www.ifc.org).

5.3.3 Archaeological Impact Assessments (AIA)

Definition: a process where a trained professional looks at an archaeological site and develops plans to determine what impact the proposed development will have on it.

Archaeological impact assessment studies are initiated in response to development proposals that will potentially disturb or alter archaeological sites. The role of the assessment is not to prohibit or impede land use and development, but rather to assist a government agency and/or private sector in making decisions that will ensure effective management of archaeological resources, as well as optimal land use.

A brief outline of the sections required in an archaeological impact assessment report is as follows:

1. The identification of all known heritage sites or areas with potential for underwater cultural heritage. This can include such things as shipwrecks and submerged cultural landscapes, which are shown to contain archaeological potential during a baseline review. The review will determine the need for appropriate field surveys. An archaeological survey will consist of field scans, survey, and excavations and a desk-based survey of written, photographic and map documentation on all identified and potential archaeological sites.

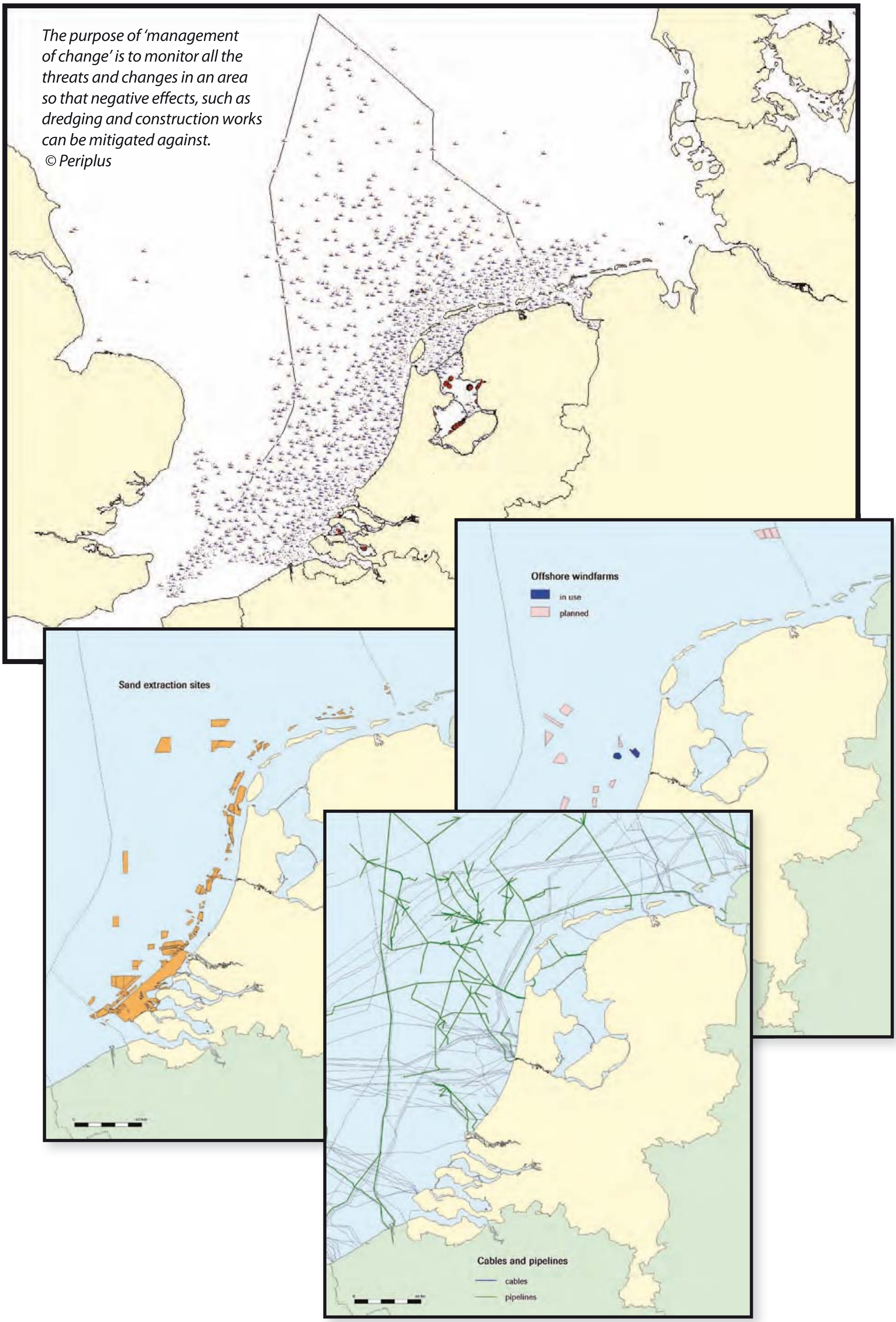
2. The identification of the impacts associated with the project and how (or if) they will affect the identified heritage sites. These include both direct impacts, which can damage or destroy heritage sites, as well as indirect impacts, such as a change in the environmental setting of a shipwreck site.

3. The presentation of mitigation recommendations designed to remove or at least minimize any identified impacts to acceptable levels. These can include changing alignments to avoid archaeological sites or the implementation of a rescue excavation, if avoidance is not possible. This should also include a schedule for the implementation of the mitigation measures.

4. Archaeological impact assessment studies should be required where potential conflicts have been identified between archaeological sites and a proposed development. Sites need to be located and recorded and site significance evaluated, in order to assess the nature and extent of expected impacts. The assessment includes mitigation recommendations to manage the expected impact of development on the site.

These mitigation recommendations may include:

- *Avoiding the site*
- *Recovering archaeological site information prior to land altering activities*
- *Monitoring for additional archaeological site information during development activities*



The purpose of 'management of change' is to monitor all the threats and changes in an area so that negative effects, such as dredging and construction works can be mitigated against.
© Periplus

Assessments may require a heritage inspection permit issued by the relevant authority. Permitted archaeological impact assessments are used to identify site locations, evaluate site significance and determine the magnitude of development related impact when sites cannot be avoided.

The relevant authority would review the application and permit deliverables, such as a report, manage consultation with local and indigenous communities and provide management directions for the sites.

If the site is found to be highly significant and development cannot avoid disturbing these values, systematic data recovery excavations may be required to retrieve information that will be destroyed as part of the development. These studies may answer general questions such as the age of the site, the type and nature of the site. Detailed systematic data recovery can be expensive, but is relatively rare, as most developments have the flexibility to minimize disturbance to archaeological sites by avoiding them.

If development activities that disturb the seabed, such as wind farms, building bridges or marinas, laying subsea oil or gas pipelines, need to be conducted within the boundaries of a recorded archaeological site. The development may need to be moved or a site alteration permit may be required. These permits may be issued by the relevant authority. Permit applications may be prepared by a qualified professional archaeologist on behalf of the developer (such as the assessment undertaken by the University of Southampton for the BritNed project – a pipeline being laid between Britain and the Netherlands), and are designed to minimize and mitigate impacts to the archaeological site.

Screening

Screening should be based on a development proposal and so needs be undertaken during the early part of the planning stage. This will help to determine whether a development proposal should be subject to an impact assessment and if so, what level of detail is necessary to determine which proposals may cause potentially significant effects.

Scoping

Scoping is used to identify both the issues and impacts that are likely to be important and to establish terms of reference for an impact assessment. Qualified, experienced and competent staff within government agencies are required to undertake both screening and scoping.

Submission

Usually an impact assessment should be undertaken by an independent consultant or expert, although an alternative is for a government agency to take responsibility for it. Regardless of who undertakes the impact assessment, the resulting submission should be evaluated by qualified staff from a government agency. In the event of a conflict of interest, one solution can be to have an independent evaluation of the report.

Consultation

Where a project may affect cultural heritage, the expert (or the government agency) should consult with affected communities and other stakeholders within the country who use, or have used within living memory, the cultural heritage for cultural purposes. This will help identify significant cultural heritage and to incorporate into decision-making process the views of the affected communities. Consultation will also involve the relevant national or local regulatory agencies that are entrusted with the protection of cultural heritage.

Consideration

Ultimately one party, usually a Minister on behalf of a government, has to consider the impact assessment. During this part of the process, the Minister should be guided by expert evaluation from within government agencies. Finally, the decision can be finalized and the result announced.

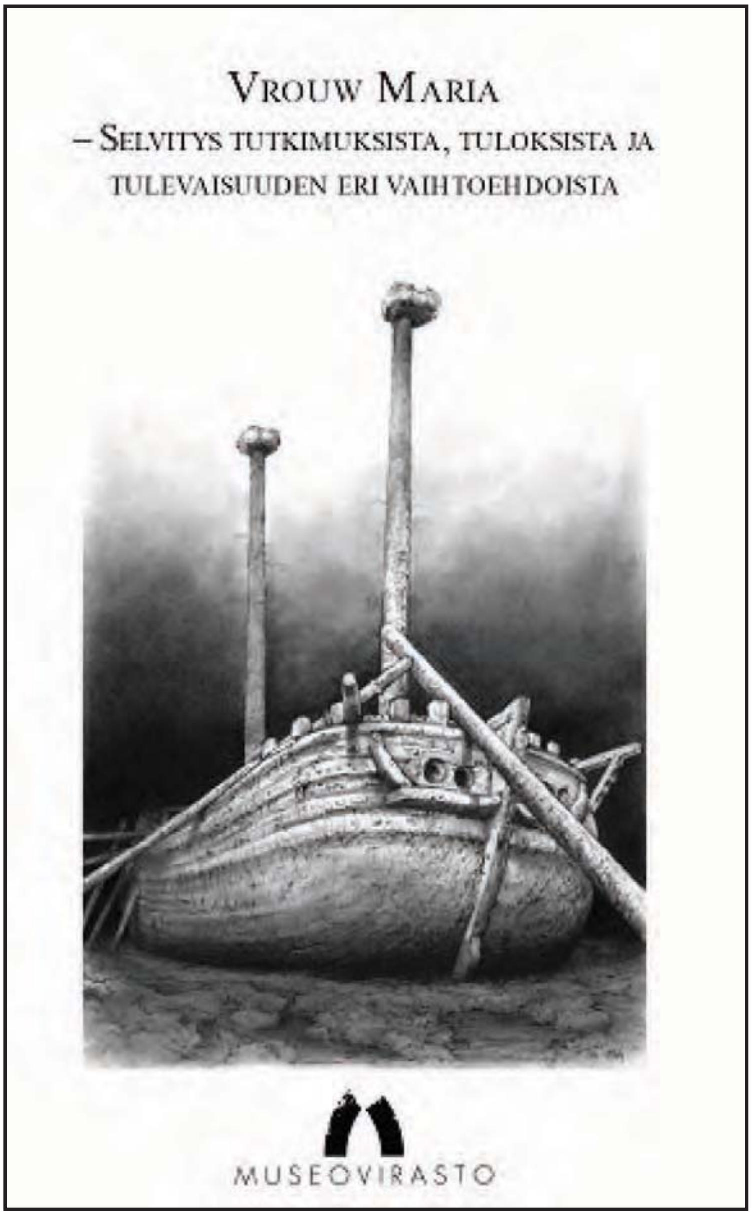
For more information on assessing sites see Unit 5: *Desk-based Assessment*.

5.4 Management Plans for Underwater Cultural Heritage

A management plan is a tool that structures the work that has to be or has been undertaken at a site. If well structured, all sites utilizing a management plan can be compared and used for planning time and budget. Due to the fact that maritime history and archaeology, especially regarding shipwrecks, has an international setting, trials are being undertaken to structure the way individuals observe, assess and overall manage, archaeological sites world wide. In the future it might be possible to compare assessed sites from Sri Lanka with those from Indonesia and European countries. In that way, information gathered will be available and of use by all researchers and policy-makers regardless of where they are from.

5.4.1 MoSS Management Plan

A management plan developed within the MoSS project (Monitoring, Safeguarding and Visualizing North European Shipwreck Sites: www.mossproject.com) has been executed in several EU countries and is available in English. The plan has been especially designed for sites underwater and is a dynamic document that requires updating each time something changes on the site. This design, for example, has been used by the Maritime Archaeological Unit of Sri Lanka.



Management plan of the Vrouw Maria *wreck in Finland, as it was developed within the MoSS Project. © MoSS Project*

The MoSS-project management plan is based on the following principles:

1. The format has to be the same in all countries working on the MoSS project and all countries should be able to use it.
2. A management plan should be made for all kinds of shipwreck sites.
3. A management plan can be based on very little information.
4. The management plan is not a static document; it should develop over the years.
5. All subjects should be clear to everyone and what to put in each section of the plan should be self-evident.
6. Wrecks should be described in the same way.
7. The importance of the wreck for maritime archaeology should be stated.
8. All types of research can be incorporated.
9. The management plan should be accessible and understandable for different kinds of professionals.
10. Each part of the management plan should be able to be used as an independent document.
11. It is unlikely that everybody who needs to obtain information from the management plan will read the complete document. It is therefore important that the format should be designed in such a way that there is a general summary and index which will aid simple navigation through the plan.

The format used for the MoSS developed Master Management Plan consists of the following chapters:

Management Plan of [Name] Shipwreck Site

0.0 Administrative details
1.0 Introduction
1.1 Previous studies
1.2 Historical context
2.0 Assessment of the site
2.1 Description of research
2.2 working procedure
2.3 Research results
2.4 Risk assessment
3.0 Cultural valuation of shipwreck
3.1 Experience aspects
3.2 Physical quality
3.3 Quality of archaeological information
3.4 Conclusion
4.0 Site management agenda

Date of re-evaluation by different professionals should also be indicated in the plan. Interested parties, such as scientists and policy makers, should be able to gain access to at least some parts of the management plan. It is, therefore, very important that everybody understands each other, as miscommunication can be disastrous for maritime heritage.

Unit Summary

It is necessary to understand in detail the nature and extent of the significance that a heritage place has in society, in order to protect, preserve and conserve the values of that place. What is of value and what is not, may and often will, differ from person to person, or country to country. In order to determine significance for heritage management purposes, it is important to establish criteria, specifically designed to help heritage managers examine all of the factors that need to be taken into consideration. The intrinsic archaeological significance and the significance of change are important in this respect. Working with cultural impact assessment forms or management plans can help to further standardize assessments of archaeological significance. A summary of criteria covered in this unit are outlined below.

Value and Significance: A Summary Table

Is there enough of a wreck here to be significant?

Provenance
Representativeness
Rarity/uniqueness
Condition/completeness
Interpretive potential
Capacity to inform us about the past

Does this wreck have intrinsic significance/value?

Potential to yield important information
Associated with important events or people
Distinctive characteristics of a period
Representativeness
Social or spiritual significance
Significance in experience aspects
Economic value in the present time and future

What are the implications of change to this value?

Dynamics of change
Beneficial/ neutral/adverse
Permanent/temporary
Process of change
Sources (causes)
Direct/indirect
Synergistic/cumulative
Outcomes of change
Physical fabric
Setting and surroundings
Perceptual and cultural issues
Socio-economic aspects

Suggested Timetable

15 mins	Introduction
75 mins	Assessing Underwater Cultural Heritage Significance I - *Introduction* - *Significance Assessments* - *Difficulties and Sensibilities of Adding Value to Cultural Heritage*
	Break
90 mins	Assessing Underwater Cultural Heritage Significance II - *Different Kinds of Cultural Heritage* - *Why is it Necessary to Assess Significance?* - *Different Methods of Assessing Significance*
30 mins	Concluding Remarks and Closure

Teaching Suggestions

Throughout this unit students are introduced to the concept of significance in the management of underwater cultural heritage. The unit provides students with an understanding of the importance of significance assessments and the role they play in the management process. Some topics covered require more detailed guidance and explanation by the trainer than others. A few topics that may require additional teaching time or illustrated examples are listed below.

2 Difficulties and Sensibilities in Adding Value to Cultural Heritage

When covering this topic it may be useful for trainers to illustrate the teaching material using heritage examples from both within and outside the region. Ideally, these examples should demonstrate how value is added to cultural heritage on land (built heritage and archaeology).

5 Different Methods of Assessing Significance

When covering this topic it is crucial that trainers highlight two fundamental aspects; that there is an intrinsic significance that determines the initial value of a site and there is the significance of change that determines the stability of the site and the value it will keep over time.

5.3 Archaeological Impact Assessments (AIA) and Conservation Management Plans (CMP)

Management plans and Archaeological and Cultural Impact Assessments are some of the most complex topics presented in this unit. Additional time and guidance should be provided by the trainers to ensure that students have a solid understanding of each.

Practical Session

It is important that the students are provided with the practical task of applying significance assessment to at least one chosen area. Trainers should select two underwater archaeological sites and provide data and information regarding both for the students to consider. Students should be briefed to undertake a significance assessment based on several criteria explored in the unit and determine the overall significance of the site.

Alternatively students can be invited to bring data and information from a site in their own country to undertake a significance assessment. The advantage of this is that the results may be used and can serve as a blue print for how to do significance assessments in the student's own country. Be sure to brief students well in advance so that they have enough time to gather the relevant information required to complete a thorough assessment, prior to the start of the course.

It is recommended that students have one hour to interpret the information using the knowledge gained during the training. The conclusions of the practical assessment can be discussed in a plenary session.

Suggested Reading: Full List

Allen Consulting Group. 2005. Valuing the Priceless: The Value of Historic Heritage in Australia. *Research Report 2*. Heritage Chairs and Officials of Australia and New Zealand, Sydney, November 2005.

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- *Australian Antarctic Data Centre:* ***www.aad.gov.au***
- *European Commission:* ***ec.europa.eu/environment/pubs/studies.htm***
- *MoSS Project:* ***www.mossproject.com***
- *National Disaster Management Authority (Pakistan):* ***www.ndma.gov.pk***
- *Planning and Archaeology in North West Europe:* ***www.planarch.org***

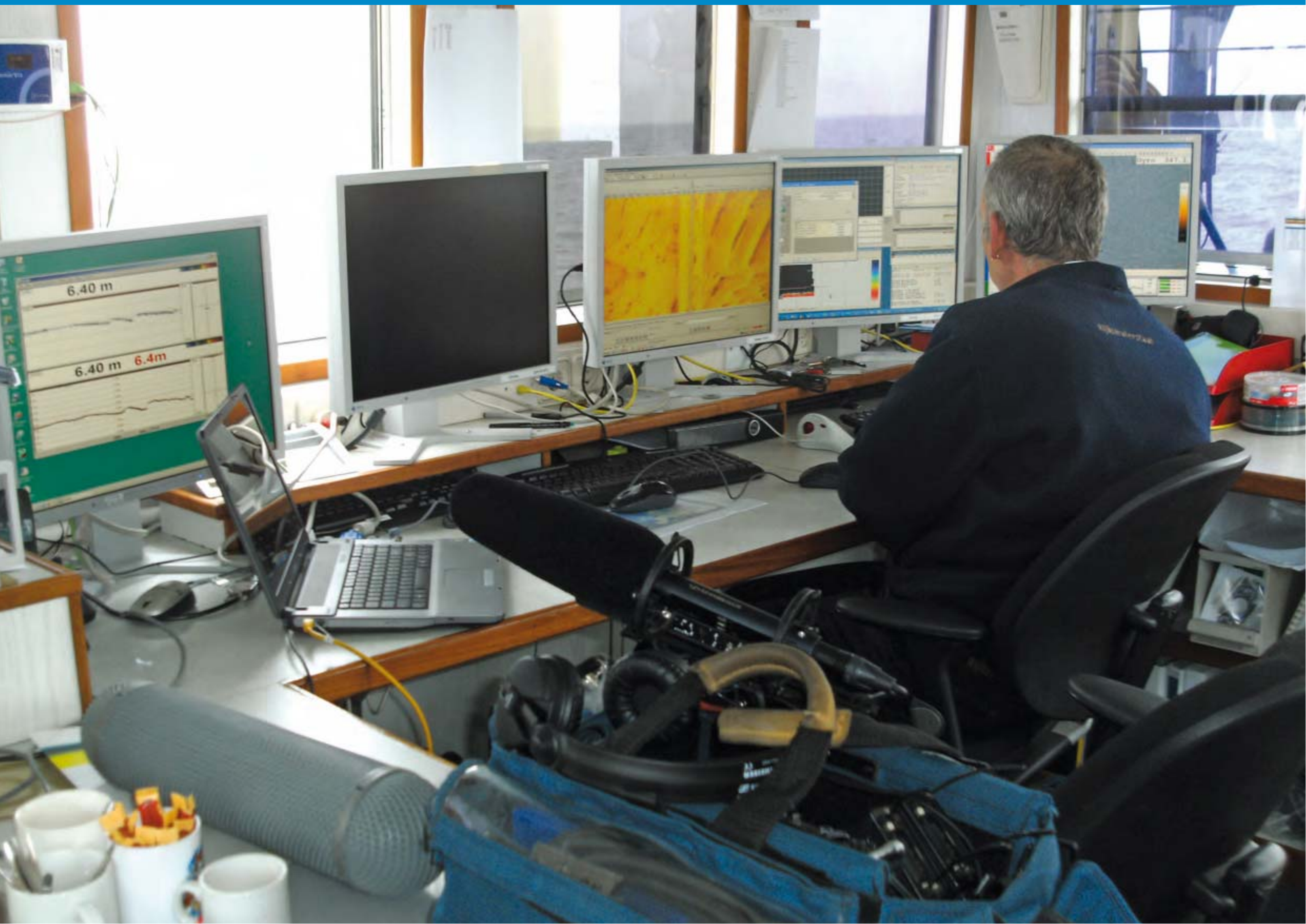
United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 7

Author Peter R. Holt

Data Management in Maritime and Underwater Archaeology



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Cover photo: Archaeologists must carefully manage data from a variety of sources throughout each phase of a project. © Martijn R. Manders

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UNIT 7

Contents

UNIT 7

Author Peter R. Holt

Data Management in Maritime and Underwater Archaeology

Core Knowledge of the Unit

This unit introduces students to data management in maritime and underwater archaeology and provides guidance on some of the techniques and methods that can be implemented during projects.

Upon completion of the Data Management in Maritime and Underwater Archaeology unit, students will:

- *Be able to identify and understand the main issues surrounding the management of archaeological data*
- *Understand the importance of managing data*
- *Be familiar with techniques and methods appropriate to each stage of a project*

Introduction to the Unit

This unit focuses on the issues relating to the management of digital data in maritime or underwater archaeology. It is important to take into account that although the problems and solutions often also relate to terrestrial and intertidal archaeology, the topics covered in this unit only mention these parallels where necessary.

1 Archaeological Archives

Archaeological fieldwork has the potential to generate a vast amount of data in the form of an archive. As a result, it is essential that the results of any fieldwork are properly documented, particularly as excavation is destructive, so that data and information can to be preserved by record.

The archive should contain all of the information available about the site, including:

- *Initial project proposals*
- *Project design documents*
- *Primary records*
- *Drawings, photographs and video*
- *Analysis results*
- *Research reports and interpretations*
- *Publications*
- *Computer generated models*

As the archive is used as the basis for future publications, project planning and museum displays, it is essential that the recorded information is both easy to recover and easy to use. A recording system used to capture site data can be as simple as a paper notebook or as sophisticated as a computerized digital information management system.

The data may be held on different media storage devices (such as CDs, DVDs, flash drives, etc.), which can often result in a variety of incompatible formats evolving as the project progresses. Any recording system must be capable of storing, managing and allowing access to this disparate set of data in an efficient way. It is, therefore, imperative that publication and archiving should be a central function of any recording system rather than an afterthought.

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2 Recording System Types

Recording systems used on maritime archaeological projects vary widely in their content and complexity. They are usually based on one of the methods outlined in this section.

2.1 Paper-based Systems

Paper based recording systems are appealing as the paper records are physical, can be created by anyone and they can be inspected or modified at any time.

An example of a paper-based system. *© Peter R. Holt*

2.1.1 Notebooks

Paper-based systems usually come in the form of notebooks. Some of the benefits and drawbacks of using notebooks are:

- *They are readily available and easy to use*
- *Flexible enough to be able to record any information, allowing for both text and illustrations to be made on the same page*
- *Unlike a digital system, a notebook can be read at any time without the need for electrical power or a suitable computer*
- *Unfortunately, it is difficult to be consistent in the information recorded in a notebook, especially if more than one person is compiling the data*
- *Training people in the use of the notebooks can be difficult if little consideration has gone into the structure and content of each book*
- *For large projects, the use of notebooks rapidly becomes unmanageable as the number of notebooks increases*
- *Notebooks are hard to copy and, thus, hard to archive, they are also both easy to lose and are easily damaged, so data security can be a problem*
- *The information in a notebook is hard to process and often hard to recover, especially if the handwriting is illegible*

2.1.2 Pre-Printed Forms

- *Pre-printed forms allow information to be structured under the designated framework of fields, with each field acting as a prompt. This makes the recording of the information more consistent and easier to locate and analyse. The information about a site can be sub-divided into separate forms, for example, for recording sketches, context and structural features of individual objects*
- *Unstructured text notes can also be recorded on areas of the form allocated for that use*

2.2 Digital Systems

Computer-based or digital recording systems are a modern alternative to paper-based systems and offer a range of advantages:

- *Digital systems often work with pre-printed forms as an interim step where direct entry of data is not possible, for example, for recording survey measurements underwater*
- *Information in a digital documentary archive is easily displayed, retrieved, shared and copied, leading to increased productivity and reduced data loss*
- *Digital recording places greater demands on the accuracy and availability of the data, which subsequently improves the quality of the information recorded*
- *Digital systems offer improvements in efficiency and can allow site records to be updated in the field.*
- *Offer the potential to publish both rapidly and widely using online digital archives*

Five types of digital systems have been developed:

2.2.1 Spreadsheet Systems

A simple, but effective recording system can be created using a spreadsheet programme, such as Microsoft Excel. A single spreadsheet contains rows and columns of cells that can be used to contain information. Each column can contain one particular property or item of information and each row can relate to one particular object. Separate sheets can be created within the same file for recording different categories, such as survey measurements, artefact information or details about features and contexts.

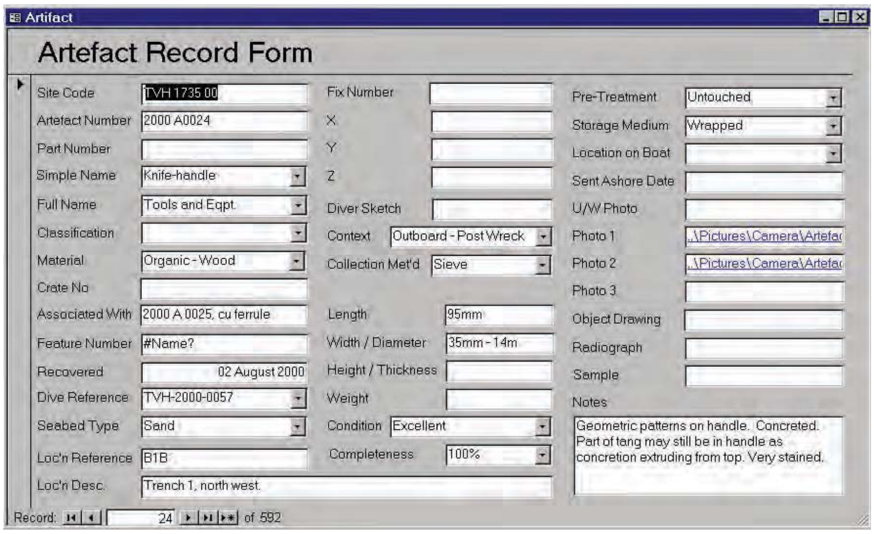
Each column can be configured to accept the correct type of information, such as text in a 'Description' column or numeric data in a 'Length' column. For cells that have a limited number of options it is possible to create a spreadsheet that only allows entry of a limited set of options, which can provide a solution to the problem of data validation. It is also possible to add links to cells, so that an image or text document can also be displayed. This can be useful for linking artefact images with artefact records.

The data contained within the spreadsheet can be searched and filtered simplifying the subsequent processing. The contents can be exported to files that can be read by other programs and the data can also be printed.

Spreadsheet systems are very easy to set up, use and extract information from, but are rather limited in capability compared with the other digital options.

2.2.2 Database Systems

Although similar to a spreadsheet, database systems offer more powerful data entry, searching, export and reporting options, which for larger projects can offer some advantages over a spreadsheet. Database systems are usually more difficult to set up and manage than a simple spreadsheet, requiring expert knowledge to do all, but basic tasks.



An example of a database artefact record.
© Peter R. Holt

2.2.3 Computer Aided Design (CAD) Systems

Computer Aided Design (CAD) systems are used to create drawings and 3-dimensional models. By providing a means of recording spatial information missing from a database, these systems can work in conjunction with a database to record the dataset for an entire archaeological project. Some modern CAD systems can be tightly coupled with a database, allowing properties to be recorded along with spatial information, blurring the edge between what is a CAD and what is a Geographical Information System (GIS).

2.2.4 Geographical Information System (GIS)

One major disadvantage of both spreadsheets and database systems is their inability to display maps. The position of objects is very important in archaeology, so the ability to display spatial information is a great benefit, as it helps us identify patterns not easily determined from non-spatial records. In its most simple form, Geographic Information System can be thought of as a database that can manage spatial data, so it can be used to display information on a site plan, therefore, increasing clarity and accessibility of the information. See Unit 8: *Geographical Information Systems (GIS) in Underwater Archaeology.*

Most low cost commercial GIS are not designed for one particular task, but can be used to display and process any spatial data. These systems need to be configured for recording archaeological information, so they also require expert knowledge in their set up and usage.

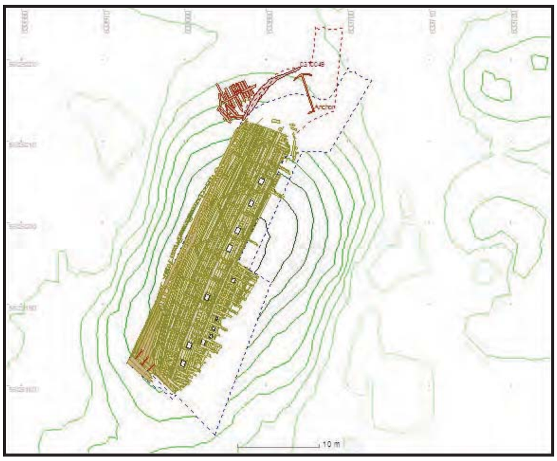
2.2.5 Information Management Systems (IMS)

Information management systems that are designed for recording archaeological data have been developed. These systems incorporate the best features of database systems and GIS, but also include many other useful features not found in generic systems. As well as being more powerful than generic systems, they are also easier to use and have the advantage of being designed for the task, containing only tools that are useful.

Some of these systems are capable of managing data collection and processing in real time, an essential feature where timescales and funding are constrained or data is being collected at a very high rate.

Processing the data as it is collected allows problems to be identified and rectified before leaving the field. It also dramatically reduces the work that has to be done after the fieldwork is complete.

An example of such a system is 3H's Site Recorder, which has been used on sites in over twenty countries including: the *Avondster* (Sri Lanka), *Mary Rose* (United Kingdom), Kizilburan Wreck (Turkey), *Le Forniche* (France) and *Pandora* (Australia).



The Mary Rose *hull and bow positions shown in Site Recorder. © Peter R. Holt*

2.3 Disadvantages with Digital Systems

As well as providing a significant number of benefits, there are some disadvantage to using a digital recording system. The most significant problem is the need for a computer to be available before the records can be viewed. This restricts the use of the recording system to sites where power is available and the working environment allows the use of a computer. Netbooks might provide an interim solution to the lack of mains supply, as they tend to have a longer battery life than most laptops and the battery can either be replaced with a spare or recharged overnight.

Digital records are sometimes seen as fragile or ephemeral and can be easily accidentally deleted or destroyed. Although this is true, problems can be avoided by a carefully designed recording system that is accompanied by a robust backup and archiving policy. It is important for measures to also take into account potential problems associated with the unknown lifetime of digital systems and changes in formats.

ADDITIONAL INFORMATION

Further information about the use of Site Recorder on sites around the world can be found on 3H's website: http://www.3hconsulting.com/SitesMain.htm (Accessed February 2012).

2.4 Digital Recording System Requirements

Although systems may differ in what information they record, the basic requirements for any system are very similar. They include:

- *Information capture*
- *Ease of use*
- *Sharing*
- *Backup and archiving*
- *Searching, sorting and associating*
- *Data validation*
- *Collection management*
- *Publishing*

Suggested Reading

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3 Recording System Requirements

3.1 Information Capture

The most important requirement of any recording system is to be able to capture sufficient information about a site in a systematic way. The aim is to record a site accurately and completely, and to do the work efficiently. The recording system needs to be able to capture all of the diverse information about a site: the spatial information defining the positions of things, the descriptive information defining the properties of objects and the temporal information that records what happened and when. Information that is not recorded may be lost forever if the site is being excavated or if the site is damaged or destroyed at a later date.

The systems should primarily deal with information as hard facts and clearly separate these from interpretation, which being based on experience and background allows for different opinions. Interpretations of what things are or what they are used for should be kept separate from absolutes, such as position or dimensions.

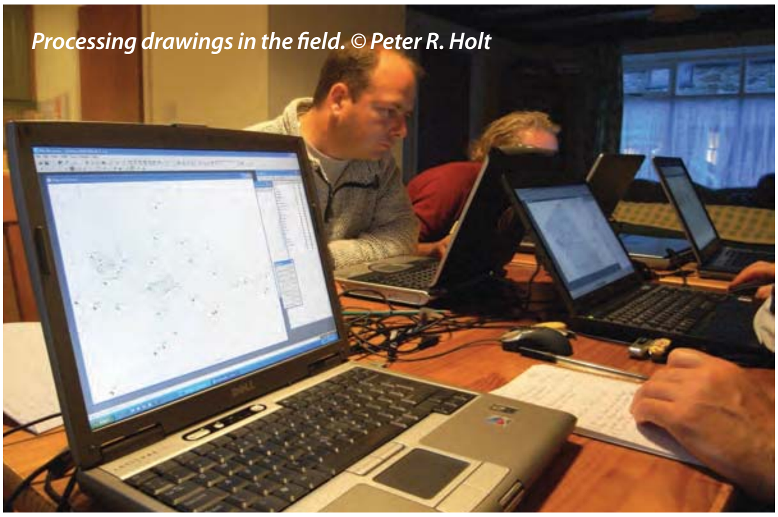
3.2 Ease of Use

The second most important requirement is that the system is simple to set up and to use. The factors to consider are the same as those for any software application development and include:

- *Ensuring that the most common tasks and actions are simple and can be easily completed*
- *The way the system works should be consistent, so that the controls for similar tasks can be grouped together*
- *The information contained within the system should be well organized, conveniently accessible and easily retrieved*
- *The system must be scalable; it must work just as well for recording a simple survey, as it does for a full excavation*
- *The system must be efficient and must respond within a reasonable time. All common actions should be completed within 1 second for the system to feel responsive, rather than sluggish*
- *The system must be low cost and easily implemented. Any system that is too expensive to use will not be utilized and any system that is too difficult may be used incorrectly*

3.3 Sharing Information

Information about a site can be readily shared using a digital recording system. The complete set of records about a site may be held on several DVDs, external hard drives or flash drives, which enables the entire dataset from a project to be made available online.


Processing drawings in the field. © Peter R. Holt

3.4 Metadata

An integral part of the recording system is the additional information about the data that it contains, known as metadata. The metadata provides information about what has been recorded, how and when it was recorded, who did the work and who owns it. Metadata provides a useful summary and can be used by people and computers to determine whether the information is of interest, without having to examine a full set of data.

3.5 Backup and Archiving

It is easy to copy electronic information, make backups and create an archive. Having multiple copies of essential information mitigates loss or damage to the original and overcomes some of the problems associated with the fragility of digital data.

3.6 Searching, Sorting and Associating

Another powerful feature of a digital system is the ability to search rapidly and accurately through thousands of records, something that is impossible with paper records. Associated with this is the ability to filter records so that sub-sets of the data can be displayed in lists and on charts.

The ability to search and filter by object name, object type or any other property is essential. Keywords can be appended to each object to help with targeted search, so long as they are known in advance. Just as powerful is the ability to associate or relate information within the system, as this adds value to the data.

Associations form a direct cross-referenced connection between objects in the recording system, allowing a seamless jump between one and the other. An example of this would be to allow associations between information about dives recorded in dive logs with artefact records. From the artefact record, it is then possible to retrieve the dive record on which the artefact was discovered, along with the notes and sketches the diver made at that time.

3.7 Data Validation

A digital recording system limits the opportunities for making mistakes, either when adding data or when searching for information. This feature is less significant when data is added to the system by only a small number of key team members.

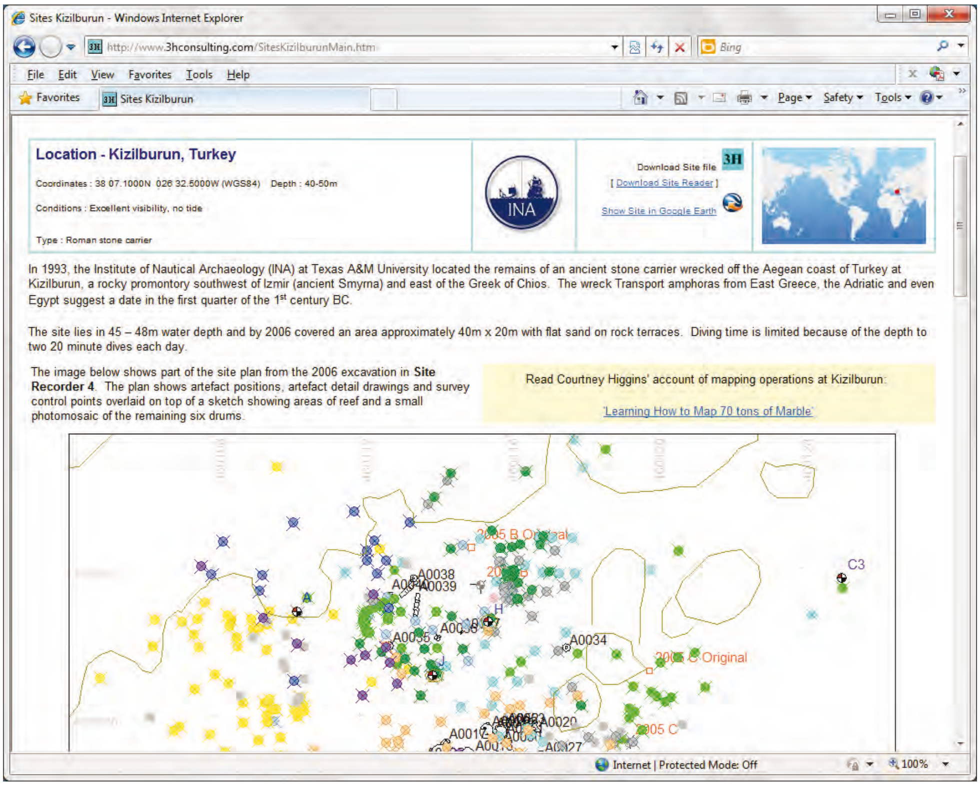
Some information entered into a digital system can be restricted to ensure that only valid information is provided. Examples of this include limiting input to only one of a set of valid values or ensuring that a numeric value entered is above or below a given number. This restriction of choice can be applied to descriptive terms, as well using a list of valid words defined in a word list or thesaurus, such as those that are part of the Information Management System, Site Recorder.

3.8 Collection Management

As well as being used as a repository for information, the recording system may be used as a tool for managing the collection of cultural material. The system contains information about each artefact in the material archive, so can be used to track its progress from discovery through recovery, registration, conservation and storage.

3.9 Publishing Information

Access to data is a major driving force in archaeology today and publication is a natural extension to the role fulfilled by a recording system. A digital recording system should allow for public access to primary data, perhaps even before preliminary and final interpretations have been made. Publishing information from a digital system is a simple process as the digital information can readily be converted to a format used by other computer programs. Information in a digital form can also readily be converted into a form that can be deployed on the Internet, either by using fixed pages of information or by using dynamic pages fed with data from an online database. Archaeological site information published online can then be directly searched by anyone or any program on the Internet.



Site information published on the internet.
© Peter R. Holt

Suggested Reading

Madsen T. 1998. *Design Considerations for an Excavation Recording System, Design and use of Field Information Systems*, CAA-NL98.

4 Recording Systems: What Should be Recorded?

It is important to make sure that the recording system is capable of handling all of the different types of information that need to be recorded. The system may use a basic design and be limited to simple survey work or it may be more powerful and used for managing data from an excavation.

The first step is to make a list of all the information to be recorded about the site. The information can then be sorted into groups according to information type.

4.1 Information Types

Having decided on the scope of the system, the requirements can then be defined in detail. The aim is to record both the information contained in the archaeological site and that relating to the work undertaken to acquire it, as this helps with later analysis.

4.2 What Needs to be Recorded?

Primary data: original recordings taken at the site by archaeologists and site recorders.

Activities: what has been done at the site in terms of recording, excavation and monitoring activity.

Historical records: any documents or images relating to the site.

Reference documentation: information regarding other similar sites and historical events.

An archaeological site and the work done on that site can be recorded in a set of individual records that relate to each phase of work.

These records can include events that have already happened and any fieldwork planned for the future. Different records or different units of information in common records, will be required for each of the phases of work on a site: planning, searching, mapping, excavating, conserving, publishing and monitoring. By identifying what is to be recorded at each stage, the data can be defined and be managed by the recording system.

4.3 Records as 'Objects'

Computer records are most easily modelled as an individual 'object' rather than as something in a simple list. Recording 'objects' can be thought of as physical 'things' inside the computer, even though they do not physically exist. The advantage of using objects is that we can make our records more useful, as they can be associated with one another.

4.4 Object Properties

The framework of a database schema can be determined once what will be recorded has been decided. This involves determining which objects will be recorded and what properties they contain.

Object properties are the items of information that need to be recorded. Each recording system contains objects and each object contains a list of properties. For example, for an artefact it might be necessary to record properties such as its name, position, length, width and height. For a dive log, a record of the name of the diver, supervisor, time in, time out and maximum depth will be required.

4.5 Names and Object Identification

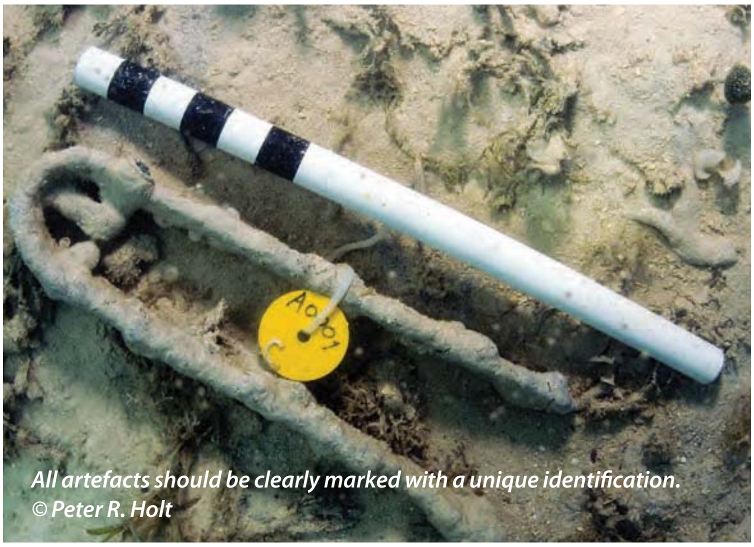
One of the fundamental requirements of a recording system is that every object must have a unique identifier so that it can separate one object from another. The name of the object is often used to do this. Using the name as the identifier means that two objects with the same name cannot be allowed to exist in the system, even by accident.

In practice, appending an object type identifier to the name can help interpretation of maps and charts. For example, all artefact objects use the prefix ‘A’, while all survey control points use the prefix ‘CP’.

Adding a year code seems to be helpful in practice, even though it is not necessary, as the next free number can be used at the start of a new season and the date of recovery should identify the year. Two digit year codes are usually sufficient as the metadata associated with the site should identify the specific millennium. The year should be added at the front of the name, forming, for example, a name that reads ‘12A1564’ for artefacts recovered in 2012.

Objects that are special and few in number, such as guns and anchors can have a specific numbering scheme for ease of recognition. ‘Gun 12’ is more readily identifiable than some generic artefact name such as ‘12A1284’.

The names used for dive logs should be chosen with care as often other things are associated with the logs, such as photographs or video. The computer recording system may have an upper limit to the number of characters allowed in a name, but it is sensible to limit them anyway as shorter names are easier to remember. There may also be a limit to the characters that can be used in a name. Often such characters as ‘ , ; / . : \ “ ? * | ’ are not allowed as they have special meanings.



All artefacts should be clearly marked with a unique identification.
© Peter R. Holt

4.6 Notes

Another essential unit of information for almost every object is simple free form text to be used for adding notes. The recording system is unlikely to have sufficient scope to be able to record everything that you want to say about an object, so the notes are a useful place for the additional information.

4.7 Units

The units of length, weight, etc. used for recording will vary between projects. The most basic recording system may be fixed so that it uses only one set of units, an acceptable decision so long as the metadata associated with the project states which units are being used. A more flexible approach would be for the recording system to be able to display information in different units, but it will still need to work internally using only one particular set.

The majority of sites are recorded using the International System of units (SI); metres for survey measurements and millimetres for recording artefacts (although centimetres are used too). Weights should be measured in kilograms.

4.8 Time

An artefact on the seabed may be moved during the course of work on a site. The position of the artefact before moving is just as important as the position afterwards, so a recording system needs to be capable of recording both. This suggests that any artefact has a position at a given time, so it is important from the outset to consider this when recording positions.

4.9 Measurement Recording

A recording system should be capable of handling information about survey points, including both the measurements made at each survey point and between the survey points. Unfortunately, many of the measurements that are made will be mistakes, so it is important to make sure that these can be identified and removed. Later work may show up problems with measurements made earlier, so it is important that the raw measurements are recorded and not just the processed survey results.

4.10 Object Drawing

Ideally the recording system should also record shape information. For example, an artefact on the seabed can be represented on a site plan in a number of ways.

The simplest representation is as a point shape that identifies the position of the artefact. The size, colour and style of the point is used to identify some other property, such as the type or recovery date.

A more detailed representation would show a drawing of the artefact on the plan. Most site plans are drawn from above, so the artefact can be shown *in situ* as a 2-dimensional drawing on a plan view.

The most complex representation would show a 3-dimensional (3D) image or model of an artefact that can be viewed from any position of the site.

Drawing timbers at 1:1 scale. © Peter R. Holt

For each artefact there are two different sets of information. The first set of information is the drawing or 3D digital representation of the object. The other set is the recorded properties of the artefact, such as the material it is made from, its condition or weight.

4.11 Site Code

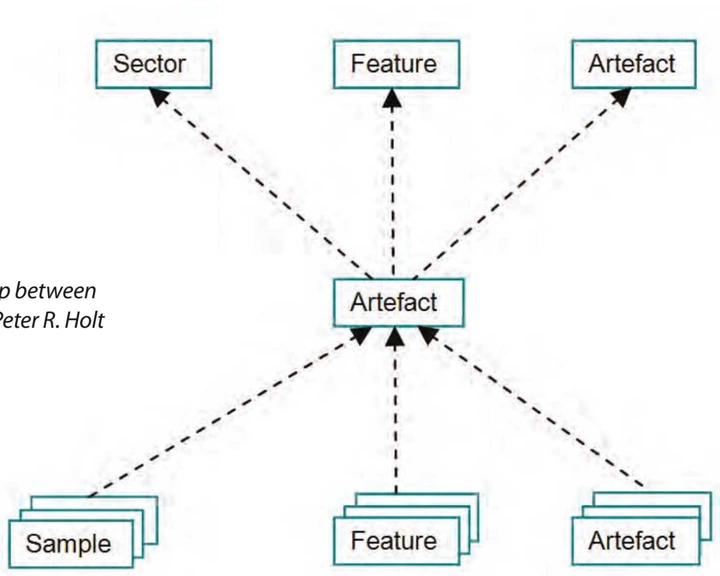
A unique code should be given to each site. Site codes need to be unique as they are used to form part of the name of every object, so that objects can be differentiated from one site to another.

With digital systems it is easy to make comparisons of datasets between sites. It is possible that the names of objects from one site are the same as those from another, so it is necessary to be able to make a distinction. To ensure that this distinction is made, the full name of each object should include the prefix of the site coded. For example, at POMR (Portsmouth - *Mary Rose*), an object can be labelled POMR/94/A1234 (location – site – year – artefact number), while at GAAV (Galle - *Avondster*) an object can be labelled GAAV/94/A1234.

4.12 Recording Associations

Archaeological objects can be associated with each other, providing extra information about the site and how it was recorded. This provides a way of relating groups of objects found in the same area that have some meaningful relationship, building up a hierarchy of associations within the site.

The relationship between these objects gives clues about their use, so the recording system should allow these relationships to be in a formal manner and provide tools to visualize them. The result is a hierarchical tree of relationships between artefacts, features and sectors.



Relationship between objects. © Peter R. Holt

Associations between objects include:

Next to: *a loose spatial relationship.*

Above: *a loose spatial relationship more specific than 'next to'.*

Below: *a loose spatial relationship more specific than 'next to'.*

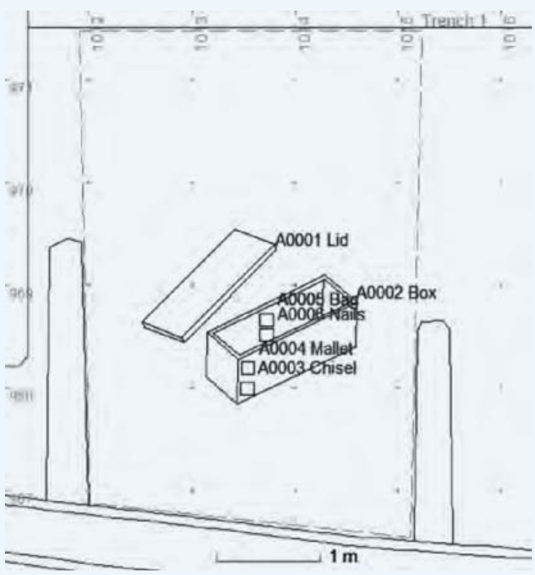
Contained by: *a tight spatial relationship.*

Part of: *a tight relationship.*

Objects can only be associated 'upwards' by being related to a 'parent' object. The 'parent' can have many 'child' objects below it, each linked once to the parent itself. An object does not have to be associated with a 'parent' and can remain unrelated to anything else.

The use of these associations can be represented by an example:

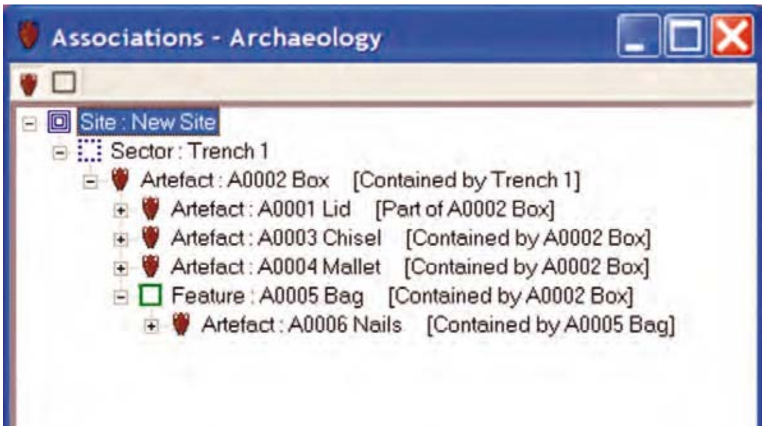
- *A wreck site had an excavation trench defined by the bulkheads of the carpenter's cabin*
- *In the trench was found the lid of a box*
- *Below the lid was found a box, the lid found earlier was the correct size to fit the box*
- *Found inside the box were a chisel and a mallet*
- *Also inside the box was the 'ghost' of a cloth bag, no cloth remained just a different colour sediment*
- *Inside the 'bag' were found 10 identical copper nails*



Representation of a relationahip between objects © Peter R. Holt

This image, taken from Site Recorder, shows the relationships between all archaeological objects in a hierarchy. The site is at the top, followed by sectors, features and artefacts. The type of relationship is shown in square brackets [ ]

At the top of the 'tree' is the site itself and below this is an object that represents Trench 1. Contained by Trench 1 is the Box, shown as Artefact A0002.



Object associations in Site Recorder. © Peter R. Holt

Below the Box is the Lid, Artefact A0001. The Lid is shown below the Box as it is related by being 'part of' the Box. Also below the Box are the Chisel and the Mallet represented by Artefacts A0003 and A0004.

Feature A0005 represents the remains of the Bag, also 'contained by' the Box. Contained by the Bag feature are the 10 Copper nails, represented by Artefact A0006.

Suggested Reading

- Andresen, J. and Madsen, T. 1996. IDEA Integrated Database for Excavation Analysis. CAA95. *Analecta Praehistorica Leidensia*. No. 28, pp 3-14.
- Quinn, R. 2001. The Assimilation of Marine Geophysical Data into the Maritime Sites and Monuments Record, Northern Ireland. *Historical Archaeology*.

5 Other Development Considerations

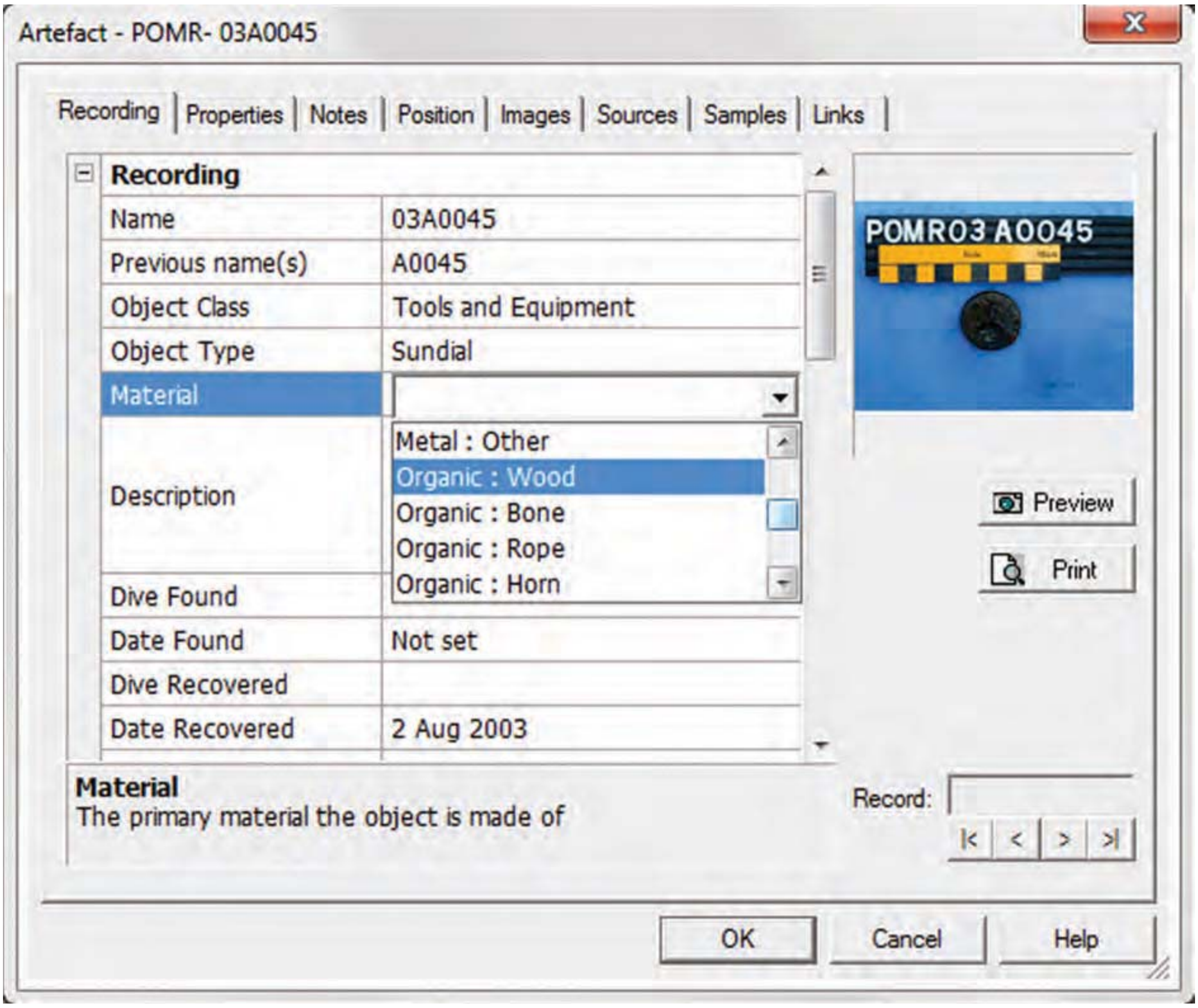
This section examines the more technical issues related to maintaining data quality, data description and data sharing.

5.1 Controlled Vocabularies, Wordlists and Thesauri

One disadvantage of paper-based recording systems is the difficulty in maintaining consistency in the information that is recorded. Consistency is not only essential for ensuring the accuracy of the information, but also simplifies the process of searching and sorting. Digital systems can go further by limiting the choice of options available for some object properties using a controlled vocabulary, similar to the wordlists available in Site Recorder or the Inscription wordlists. For more information see http://www.fish-forum.info/i_lists.htm (Accessed Feb 2012).

A controlled vocabulary is a collection of words that are allowed to be used and are useful in situations where clarity and consistency are important. Controlled vocabularies have many uses, but are particularly important where language translation occurs, as it is much easier to translate documents containing a limited selection of well defined words.

A digital recording system can readily enforce a controlled vocabulary by only offering the user the option of selecting one word or phrase from a list, known as a wordlist. Long wordlists can be laborious to work through, so the alternative is to offer a hierarchical 'tree' of options known as a hierarchical wordlist or thesaurus (Pl. thesauri). With a list, all the items are offered to the user at the same time, which may be difficult to manage if the list is long. With a thesaurus, the user can 'drill down' into the set of options starting with some general types at the top and more specific examples



Artefact record from Site Recorder. © Peter R. Holt

or component parts at the bottom. If we use a sword as an example, the user is initially offered a simple 'sword', but further down the options may include specific types of sword, such as 'rapier' or 'cutlass'. This method can also be used to offer words to describe components of a sword, such as 'sword hilt' or 'sword blade'.

Using and sharing standard wordlists brings benefits to a project, particularly as time goes on and the same lists are used by more projects, providing uniformity within not only that project, but also between other projects.

The image above shows an artefact record in Site Recorder where the material type of an artefact can only be selected from a list of options and an incorrect or new option cannot be added directly. The list of available materials can be modified or extended, but this is usually done as a separate exercise.

Consistency within a dataset can be maintained using your own wordlists, but consistency between datasets can also be achieved using standard wordlists and thesauri.

5.2 Documenting the Archive

It is important to document the dataset so it will allow others to see what it contains and how it is structured, as well as defining the formats and conventions it uses.

The documentation includes:

- *Metadata*
- *Project title*
- *History of the project*
- *Purpose of the project*
- *Topics of research*
- *Geographic and temporal extents*
- *Information about methods*
- *Methods used to create the dataset*
- *Finds recording methods*
- *Survey and georeferencing methods*
- *Sampling strategy*
- *Details of source materials*
- *Archives used for initial assessment*
- *Maps and charts*
- *Descriptions of previous work on-site*
- *Known copyrights*
- *Content and structure*
- *List of file names and a description of contents*
- *Description of naming convention*
- *List of codes and what they mean (if used)*
- *Description of any known errors*
- *Description of any known areas of weakness*
- *Wordlists, thesauri*
- *Names of the primary project staff*
- *History of format changes to the dataset*
- *Archives and publications*
- *Bibliographic references to publications about the site*
- *Information about any museums or archives which hold related material*
- *Information about any non-public related material*

5.3 Exporting and Publishing Data

The recording system may only be suitable for collecting data rather than in depth analysis or public dissemination. As the data is to be used for analysis and in publications, it is necessary to ensure that the data in the system can be extracted easily and reliably.

Although any format for the data could be used, more widespread re-use would be possible if the data were in a standard format. The ideal mechanism for data interchange is now available as the extended Markup Language (XML), which is a non-proprietary standard available to all.

Coupled with related formats for graphics called Scalable Vector Graphics (SVG) and Geographic Markup Language (GML), both data and graphical elements can be exchanged. Use of these data formats brings with it the ability to easily exchange information between different types of computers (or computer systems), something which was a problem in the past. Another benefit is the ability to automatically validate the information before use and so avoid corruption of crucial data.

5.4 Archiving

The site data on a computer is vulnerable to deliberate or accidental destruction and steps should be taken during and after a project to ensure its survival. A computer used in the field may get stolen, dropped, water damaged or damaged by a poor quality power supply. The files containing the site data may get corrupted, deleted, overwritten or lost.

The first and most simple security measure is to make electronic copies of the dataset, in the hope that at least one of these copies survives if the original gets destroyed. To do this you only need to save a copy of the relevant files onto an external hard drive, CD or memory stick.

If multiple copies exist then it is essential to be able to tell which the master copy is. Each dataset that is copied should have a unique version number, so that older copies (usually with lower version numbers) can be easily identified.

Using the date stamp on a file for version control is not recommended as it is too easily altered. The date stamp on a file is the date and time shown in Windows Explorer or similar program. It is simply the date and time that the file was last saved, so you can get an older version of a file then save it, which would give it a new date stamp of a younger, more up to date version of the same data file.

5.5 Media Survival

The dataset can be copied to any media large enough to hold it. The favoured media include: external hard drives and DVDs for large projects or USB memory sticks for small projects. It is essential that the copies can survive on the media they are written on. As all digital storage media have a limited life, true long term survival of the data may require the use of redundant data servers and a robust data backup strategy.

The format of the data stored in the archive should also be considered, as curation problems can occur with proprietary data formats. Ideally, the digital data should be archived in a generic and open format, so the data can be recovered even if the viewing software is no longer available. However, it is essential that no data, links or associations are lost when converting the dataset from a proprietary format to the open format used for archiving.

The content of the documentary archive for a digital system is often self-documenting, especially if metadata has been included and digital copies of the final reports are linked to the archive.

For security reasons it is often desirable to produce a paper copy of the site records. This will be a ‘snapshot’ of the archive at the time of printing, so needs to be clearly identified with a date, time and version number.

5.6 Existing Standards

Wherever possible, it is recommended that recording systems are developed so that they comply with any existing international or local standards, such as Infrastructure for Spatial Information in Europe (INSPIRE), so that any information gathered can be used directly with no translation. Adhering to existing standards allows for a more ready exchange of information between one system and another that may wish to use or archive that data. In addition, you gain the benefit of the knowledge embedded in the standard, as the creators may have considered an issue that you have overlooked. Reviewing more than one standard may also provide ideas about additional information that you may wish to record.

6 Data Sources for Each Project Phase

Projects go through a number of phases during their lifetime, from initial inception through to the final end of project archiving. Each phase requires a different set of tasks to be undertaken using the recording system, to ensure that the information contained within it is accurate, comprehensive and up to date.

The phases of a typical maritime or underwater archaeology project are:

Planning and Assessment
- Search
  - Survey and Marketing
    - Excavation
      - Conservation
        - Analysis and Interpretation
          - Publication and Archiving

Phases of a project © Peter Holt

6.1 Planning and Assessment

During the planning phase, it is usual to gather together all of the readily available information about a site or its location. The information that exists can then be collated and reviewed to see what can be obtained from it or to determine what is missing.

6.1.1 Typical Sources of Information

Typical sources of information include:

- *Modern charts and maps*
- *Old charts and maps*
- *Reports from previous work*
- *Existing site plans*
- *Newspaper articles*
- *Web sites*
- *Environmental reports*
- *Photographs*

6.1.2 Typical Tasks

Typical tasks include:

- *Position site, geodesy, north*
- *Scan and import or digitise charts, chart copyright*
- *Import, geo reference and digitise site plans*
- *Import digital site plans*
- *Scan and link images*
- *Scan and link documents, copyright*
- *Create a timeline of events*

6.2 Search

If the project involves a search phase then geophysical survey techniques will be employed. Geophysical survey equipment produces georeferenced measurements of depth, magnetic field or sonar signals which can be incorporated into the recording system. The measurements themselves can be added or a more simple approach is to add just the list of targets detected by each survey. Often the raw survey data can be quite large in size; by processing survey data and extracting the position and size of any anomalies, a large raw data set can be reduced to a more manageable list of targets.

6.2.1 Typical Sources of Information

Typical sources of information include:

- *Magnetometer data*
- *Sub bottom profiler traces*
- *Raw multibeam echo sounder (MBES) data*
- *MBES data as a post-processed image*
- *Side scan sonar data as a post-processed mosaic*
- *Lists of targets*

6.2.2 Typical Tasks

Typical tasks include:

- *Import target lists*
- *Import raw survey data and reprocess to create target lists*
- *Import side scan sonar mosaics and multibeam images*
- *Check metadata*

6.3 Survey and Monitoring and *In Situ* Protection

Once a site has been located, the first task is to undertake a survey to record the site as it was found. This work may be a simple assessment survey which aims to create a simple site plan quickly and efficiently. A more accurate pre-disturbance survey is usually required in advance of any intrusive fieldwork; this has to be done carefully as the work cannot be repeated at a later date. High accuracy survey work usually continues during excavation as more of the site is uncovered.

In situ recording of artefacts and features can be undertaken at this stage. It is not necessary to excavate or recover finds to be able to record them sufficiently for identification or dating.

If a site is to be monitored, then this usually involves the recording of changes to the site over time. Typical measurements include the movement of tracer objects and relative movement of a structure as a way of monitoring gradual collapse, or the measurement of sediment depth in and around a site.

6.3.1 Typical Sources of Information

Typical sources of information include:

- *Primary, secondary and detail control points*
- *Distance, depth, height, offset, ties and radial measurements*
- *Surface position measurements from a Global Positioning System (GPS)*
- *Subsea position measurements from an Acoustic Positioning System (APS)*
- *Drawing frame drawings*
- *Photomosaics*
- *Point positions from 3-dimensional photogrammetry*
- *Tide measurements for correcting depths*
- *Survey measurements defined above*
- *Sediment depth measurements*

6.3.2 Typical Tasks

Typical tasks include:

- *Design the survey control point network*
- *Add survey points*
- *Add survey measurements*
- *Process measurements*
- *Scan, import and digitize drawing frame drawings*
- *Import and georeference photomosaics*
- *Import point positions from 3-dimensional photogrammetry*
- *Correct depth measurements for the effects of tide*
- *Changes on site after* in situ *protection*

6.4 Intrusive Fieldwork

If a site is excavated, then information becomes available about artefacts, features, samples and trenches, however, the process of recording finds may start earlier with the recording of finds *in situ* during the survey phase.

6.4.1 Typical Sources of Information

Typical sources of information include:

- *Artefact records*
- *Artefact* in situ *photographs and video*
- *Artefact recovery photographs and video*
- *Artefact registration photographs*
- *Artefact drawings*
- *Feature and context records*
- *Trenches and areas*
- *Sample records*
- *General site photographs and video*
- *Sections and stratigraphic records*
- *Dive logs*

6.4.2 Typical Tasks

Typical tasks include:

- *Add artefact, feature, trench and sample records*
- *Add linked images*
- *Add dive logs*
- *Scan, import and digitize artefact drawings or photographs and add to the site plan*

6.5 Conservation

During conservation work, further information is recorded about the artefacts being conserved. The artefacts will need to be cleaned and recorded before conservation, and then recorded after conservation to note any differences. The conservation treatments applied to each artefact will also need to be recorded as the artefact may need further treatment at a later date.

6.5.1 Typical Sources of Information

Typical sources of information include:

- *Pre and post-conservation artefact records*
- *Artefact conservation process records*
- *Artefact pre and post conservation photographs*

6.6 Analysis and Interpretation

During analysis and interpretation, the recording system will be used as a source of information about everything to do with the site and its environment. Information will be added in the form of results taken from the analysis of samples taken during fieldwork.

6.6.1 Typical Sources of Information

Typical sources of information include sample analysis reports.

6.7 Publication, Deposition and Curation

The publication of the site archive does not usually involve the addition of information to the recording system. The process of deposition may require the creation of indexes and summary documents, as specified by the archive repository. Curation involves the management of the archive to ensure its long term survival, but also includes management of access to the information; neither task should alter the archive itself.

Unit Summary

This unit highlights the importance of archaeological archives as the means for the long term preservation of archaeological information. The advantages of digital documentary archives and the problems associated with them have been illustrated. The significance of the quality recording of all aspects of the fieldwork has also been highlighted, as has the need for widespread re-use of the captured information.

Suggested Timetable

15 mins	Introduction to Data Management
75 mins	Data Management Part I - *Site Archive* - *Finds* - *Samples* - *Documentary archive initial project proposals* - *Project design documents* - *Primary records, finds records, dive logs* - *Drawings, photographs and video* - *Analysis results* - *Research reports and Interpretations* - *Publications* - *Computer generated models* - *Meta data*
	Break
30 mins	Data Management Part II - *Preservation by record* - *Recording system types* - *Paper notebooks and pre-printed forms*
30 mins	Data Management Part III - *Object drawing* - *Site codes* - *Recording associations* - *Wordlists and Thesauri* - *Archive version control* - *Documenting the archive* - *Data security* - *Existing standards* - *Sources of data for project phase* - *Data sources – planning and assessment* - *Data sources search, survey and monitoring, intrusive activities, conservation*
30 mins	Concluding Remarks and Closure

Teaching Suggestions

The topics covered during the unit provide students with the theoretical knowledge required to understand the importance of recording data in a systematic way and the advantages of using these digital systems.

This unit is linked to Appendix D: *How to Use Site Recorder* and the survey and practical experience gained during Unit 12: *Practical Dive Session of the Foundation Course*. Aside from activities included in these units, there is also the opportunity for students to practice using the full licensed version of Site Recorder held by the centre, or the demo version, which allows most of the software's tools to be used.

To provide students with further insight and understanding of data management, it may be useful to include additional presentations prepared by 3H Consulting. These presentations can be downloaded from their website: www.3hconsulting.com.

PowerPoint lecture

Management of Digital Data in Maritime Archaeology.

www.3hconsulting.com/Downloads/SRPP03_ManagementOfDigitalDataV1_0.pdf (Accessed February 2012).

Notes

Management of Digital Data in Maritime Archaeology.

www.3hconsulting.com/Downloads/SRDC03_ManagementOfDigitalData.pdf (Accessed February 2012).

Site Recorder Database Schema

www.3hconsulting.com/Downloads/TheSiteRecorderDatabaseSchema.pdf

Suggested Reading: Full List

Andresen, J. and Madsen, T. 1996. IDEA Integrated Database for Excavation Analysis. CAA95. *Analecta Praehistorica Leidensia* 28, pp 3-14.

Brown, D. 2007. Archaeological Archives: A Guide to Best Practice in Curation, Compilation, Transfer and Curation. *Archaeological Archives Forum*. London.

Drap, P. and Long, L. 2001. Towards a Digital Excavation Data Management System: The *Grand Ribaud F Estruscan* Deep Water Wreck. *Proceedings of the 2001 Conference on Virtual Reality, Archaeology and Cultural Heritage.*

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Lledo, B. 2004. Field Example of a Database System Applied to Underwater Archaeology, the FileMaker Pro Approach. *TARAUDSTUA Conference*, Bodrum.

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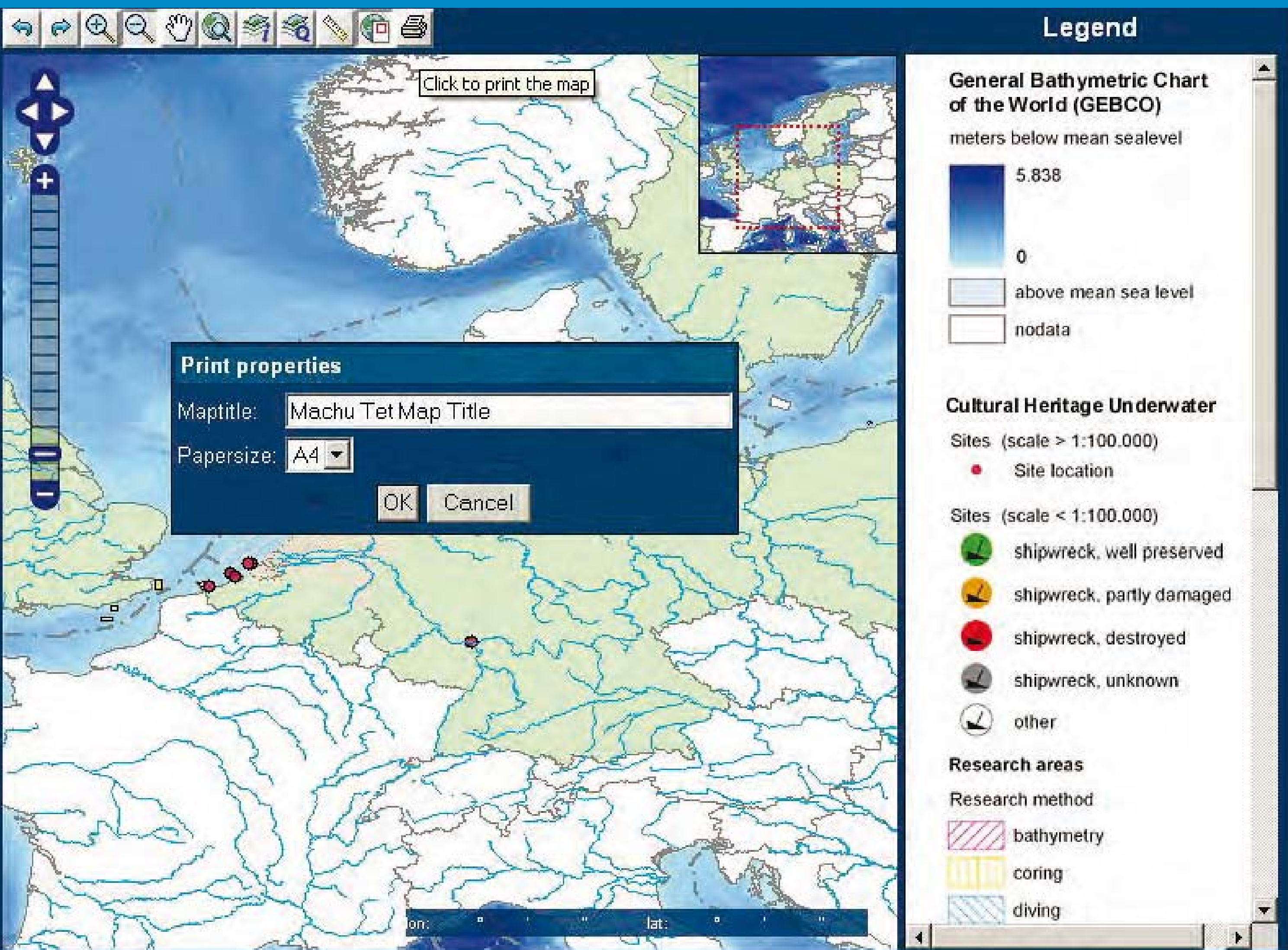
United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 8

Authors Manithaphone Mahaxay, Will Brouwers and Martijn R. Manders

Geographical Information Systems (GIS) in Underwater Archaeology



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UNIT 8

Contents

UNIT 8

Authors Manithaphone Mahaxay, Will Brouwers and Martijn R. Manders

Geographical Information Systems (GIS) in Underwater Archaeology

Core Knowledge of the Unit

This unit introduces students to Geographic Information Systems (GIS) and provides guidance on how they can be utilized in underwater archaeology.

On completion of the Geographic Information Systems unit students will have an understanding of:

- *What a Geographical Information System is*
- *How GIS works and why it is important*
- *The benefits of using GIS and data sharing*
- *The applications of a GIS in the field of underwater archaeology.*

Introduction to the Unit

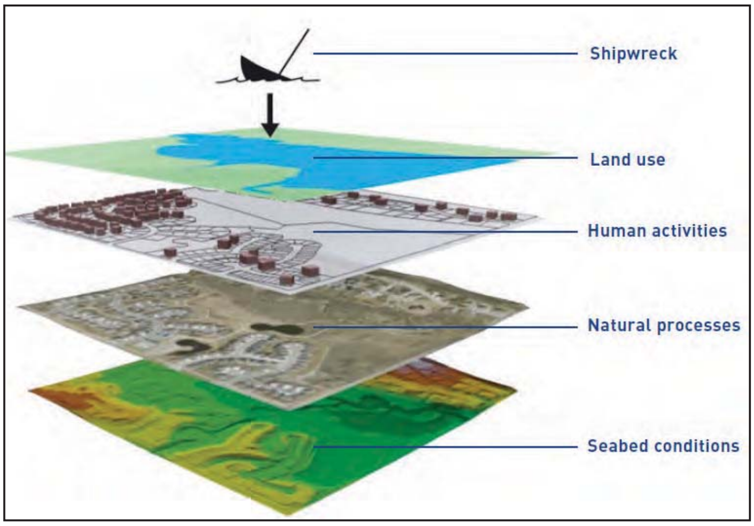
The number of shipwrecks discovered each year has grown so rapidly that there is no longer enough capacity to undertake the research required to investigate each wreck. As on land, underwater archaeological sites are becoming more easily accessible. Equipment that can 'look' through water of even low visibility (side scan sonar and multibeam sonar) has developed quickly, alongside equipment that can penetrate deep into the seabed (sub-bottom profilers). This has caused more archaeologically interesting shipwrecks to be listed in monument registers and other archaeological databases all over the world. This burgeoning access to information about our maritime past has created an immense problem; to be able to keep pace with the amount of wreck sites reported every year and to investigate those that can be reached, the maritime archaeological community would need thousands more archaeologists to do the job.

A fundamentally important factor of site management is to know where sites are located and to know what factors threaten their preservation. With so many existing sites there is an enormous amount of information that needs to be managed.

An effective tool to deal with this is a Geographic Information System which has the capacity to combine all disciplines concerning the management of underwater sites. The idea is to create an online archive of underwater cultural heritage that is accessible for scientists, policy-makers and to a lesser extent the general public. A GIS or numerous regional or national GIS' will be helpful tools for the preservation and management of the underwater cultural heritage.

1 What is a GIS?

A Geographic (or Geographical) Information System captures, stores, analyses, manages and presents (digitized) data that is linked to one or more locations on a map. The system is computer based and stores data in a series of layers. Combing layers or data (mostly stored in a database) provides new information and insight concerning a site or collection of sites.



Example of the spatial relationship of a shipwreck and its surrounding area, presented as map layers in a GIS. © MACHU Project

One of the most important features of a GIS is the ability to query data. Location may be annotated by x, y, and z coordinates of longitude, latitude and elevation, or by other geocode systems such as ZIP codes or highway mile markers. Any variable that can be located spatially can be fed into a GIS.

'Every object present on the Earth can be georeferenced', is the fundamental key of associating any database to a GIS. Here, the term 'database' is a collection of information about things and their relationship to each other. Georeferencing refers to the location of a layer or coverage in space defined by the coordinate referencing system (e.g. WGS84 as used in Google maps).

1.1 The History of GIS

Linking spatial information to maps is something that has been done for centuries. The next evolutionary step was to plot research data on a map. This produces, together with the spatial data, information that can be analysed and forms new spatial-dependent data, on which decisions can be made. The first individual to do this was Dr. John Snow who, in 1854, depicted a cholera outbreak in London using points to represent the locations of individual cases. His study of the distribution of cholera led to the source of the disease, a contaminated water pump within the heart of the cholera outbreak. While the basic elements of topography and theme existed previously in cartography, the John Snow map was unique as it used cartographic methods not only to depict, but also to analyse, clusters of geographically dependent phenomena. See *Additional Information 1*.

ADDITIONAL INFORMATION

1 See www.csiss.org/classics/content/8 (Accessed February 2012) and Stamp (1964).

In 1962 the world's first true operational GIS was developed in Ottawa, Ontario, Canada by the federal Department of Forestry and Rural Development. Developed by Dr. Roger Tomlinson, it was called the 'Canada Geographic Information System' (CGIS) and was used to store, analyse and manipulate data collected for the Canada Land Inventory (CLI). The Canada Land Inventory was an initiative that determined the land capability for rural Canada by mapping information about soils, agriculture, recreation, wildlife, waterfowl, forestry and land use at a scale of 1:50,000. A rating classification factor was also added to permit analysis.

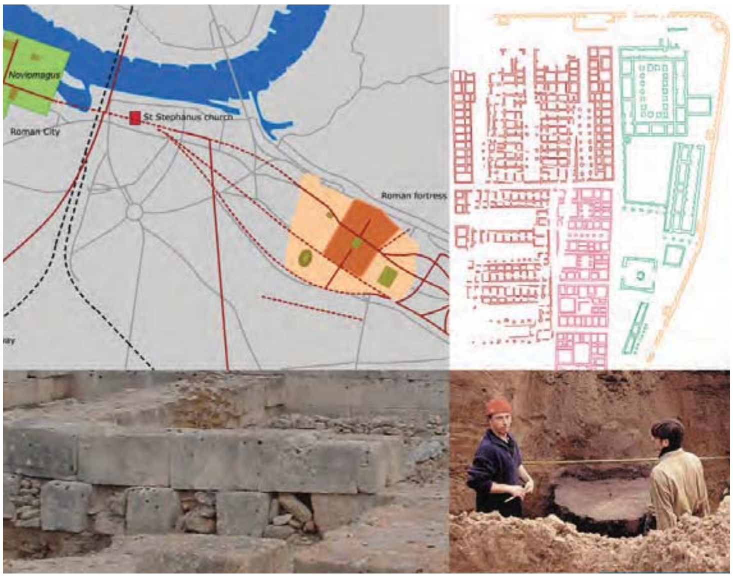
Tomlin was one of the first to recognize the benefits of combining all kinds of data in a computer programme and using it to analyse and manage land use in Canada. Since then computer use and technology has advanced rapidly. Today, GIS is a multi-billion dollar industry employing hundreds of thousands of people worldwide. GIS is taught in schools, colleges and universities throughout the world. Professionals in every field are increasingly aware of the advantages of thinking and working geographically.

It should be noted that any task begins and ends with the real world, which is what data is all about. Out of necessity, any system can only provide an abstraction, a model; it is not possible (or desirable) from them to handle every last detail. After the data is analysed, information has to be compiled for decision-makers and based on this information, actions are taken and plans implemented.

Public access to geographic information is dominated by online resources such as Google Earth and Google Maps. Some of them, such as Google Maps and Open Layers, expose an Application Programming Interface (API). An API enables users to create custom applications. These toolkits commonly offer street maps, aerial/satellite imagery, geocoding, searches and routing functionality.

1.2 GIS in Archaeology

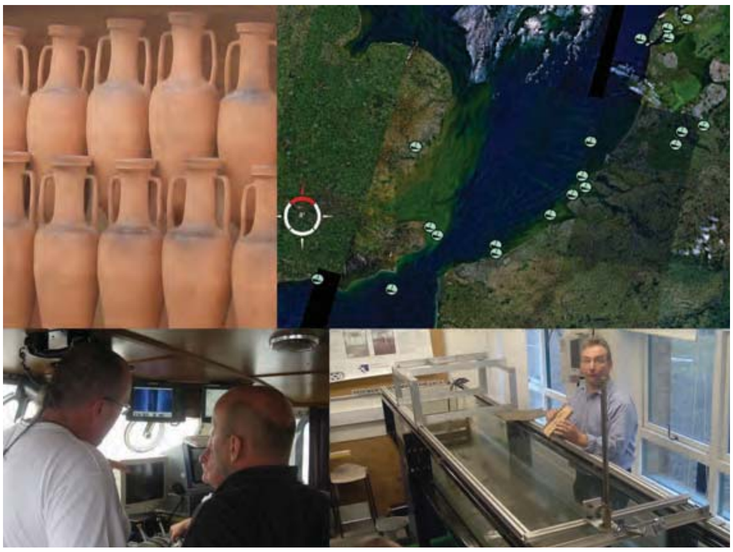
In archaeology, linking bits and pieces of information to maps is so essential that one can say that without mapping there is no archaeology. Only by connecting single objects to their context can we reconstruct the past on the basis of the material resources. This is the core of archaeology. Linking data to maps has always existed, but since the digital revolution this linking has grown exponentially and as a logical consequence, GIS use in archaeology is now widespread.



Archaeology combines data with a spatial component. © Will Brouwers

Geography influences the degree of exposure of archaeological sites and the impacts that they face from human activity and natural forces. GIS facilitates mapping to analyse depositional patterns as well as to catalogue and quantify artefacts. It can provide a well-structured descriptive and analytical tool for identifying spatial patterns.

GIS technology is not only widely used in science and research (history and archaeology), but is also especially useful as a tool to assist decision-makers, as it can indicate various alternatives in development and conservation planning. These alternatives can then be modelled into a series of potential outcomes for the scenarios identified.



Comparing research results. © Will Brouwers

1.3 GIS in Maritime Archaeology

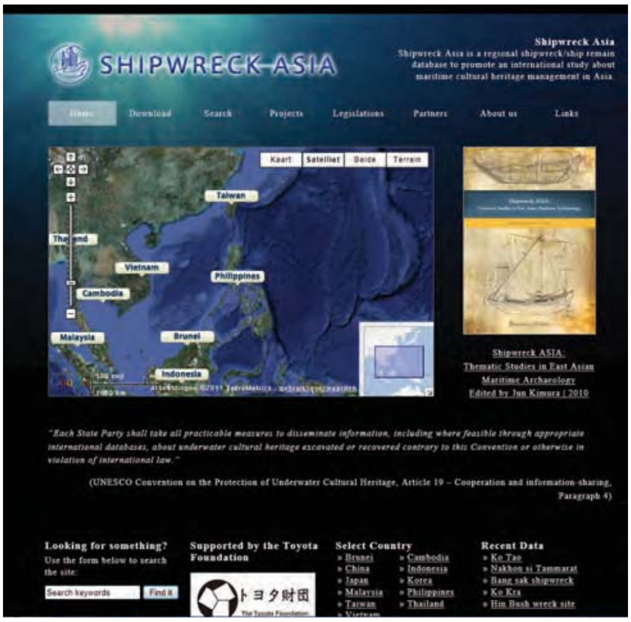
Over the past few decades, maritime archaeology has evolved from an object related profession into one that encompasses underwater cultural heritage; a non-renewable resource that provides a unique opportunity to investigate and learn from our past. Shipwrecks are essentially time capsules (closed finds) and their informative strength is the assemblage value of all the associated objects; the ship itself, its inventory, personal belongings and cargo collectively. Every shipwreck has its own unique story to tell.

This source or resource has to be managed in a responsible and sustainable manner (see Unit 4: *Underwater Archaeological Resources* and Unit 3: *Management of Underwater Cultural Heritage*). Management means that sites or information from these sites, are being secured over a long period of time. Sites have to be investigated according to international standards such as those presented in the Annex of the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris, 2001) and more often sites are also being protected *in situ* (See Unit 9: *In Situ Preservation*). Archaeologists, conservators and policy-makers are now all involved in the management of underwater cultural heritage. A GIS of sites, research and management can form an integral component of this management process.

1.4 UNESCO and GIS

UNESCO has been supporting and utilizing GIS technology in the Asia-Pacific region since 1992. GIS was first used for World Heritage sites to assist in the preparation of site management plans, as part of the World Heritage nomination process. During the past few years, UNESCO Bangkok has implemented GIS in a number of projects related to education, culture and social science sectors, such as projects on Trafficking, HIV/Aids and Cultural Mapping. For more information see: www.unescobkk.org.

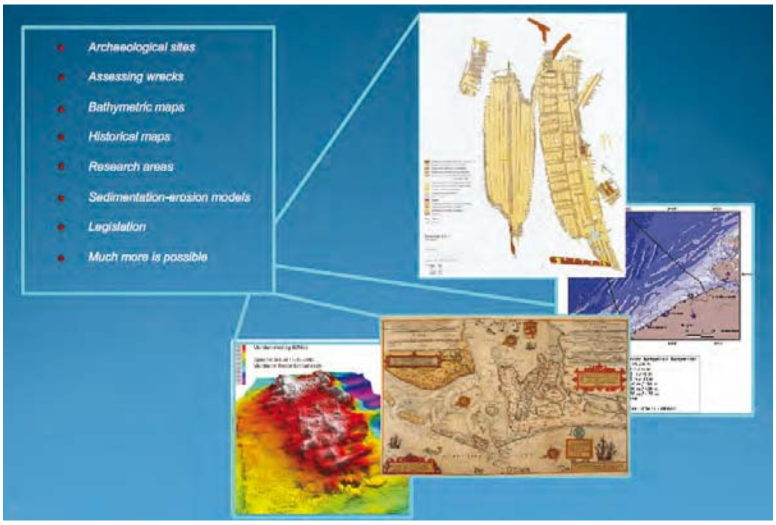
At present, underwater cultural heritage data and information sharing across the Asia-Pacific region is still limited and usually unavailable to decision-makers, managers, planners, conservation practitioners, scientists, researchers and the general public. In most countries located in this region, data (in both spatial and non spatial formats) has been individually collected, stored and managed. Shipwreck Asia is an online database of shipwrecks in Asia. Available to the public, the site gives basic information on (excavated) shipwrecks, their (preservation) status, position, date, etc.



Shipwreck Asia is a regional shipwreck database (www.shipwreckasia.org). © Shipwreck Asia

Another GIS database that describes underwater cultural heritage is that of the Managing Cultural Heritage Underwater (MACHU) project. This system not only provides a description of wrecks and sites, it contains also layers for management (legislation, research and projects). The information is not public due to governmental restraints and management reasons (e.g. to prevent uncontrolled diving on vulnerable sites). However, with all the discussions on the rights to have access to data in the European domain, it is possible that soon much more information will be in the public domain. For more information see: http://inforrm.wordpress.com/2010/12/15/eu-law-freedom-of-information-and-data-protection-part-1-aidan-oneill-qc/ (Accessed February 2012).

However, not all countries are using GIS when managing their underwater cultural heritage.



Data relevant for managing underwater cultural heritage in a GIS. © MACHU Project

Suggested Reading

Arnoff, S. 1989. *Geographic Information Systems: A Management Perspective*. Ottawa, Canada.

Burroughs, P.P. and McDonnel, R.A. 1998. *Principles of GIS*. Oxford University Press

Conolly, J. and Lake, M. 2006. *Geographical Information Systems in Archaeology*. Cambridge University Press.

Longley, P. A. 2005. *Geographical Information Systems: Principles, Techniques, Management and Applications*. John Wiley & Sons.

Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

Stamp, L. D. 1964. *A Geography of Life and Death*. Cornell University Press.

2 Defining GIS

A typical GIS can be defined in various ways:

- *A computer-based tool for mapping and analyzing things that exist and events that happen on Earth.*
- *Burrough (1986) defined GIS as a 'set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes'.*
- *Arnoff (1989) defines GIS as a 'computer based system that provides four sets of capabilities to handle georeferenced data: data input, data management (data storage and retrieval), manipulation and analysis, data output.'*

Overall, GIS is looked upon as a tool to assist in decision-making and management of attributes that needs to be analysed spatially.

Suggested Reading

Conolly, J. and Lake,M. 2006. *Geographical Information Systems in Archaeology*. Cambridge University Press.

Longley, P. A. 2005. *Geographical Information Systems: Principles, Techniques, Management and Applications*. John Wiley & Sons.

Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

3 Advantages of GIS

A Geographic Information System is an effective tool for the management of cultural heritage and especially underwater cultural heritage.

The use of GIS has been popular primarily due to the following advantages:

- *Project planning and modeling are possible*
- *Ability to make better decisions because more data and information can be incorporated and compared*
- *Visual Analysis*
- *Low cost (remote) research*
- *Can combine information from many stakeholders (archaeology, hydrographic services, offshore industry fisherman, UNESCO, navy, etc.)*

Suggested Reading

Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

4 Components of GIS

A GIS constitutes of five key components:

- *Hardware (computer and , scanner)*
- *Software to run geographic related programs. The best known is Google Maps/Earth*
- *Data (databases and, information from all kinds a variety of fields)*
- *People (users and developers, policy-makers, scientists and the general public)*
- *Method (standard formats, information and processing)*

4.1 Hardware

The hardware consists of the computer system on which the GIS software will run. Scanners are used to convert a picture into a digital image for further processing. The output of the scanner can be stored in many image formats, for example (with extension): TIFF, BMP, JPG, etc.

4.2 Software

GIS software provides the functions and tools needed to store, analyse, and display geographic information. Popular GIS software includes in use are Google Maps/Earth, MapInfo, ARC/Info and AutoCAD Map, etc.

4.3 Data

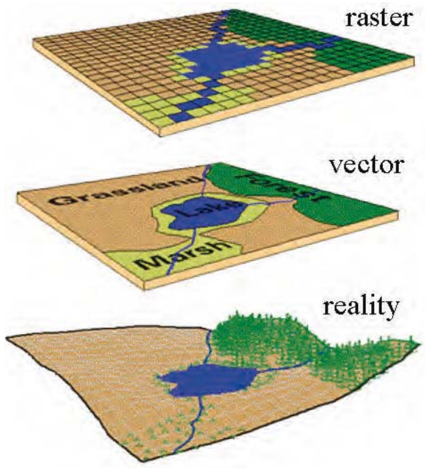
Geographic data and related tabular data can be collected in house or purchased from a commercial data provider. The digital map forms the basic data input for a GIS. Tabular data related to the map objects can also be attached to the digital data. A GIS will integrate spatial data with other data resources and can be incorporated into a database management system (DBMS) used by most organizations to maintain and manage their data.

4.4 People

GIS users range from technical specialists who design and maintain the system, to those who use it to help them perform everyday tasks, such as scientists, researchers and policy-makers.

4.5 Making Maps for GIS

There are various techniques used to create a map. This can either be made using an automated raster to vector creator (software that recognizes raster drawings and automatically transforms them into geometrical features such as vectorised points, lines and polygons) or it can be manually vectorised using scanned images. The source of these digital maps can either be prepared by a survey agency or by using satellite imagery.



Raster and vector data structures and how they represent real world features.
© Lincoln University

Suggested Reading

- Conolly, J. and Lake, M. 2006. *Geographical Information Systems in Archaeology.* Cambridge University Press.
- Longley, P. A. 2005. *Geographical Information Systems: Principles, Techniques, Management, and Applications.* John Wiley & Sons.
- Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course)* and *Volume 2 (Technical Course).*

5 Major Areas of Application

- *GIS can be used in different streams of planning, such as urban planning, housing, transportation planning and urban design.*
- *Specific maritime examples are wind farm planning, planning of dredging areas, sea level rising monitoring, etc.*
- *GIS is also used in the management process. For example, as part of a management and environmental impact analysis of wild and scenic recreational resources, flood plain, wetlands, aquifers, forests and wildlife. During a wild life habitat study, incorporating a GIS can help facilitate management.*
- *GIS can also locate underground pipes and cables for maintenance, planning and tracking energy use. This makes it integral in archaeology and the management of cultural resources.*
- *It can also predict (maritime) archaeological sites in specific areas using statistical models based on previously identified site locations and or historic (sea) maps.*
- *GIS can facilitate modelling by simulating changes in past landscapes and future changes of the seabed (sediment erosion). This helps predict where underwater cultural heritage will be in danger in the future.*
- *GIS as a tool on site level analysis.*

The use of historic sea maps to predict where to expect shipwrecks. © Will Brouwers

Suggested Reading

- Delgado, J. P. 1997. *Encyclopaedia of Underwater and Maritime Archaeology.* British Museum Press
- Conolly, J. and Lake, M. 2006. *Geographical Information Systems in Archaeology.* Cambridge University Press.
- Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell.
- Longley, P. A. 2005. *Geographical Information Systems: Principles, Techniques, Management and Applications.* John Wiley & Sons.
- UNESCO. 1999. GIS and Cultural Resource Management. *Manual for Heritage Managers*. Keen Publishing Thailand Co. Ltd.

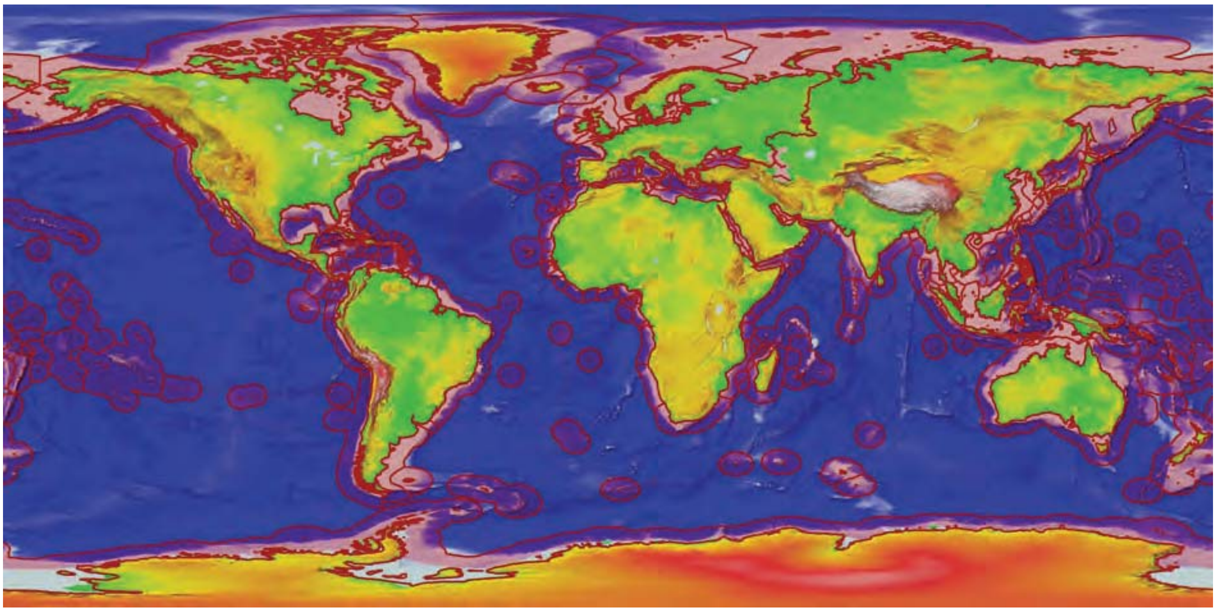
6 What is Unique about a GIS?

6.1 Information Retrieval

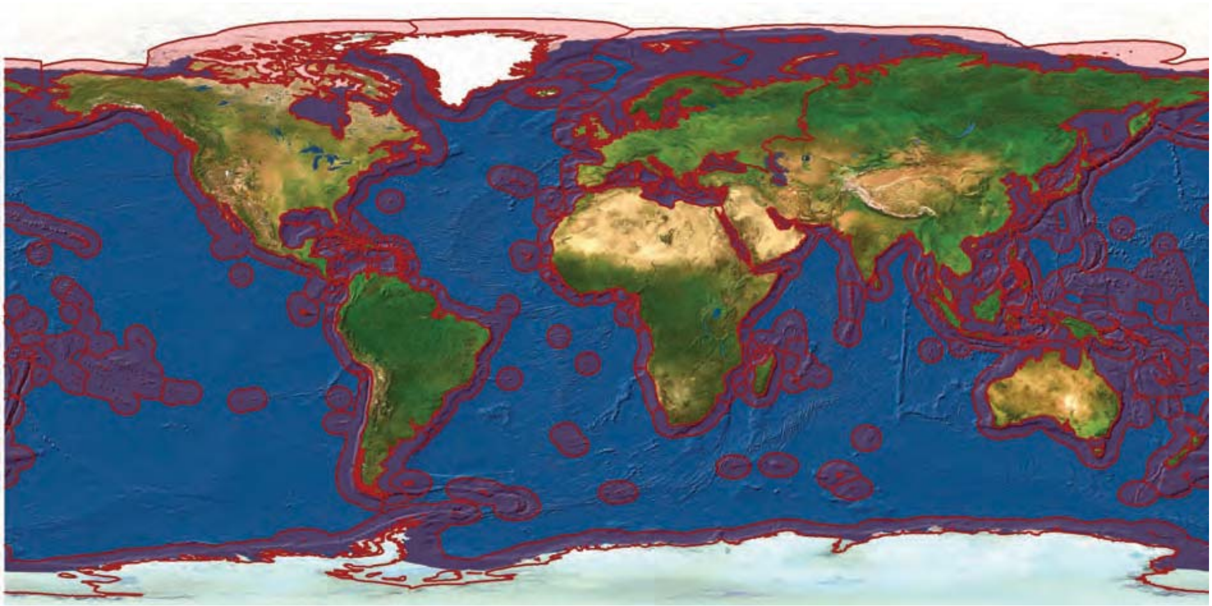
This is a crucial component of GIS since it greatly affects the user's ability to interact with the data, and the way the user is able to restructure the data to solve specific problems. Many variations of the data are retrievable, for example, by specified area or region, theme or class, etc. These may also be retrieved using two separate retrieval systems; one for map data (lines, points, polygons) and one for non-map data e.g. attributes.

6.2 Topological Modelling

A GIS can recognize and analyse the spatial relationships between mapped phenomena. For example, between 2009 and 2012 a pipeline (Northstream) was planned and built between Russia and Germany in the Baltic Sea. During the project a variety of data could be fed into a GIS to plan and manage the construction. Questions could be asked such as: what is the geological condition of the seabed? What



The world topography and bathymetry map with maritime boundaries. © Manithaphone Mahaxay



Map showing the world maritime boundaries and bathymetry on world satellite image. © Manithaphone Mahaxay

is the known infrastructure (e.g. pipes and cables)? What are the known archaeological resources? And the unknown archaeological resources? Are there any other obstacles (such as explosives from Second World War) to be considered? What are the conditions of adjacency (i.e. what is next to what), containment (i.e. what is enclosed by what), and proximity (i.e. how close something is to something else)? All these questions can be determined with a GIS.

6.3 Networks

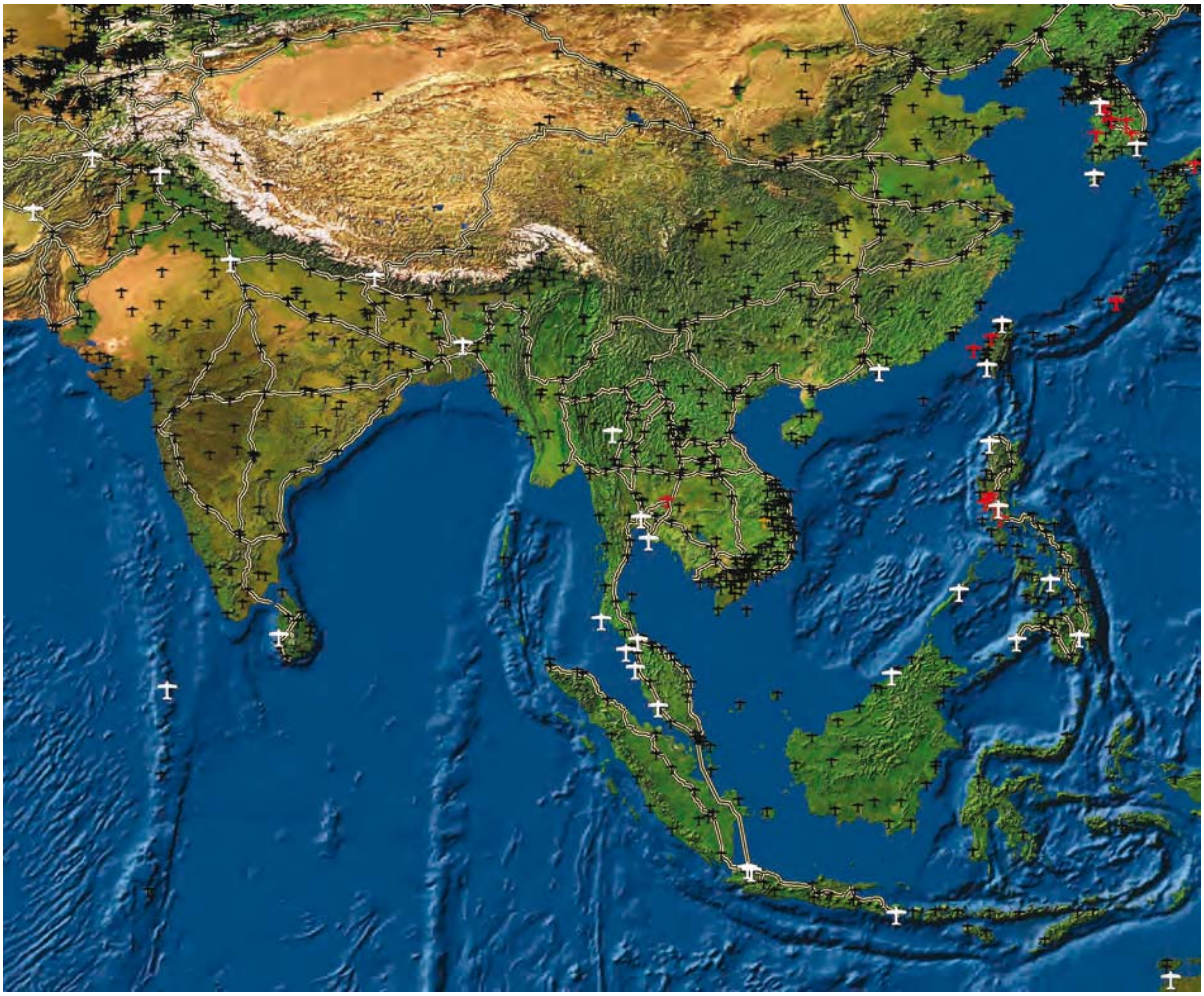
When nutrients from farmland run off into streams, it is important to know the direction in which the streams flow and which empty into other streams. This is done by using a linear network. It allows the computer to determine how the nutrients are transported downstream. Additional information on water volume and speed throughout the spatial network can help a GIS determine how long it will take the nutrients to travel over a given distance.

6.4 Overlay

GIS can also produce a series of new map layers or can be used to overlay natural conditions and human interventions.

6.5 Data Output

A critical component of a GIS is its ability to produce graphics on the screen or on paper, to convey the results of analyses to the people who make decisions about resources. Wall maps, Internet-ready maps, interactive maps and other graphics can be generated, allowing decision-makers to visualize and thereby understand the results of analyses or simulations of potential events.



Examples of finished maps that can be generated using a GIS, showing man made and physical features.
© Manithaphone Mahaxay

Suggested Reading

- Harmon, J. E. and Anderson S. J. 2003, *The Design and Implementation of Geographic Information Systems.* John Wiley & Sons Inc.
- Shunji, M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

7 GIS Tasks

General purpose geographic information systems GIS essentially perform six processes or tasks:

- *Input*
- *Manipulation*
- *Management*
- *Query and analysis*
- *Visualization*
- *Manipulation*
- *Before geographic data can be used in a GIS, the data must be converted into a suitable digital format. The process of converting data from paper maps into computer files is called digitizing.*

Modern GIS technology can automate this process fully for large projects using scanning technology; smaller jobs may require some manual digitizing (using a digitizing table). Today many types of geographic data already exist in GIS compatible formats. This data can be obtained from data suppliers and loaded directly into a GIS.

7.1 Transformation

It is likely that data types required for a particular GIS project will need to be transformed or manipulated in some way to make them compatible with an in-house system. For example, geographic information is available at different scales (from detailed street centreline files to less detailed census boundaries and postal codes at a regional level). Before this information can be integrated, it must be transformed to the same scale with the same degree of detail or accuracy. This could be a temporary transformation for display purposes or a permanent one required for analysis. GIS technology offers many tools for manipulating spatial data and for weeding out unnecessary data.

7.2 Management

For small GIS projects it may be sufficient to store geographic information as simple Excel (.xls) files. However, when data volumes become large and the number of data users becomes more than a few, it is often best to use a database management system to help store, organize and manage data. A database management system is nothing more than computer software for managing a database.

Database management systems can have one of many different designs, but in a GIS the relational design has been the most useful. In the relational design, data is stored conceptually as a collection of tables. Common fields in different tables are used to link them together. This simple design has been widely used primarily because of its flexibility and its widespread deployment in applications both within and without GIS.

7.3 Query and Analysis

Once a GIS contains geographic information, simple questions can be asked, such as:

- *Who owns the coastal land adjacent to the proposed designated wreck site?*
- *How far is it between two wreck sites?*
- *Where is the seabed zoned for industrial use?*
- *Where are the mineral extraction zones?*

Alongside analytical questions such as:

- *What underwater cultural heritage will be affected by extending the harbour?*
- *What are the dominant seabed characteristics close to the protected cultural heritage?*
- *If a container port is built here, how will the submerged cultural heritage be affected?*
- *With historical data (maps) where can I expect or even predict underwater cultural heritage?*

A GIS provides both simple point-and-click query capabilities and sophisticated analysis tools that provide timely information to managers and analysts alike. GIS technology really comes into its own when used to analyse geographic data to identify patterns and trends, and to undertake 'what if' scenarios.

7.4 Visualization

For many types of geographic operations, the end result is best visualized as a map or graph. Maps are very efficient at storing and communicating geographic information. While cartographers have created maps for millennia, GIS provides new and exciting tools to extend the art and science of cartography. Map displays can be integrated with reports, three-dimensional views, photographic images, and other output, such as multimedia.

Suggested Reading

Conolly, J. and Lake, M. 2006. *Geographical Information Systems in Archaeology*. Cambridge University Press.

Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

8 How Does a GIS Work?

8.1 Relating Information from Different Sources

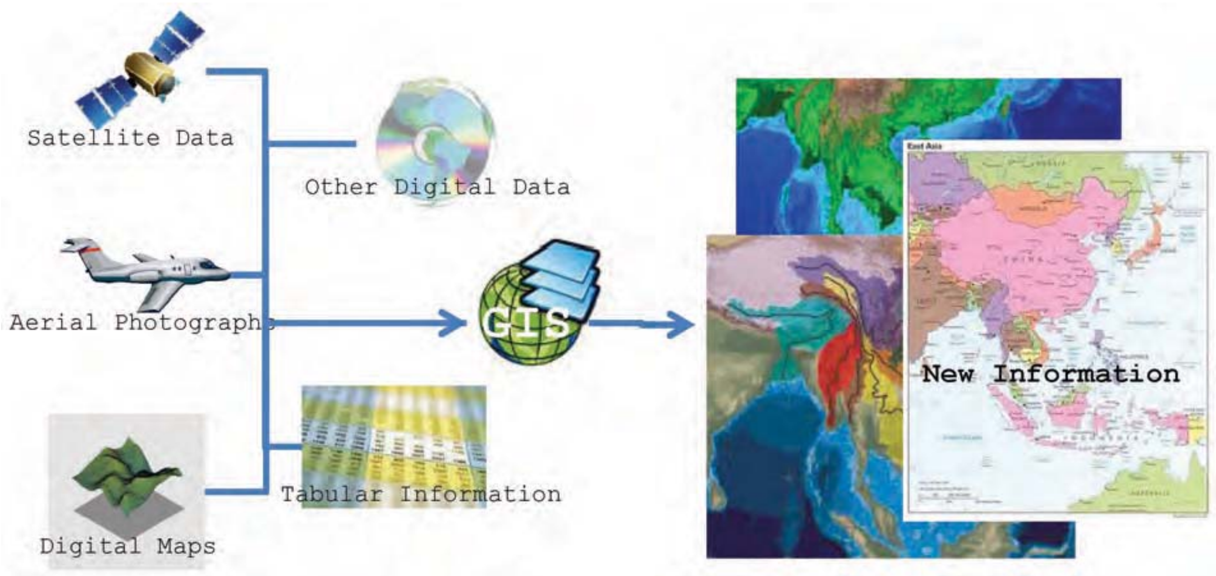
The power of a GIS comes from the ability to relate different information in a spatial context and to reach a conclusion about this relationship. Most of the information we have about our world contains a location reference, placing that information at some specific point on the globe. A GIS, therefore, can reveal important new information that leads to better decision making.

8.2 Data capture

How can a GIS utilizese the information in a map? If the data to be used is not already in digital form, that is, in a form the computer can recognize, various techniques can capture the information. Maps can be digitized by hand-tracing them using a with a computer mouse on the screen or on a digitizing tablet, to collect the coordinates of features. Electronic scanners can also convert maps to digits. Coordinates from Global Positioning System (GPS) receivers can also be uploaded into a GIS.

8.3 Data Integration

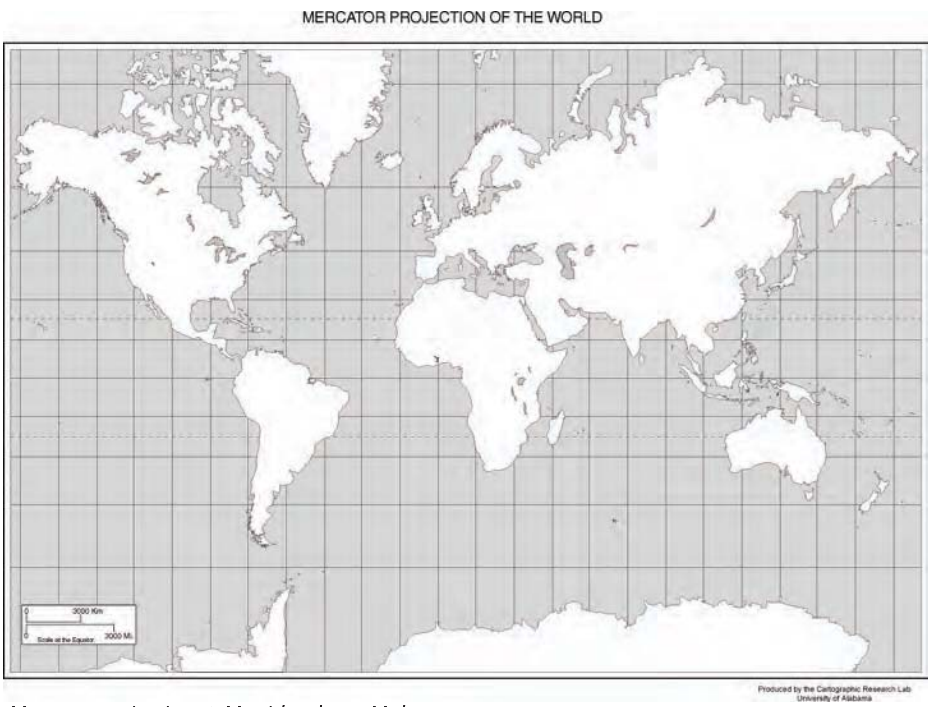
A GIS makes it possible to link or integrate information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analysze new variables.



Data integration is the linking of information in different forms through a GIS. © Manithaphone Mahaxay

8.4 Projection and Registration

Projection is a fundamental component of map making. It is a mathematical means of transferring information from the Earth's three-dimensional, curved surface, to a two-dimensional medium e.g. paper or a computer screen. Different projections are used for different types of maps because each projection is particularly appropriate for certain uses. The most common projection is the Mercator projection, while the most used coordinate system is the World Geodetic System (WGS84).



Mercator projection. © Manithaphone Mahaxay

8.5 Data Structures

The data model represents a set of guidelines to convert the real world entity to the digitally and logically represented spatial objects that consisting of the attributes and geometry. There are two major types of geometric data model: the vector and the raster model.

8.5.1 Vector Model

Vector model uses discrete points, lines and/or areas.

- *Vector GIS data layers represent real -world features using basic GIS elements, such as lines, points and polygons*
- *Lines represent linear features such as streams, roads, power lines and, pipelines*
- *Points represent specific locations, such as shipwrecks or towns*
- *Polygons represent complex shapes, such as land boundaries, site locations or research areas*

1	1	1	1	1	1	1	2	2	2
1	1	1	1	1	1	2	2	2	2
1	1	1	1	1	2	2	2	2	2
1	1	1	1	2	2	2	2	2	2
1	2	2	2	2	2	2	2	2	2
2	2	2	2	2	2	2	3	3	3
2	2	2	2	2	2	3	3	3	3
2	2	2	2	2	3	3	3	3	3
2	2	2	2	2	2	3	3	3	3
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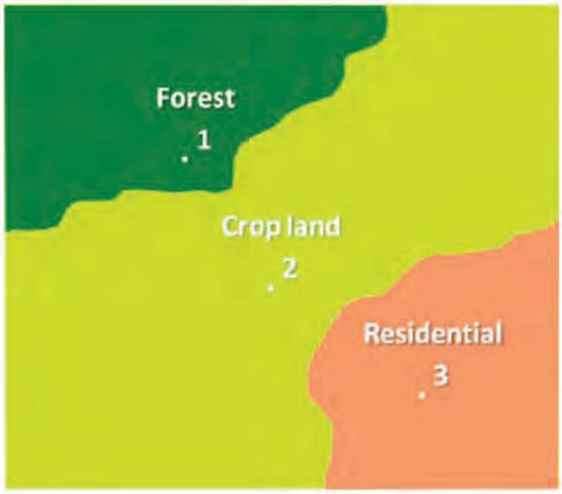
An examples of vector data structure.
© Manithaphone Mahaxay



An example of raster data structure.
© Manithaphone Mahaxay

8.5.2 Raster Model

Raster model uses regularly spaced grid cells in specific sequence. An element of the grid cell is called a pixel (picture cell). In the raster data structure, the area of interest is divided up into equal sized pixels.

Each cell contains data that is used to represent:

- *A real world feature or a portion of a feature*
- *A spatially distributed quantity (e.g. precipitation, temperature or elevation)*

As compared to the vector data structure, the raster data structure is not particularly accurate at representing discrete features; that is those features that have a distinct boundary or shape.

8.6 Data Modelling

It is impossible to collect data over every square meter of the Earth's surface. Therefore, samples must be taken at discrete locations. A GIS can be used to depict two and three-dimensional characteristics of the Earth's surface, subsurface and atmosphere, from points where samples have been collected.

Suggested Reading

- Longley, P. A. 2005. *Geographical Information Systems: Principles, Techniques, Management and Applications.* John Wiley & Sons.
- Shunji M. 1999. *GIS Work Book Volume 1 (Fundamental Course) and Volume 2 (Technical Course).*

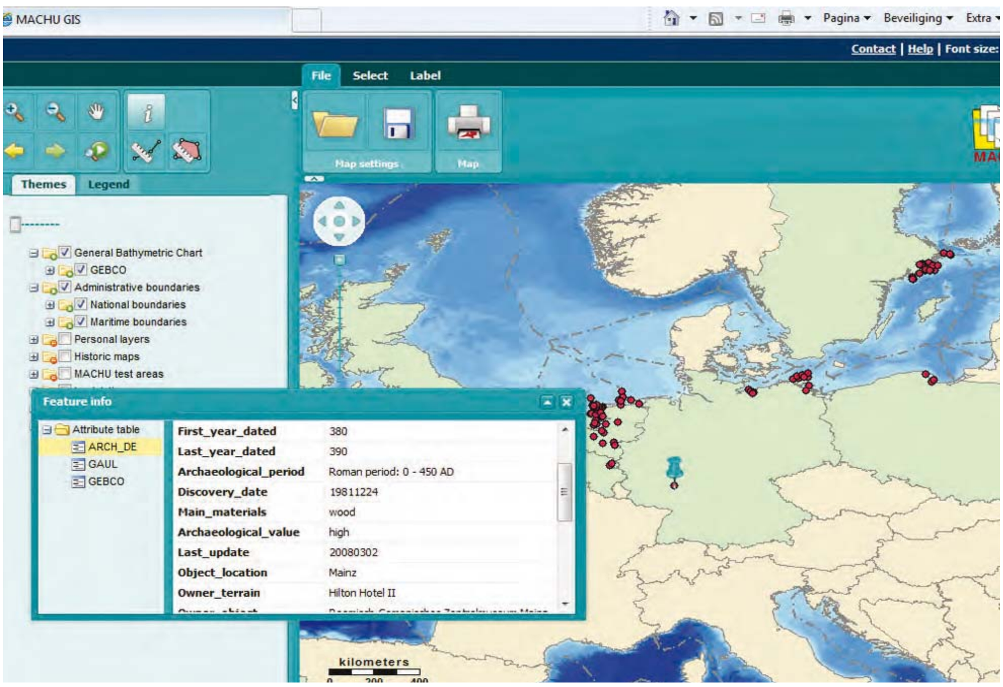
9 GIS Case Study

The MACHU project is an example of cooperation and joint management of underwater cultural heritage in Europe. The countries involved are Germany, Belgium, Poland, Portugal, England, the Netherlands and Sweden and the project is sponsored by the European Union's Culture 2000 program. One of the main project outputs was the building of a web-accessible GIS application that contains archaeological and historical information on underwater sites. The application includes, soundings, multibeam and side scan sonar images, geological, climatological, geochemical and biological information, and information about relevant human activities.

The main objective of the project is to find better and more efficient ways to manage the underwater cultural heritage and serve as a network for international cooperation and exchange.

9.1 MACHU and GIS

Much of the information that is important for the management of the underwater cultural heritage has a spatial component and is, therefore, related to a specific location or area. This again means that it is possible to link this information to other area related subjects.



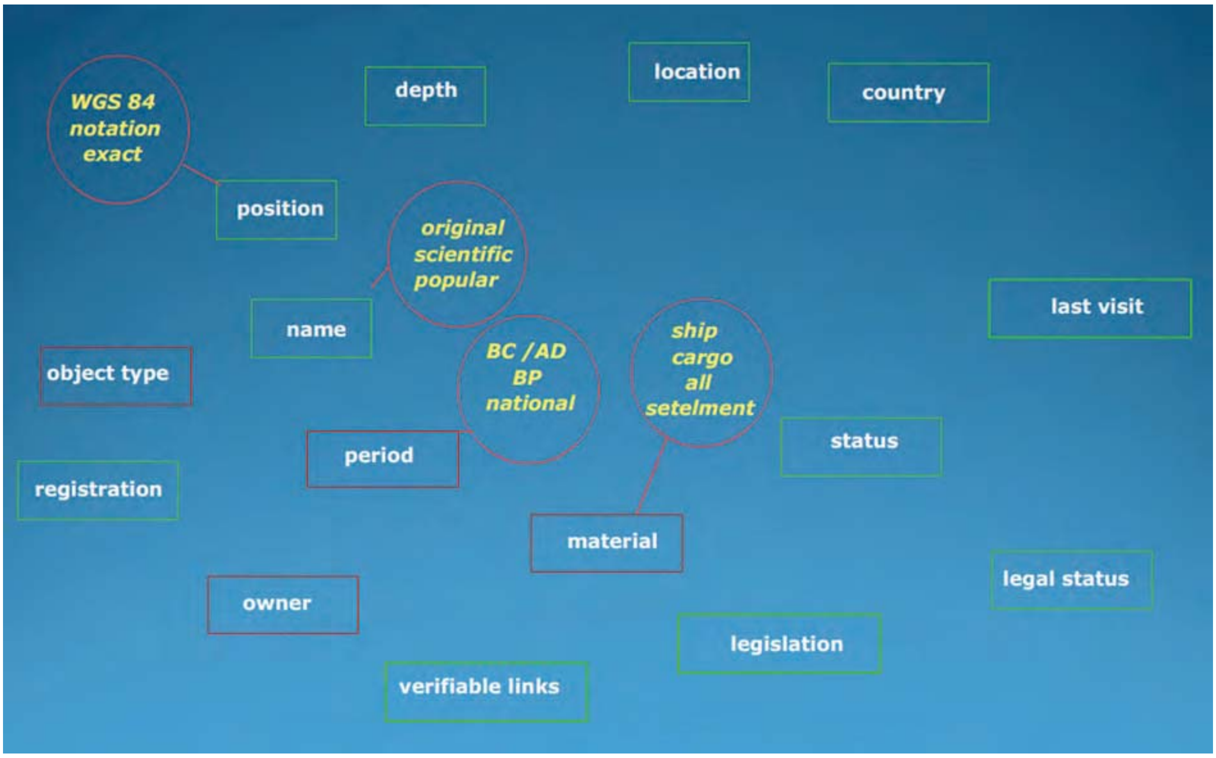
The MACHU GIS online viewer. © MACHU Project

To establish whether a site is in danger of deterioration or not, or if a site is of major archaeological importance, one needs to take a lot of information into consideration. So it would be ideal to have a single system at our disposal that contains all the information we need and presents it in a structured way. This was the starting point for the development of a Geographical Information System as part of the MACHU project: a platform and a tool to combine and interpret data from archaeological sites underwater, to be known as the MACHU GIS.

Human and biological activities affecting underwater cultural heritage. © MACHU Project

For example, a shipwreck is located at a certain location on the seabed. Depending on the location, there may be conditions that directly affect the state of the shipwreck, such as human activities (e.g. shipping, dredging, fishing, construction of wind farms, looting) or natural processes (e.g. sedimentation, erosion of the seabed or biological degradation by shipworm). The state of the shipwreck might also be subject to indirect influences, such as legislation concerning the surrounding area or measures taken to preserve the wreck site.

9.2 International Cooperation and Data Exchange



Example of GIS data on object/site level. © MACHU Project

Protecting and managing underwater cultural heritage means that many stakeholders have to work together. In maritime archaeology this often involves international cooperation and the exchange of information. A uniform way to describe and present data in a GIS (such as using standardized language) is essential. This can include soundings, multibeam and side scan sonar images, geological, climatological, geochemical and biological data, and information about relevant human activities.

The GIS stores and presents information that can be used over and over again in different combinations. It therefore, not only preserves information on underwater cultural heritage, but especially in combination with other data and information, also generates new information. Storing information that is accessible for others is important because, for example, something that is excavated will never again attain its original form as excavation is inherently destructive.

It is not easy to ascertain what is important in the selection procedure to determine which wreck should be actively preserved and which should not. Important factors, however, are age and the level of preservation; the condition of the site and the level of integrity (is it undisturbed? Does the ship still have its cargo?). If stored in a database and accessible through GIS, this information can be easily obtained.

Since it is important to know what will be protected, a non intrusive assessment on the site is executed. This assessment will give answers to some basic questions like its intrinsic value, the threats, the extension of the site, the condition of the environment and the object, how old the wreck is and whether it has a cargo on board (See Unit 5: *Desk-based Assessment* and Unit 6: *Significance Assessment)*. The information is very helpful if in the future, we are looking for an object to answer a specific scientific question. All this basic information can be stored in a GIS, similar to the one developed within the MACHU project.

9.3 MACHU Content Management System (CMS)

The location of the ship remains, combined with information on historic events or environmental conditions in the area, may help to reveal the history of the wreck. To describe the story of a shipwreck and how it came to its end is an important factor in creating awareness with the general public. Creating awareness is an important step in protecting underwater cultural heritage (see Unit 17: *Public Archaeology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology*).

Combing Wikipedia and YouTube facilities in an international underwater cultural heritage CMS would be an effective way to present information to the general public. There are a range of websites, such as Shipwreck Asia (www.shipwreckasia.org) and Wreck Site (www.wrecksite.eu) that carry written information and (if possible) images, video and audio to satisfy our modern way of communication.

The description of the wrecks in the MACHU CMS adheres to the formats agreed by the MACHU partners for the information in the GIS.

Wreck and site ID in MACHU CMS. © MACHU Project

The fields also function as buttons. Click on 'Description' and the available information will appear on the right. The right side is reserved for the extras activated by clicking a field on the left. The Type Entry tells you more about a given ship type (if possible).

The descriptive section also gives information on the archaeological background of the site, stories associated with it and/or historical information. Impressions of how a ship might have looked (artist's impression or an animated movie) can be added in the 'specials' section. Subjects like navigation, ordnance and maritime warfare in relation to the wreck can also be discussed.

In this way the MACHU CMS gives additional descriptive information on shipwrecks that is not provided by the MACHU GIS. The MACHU GIS essentially acts as more of a container that includes scientific raw data.

The cultural aspects of the sites are not extensively described in the MACHU GIS. The general public will probably not be very interested in the management of the underwater cultural heritage in itself. However, they will be drawn to the subject of management indirectly if it is incorporated into stories about sites and wrecks as in the MACHU CMS.

Combining a database of underwater cultural heritage with special features is what makes this method of presenting the underwater cultural heritage a very powerful tool for creating awareness. Visibility on the Internet depends to a large extent on extras such as these that can attract an audience. If a wreck or object can be seen in its historical and archaeological context, it will be much more appreciated.

Suggested Reading

- Manders, M., Oosting, R. Brouwers, W. (eds.) 2009. *MACHU Report*. No. 2, January 2009.
- Manders, M. *et al* (eds.). 2010. *MACHU Final Report*. No. 3.
- Oosting, R. and Manders, M. (eds.). 2008. *MACHU Report*. No. 1.

Example of descriptive information of a wreck site. © MACHU Project

Unit Summary

A geographic information system (GIS) captures, stores, analyses, manages and presents (digitized) data that is linked to one or more locations on a map. The power of a GIS comes from the ability to relate different information in a spatial context and to reach conclusions about these relationships.

Much of the information that is important for the management of the underwater cultural heritage underwater has a spatial component and is, therefore, suitable to be used in a GIS. Management means that sites or information from these sites, are being secured over a long period of time. A GIS of sites, research and related information, can be an integrated part of the management process.

An example of a GIS used to manage and describe underwater cultural heritage is the MACHU GIS.

Suggested Timetable

15 mins	Introduction
45 mins	Introduction to GIS - *Defining GIS* - *Advantages of GIS* - *Components of GIS* - *Major Areas of Application*
	Break
90 mins	Using GIS - *What is unique about GIS* - *GIS Tasks* - *How does GIS Work?* - *Demonstration of Arc GIS*
	Break
90 mins	GIS Case Study: MACHU Project
	Break
70 mins	Practical Session

Teaching Suggestions

This unit introduces students to geographic information systems and provides guidance on how they can be used in underwater archaeology. It is recommended that the information should be presented to students in the form of two lectures, followed by a demonstration and practical session. In advance of the training session, trainers should brief students to collate a selection of raw data concerning underwater sites from their home country.

Demonstration

A practical demonstration of a GIS system provides students with the opportunity to gain a better understanding of how the information is stored and how it can be used.

Trainers should demonstrate the functions and capabilities of a system (such as Arc GIS) and then run through a basic analysis using selected GIS spatial and attribute data. Students should then be shown how to upload their own underwater cultural heritage database and how to manipulate the data.

It can also be useful for trainers to demonstrate how to create a GIS database formed from other underwater cultural heritage databases, such as those that can be purchased from www.shipwreckregistry.com.

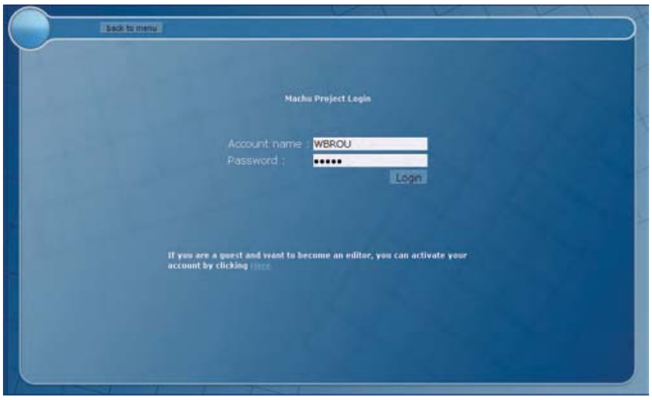
Demonstration sessions can either be scheduled at the end of the introductory lectures or split according to topics.

Discussions can also be a useful way for students to explore the issues presented in the unit. If there is time available, trainers should facilitate a discussion with students regarding how underwater cultural heritage data is managed and shared in their home countries.

Practical Session

The MACHU Content Management System is a simple form of GIS. The system can be accessed at: www.machuproject.eu/wrecksites-cms.htm (Accessed February 2012).

During the practical session, trainers should then task each student to upload a site or wreck ID on to the MACHU Content Management system (CMS). This can include information such as site name, location, history of the wreck, situation of sinking, historical political background, trade routes cargo, type of ship, etc.

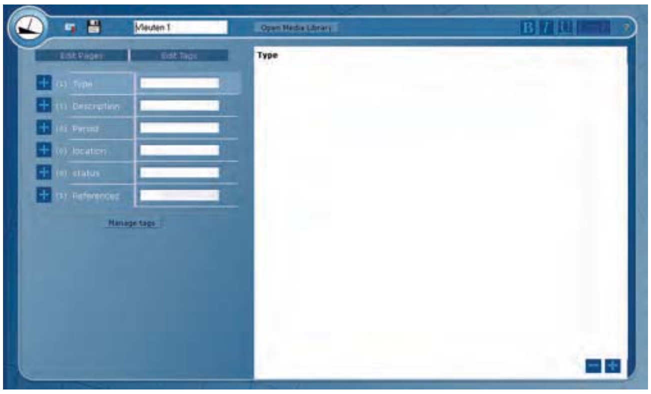


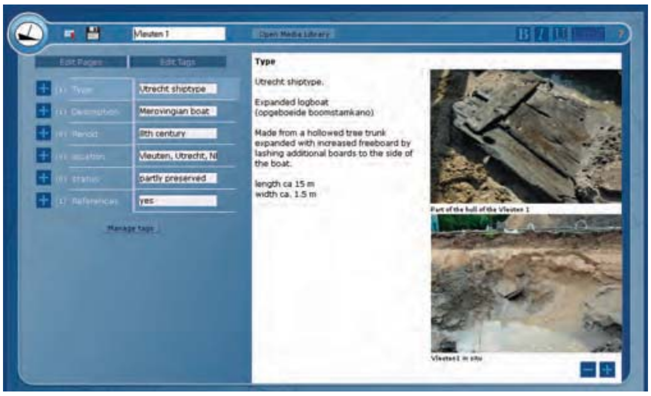
To log into the machu wreck & site viewer, go to ***www.machuproject.eu*** *and click on wreck & site viewer. There you can make your own profile and log onto the site. © MACHU Project*

Instructions on how to upload data to the CMS can be downloaded from: www.machuproject.eu/machu_cms/docs/machu_cms_help.pdf (Accessed February 2012).

By uploading new shipwrecks to the database, students will be able to see the location of the wreck, learn more about the site's environment and its relationship to other wrecks in the vicinity.

To complete the practical session, it is recommended that trainers discuss with the students what opportunities the MACHU system presents and how the additional information can be used.





With this profile you can create wreck-ID's and share them through this site with the rest of the world.
© MACHU Project

Suggested Reading: Full List

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Stamp, L. D.1964. A Geography of Life and Death. Ithaca, New York.

UNESCO. 1999. *GIS and Cultural Resource Management. Manual for Heritage Managers*. Keen Publishing Thailand Co. Ltd.

Useful Websites

- *Esri, Journal of GIS in Archaeology:* ***www.esri.com/library/journals/archaeology/index.html*** *(Accessed January 2012).*
- *Taylor & Francis, International Journal of Geographical Information Science:* ***www.tandf.co.uk/journals/tgis*** *(Accessed January 2012).*
- *UNESCO World Heritage:* ***www.unescobkk.org/culture/world-heritage-and-immovable-heritage/gis-and-cultural-resources-management*** *(Accessed January 2012).*
- *United Nations, Asian-Pacific Remote Sensing and GIS Journal:* ***www.unescap.org/publications/detail.asp?id=1100*** *(Accessed January 2012).*
- *Centre for Spatial Integrated Social Science (an article on John Snow):* ***www.csiss.org/classics/contents/8*** *(Accessed January 2012).*

United Nations
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Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 9

Author Martijn R. Manders

In Situ Preservation

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UNIT 9

Contents

UNIT 9

Author Martijn R. Manders

In Situ Preservation

Core Knowledge of the Unit

This unit introduces students to *in situ* preservation, what it means and the techniques that can be used to preserve underwater cultural heritage sites from deterioration.

Upon completion of the *In Situ* Preservation unit, students will:

- *Have an understanding of the principles of* in situ *preservation.*
- *Gain basic knowledge on when to use it.*
- *Gain basic knowledge on how to apply it.*
- *Be able to evaluate different techniques that are used around the world.*

Introduction to the Unit

Article 25 of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) states that *in situ* preservation of underwater heritage shall be considered as the first option before engaging in any activities directed at the heritage site. However, to be able to apply *in situ* preservation, one must first know what it entails. Does it mean leaving sites at the place they have been found? Or do the sites also require physical protection? Are excavations still possible? Once preserved *in situ*, what is the next step? This unit will discuss all these aspects and explore different techniques that can be used to physically protect underwater sites.

1 *In Situ* Preservation

Over the past few decades, maritime archaeology has evolved from an object related profession, into one that encompasses underwater cultural heritage; a non-renewable resource that provides a unique opportunity to investigate and learn from our past. Shipwrecks are essentially time capsules (closed finds) and their informative strength is the assemblage value of all the associated objects: ship, inventory, personal belongings and cargo. Every shipwreck has its own unique story to tell.

This resource has to be managed in a responsible and sustainable manner. Management means that the sites and the information they can yield, are secured over a long period of time. Sites have to be investigated according to international standards such as the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris 2001). Archaeologists, conservators and policy makers are all involved in the management of underwater cultural heritage. The *in situ* preservation of sites is an integral component of this management process.

Recent international standards state that *in situ* preservation should be the first option to be considered when managing a site. However, what does *in situ* preservation of underwater heritage sites mean? Why should we protect them using this method? How can sites be physically protected underwater and against what threats?

2 Why *In Situ* Preservation?

There are many reasons why *in situ* preservation is the first option by international standards.

- *Need to preserve the heritage site for the future*
- *Well developed protection system by law*
- *Enormous amount of newly discovered sites*
- *Cost effectiveness*
- *Time gap between discovery and excavation*
- *Lack of conservation knowledge*

Over the years, *in situ* preservation of archaeological sites has become increasingly important. This is also the case for those sites located underwater. The reasons to do so are pragmatic or based on philosophical thoughts on how to manage our common maritime heritage.

A representative proportion of our maritime past has to be preserved for future enjoyment and research. The 'stock' of archaeologically interesting shipwrecks is immense and unarranged. It is therefore important to investigate underwater sites ans determine their value and significance. This can be achieved by evaluating these wreck sites. After evaluation, the state or condition of these selected wrecks should be preserved, considering that without active safeguarding, many excellent examples of maritime heritage will be lost forever.

Practiced since 1980s, *in situ* preservation aims specifically at keeping something for future generations. Projects, such as MoSS (Monitoring of Shipwreck Sites) and BACPOLES, have proven that *in situ* preservation can slow down degradation. However, it is impossible to completely stop the deterioration of shipwrecks (this is also the case for shipwrecks preserved *ex situ*). It is therefore important to know how long a wreck can be preserved underwater by taking certain kinds of measures. The idea is to create an underwater 'archive' that is accessible for monitoring, making sure that the 'files' are kept intact until they are opened for serious research. For this reason it is important to have an idea how long the site has to be protected (for 5 years, 20 years or 100 years). The protective measures have to be selected in such a way that deterioration of the site can be brought down to a minimum and that it is still possible to access the site in the future for archaeological research.

To know the extent of the protection, a non intrusive assessment on the site is executed. This assessment will give answers to some basic questions such as the extension of the site, the condition of the environment and the object, how old the wreck is and whether it has a cargo on board. The information is very helpful if, in the future, it is necessary to look for an object to answer a specific scientific question.

Most countries nowadays have a well developed law and regulation system concerning the protection of maritime archaeological heritage. This is a precautionary principle. It means that these countries have taken the responsibility to preserve not only their own, but also common maritime past. *In situ* preservation is therefore the logical method for afeguarding UCH on such a large scale.

Some international regulations concerning the protection of maritime heritage underwater go even further by stating that the conservation *in situ* should be the first option. The best examples of these regulations are UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) and the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996).

The amount of shipwrecks discovered grows fast and there is not enough capacity to do the research. Not only on land, but also underwater archaeological sites are getting more easily accessible. Nowadays diving has become a popular hobby. Equipment that can look through water of even the lowest visibility (side scan sonar and multibeam sonar) has been rapidly developed, as well as equipment that can penetrate into the seabed (sub-bottom profilers). This has measured the number of archaeologically interesting shipwrecks that are listed in monument registers and other databases all over the world. These more advanced survey methods make it possible for almost everyone to explore the underwater world at a reasonable cost. This upsurge of newly discovered sites has created an immense problem; to be able to keep pace with the number of wreck sites reported every year, the maritime archaeological community would need a lot more workforce to investigate them.

The excavation of an underwater wreck is very expensive. Even though diving is no longer an exclusive activity, interventions underwater are still costly. It is still necessary to use special equipment and to be able to work accurately, it is crucial to spend a lot of time underwater. In some countries, the underwater archaeologists need special training and licences. This makes an underwater excavation far more expensive than an excavation on land.

Even if a wreck is likely to be excavated, there is usually a prolonged period of time between the discovery of objects and the actual excavation.

The following points need to be fulfilled before excavation can be started:

- *There has to be a non intrusive assessment*
- *There has to be a project design*
- *There has to be funding in advance for the entire project*
- *There has to be a timetable*
- *There has to be research objectives.*
- *Details of the methodology and techniques to be employed must be set out in the project design*
- *The investigating team must be competent, appropriate to the task and have the right qualifications*
- *Sometimes political or legal issues have to be solved (for example, the ownership of a wreck) before an excavation can commence*

Refer to Rule 10 of the Annex of the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris 2001).

The research objectives of an excavation are essential. If something is excavated, it will never again attain its original form, since excavation in itself is destructive. This is the basic premise on why these rules have been laid out to regulate archaeological excavations. It is not possible to extract all information that a site contains. For example, studying the cargo or construction of a ship could well bring about hundreds of questions. Yet by excavating the cargo and trying to answer a few questions, you remove the source, making it impossible to answer other questions that could have been asked just as well. It is therefore important to know the scope of research and to focus on the research objectives before starting an excavation. In this way, the most essential questions can be answered.

Not all wrecks can be physically protected. Large scale protection may not be necessary, if the site is located in a stable natural environment, such as the case of the *Vrouw Maria* site in the Baltic Sea (Finland). On the other hand, some environments are very hostile to underwater archaeological sites and much effort has to be done to stabilize the site, such as at the BZN 10 site (Netherlands) or the *Avondster* wreck site in the Bay of Galle (Sri Lanka). Some sites may not be considered worthy of spending that much time, effort and money on physical protection. In this case, the choice may be to leave a wreck unattended as is, i.e. not physically and legally protected. This selection of wreck sites to be protected is pragmatic and the efforts for doing research and preserving wrecks *in situ* should always be balanced.

It is not easy to determine which site has to be protected or not. Important factors to consider are the age and the state of preservation, the physical condition of the site and the level of integrity (Is it undisturbed? Does the ship still have its cargo?). See Unit 3: *Management of Underwater Cultural Heritage.*

Declaring a wreck archaeologically interesting and worthy of protection means that responsibility for its preservation has to be taken. This is not exclusively the task of maritime archaeologists, but also of the policy makers. Therefore, one of the best ways to safeguard our maritime past is to engender public interest and support.

In addition, a reason to preserve archaeological sites *in situ* is the lack of knowledge on how to treat certain processes of deterioration. As an example, the sulphur problem is damaging the hulls of the *Vasa* and the *Mary Rose*. See Unit 11: *Conservation and Finds Handling* and *Additional Information 1*.

ADDITIONAL INFORMATION

1 The majority of text in this section is taken from: Manders. M. 2004. Why do We Safeguard Ship-wrecks. *MoSS Newsletter.* 3/2004, pp. 4-6.

Suggested Reading

Sandström, M., Fors, Y. and Persson, I. 2003. The *Vasa*'s New Battle: Sulphur, Acid and Iron. *Vasa Studies 19*. Stockholm.

3 Threats to Underwater Archaeological Heritage

Some of the primary threats to underwater archaeological heritage are:

- *Physical-mechanical*
- *Biological*
- *Chemical*
- *Human*

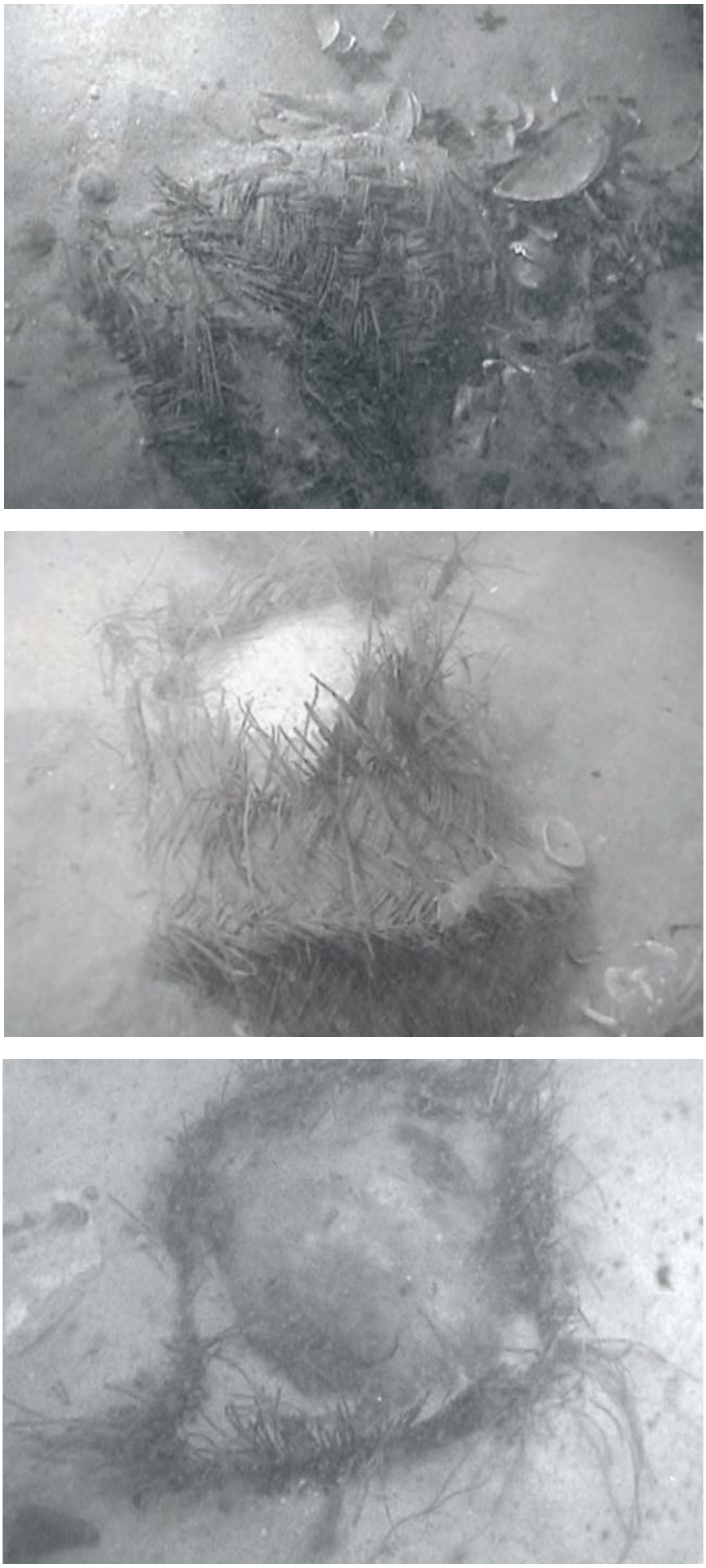
Why is it so important to physically protect archaeological sites underwater? Legislative protection is important to minimize human threats, but there are also physical, chemical and biological threats to contend with.

In fact there are many factors influencing the course of deterioration over time. Muckelroy (1975) developed a model on the process of deterioration that still stands, but more have also been developed (e.g. Ward 1999). The models are there, but observation and monitoring are required to determine the most important threats to a particular site.

3.1 Physical-mechanical Threats

- *Erosion and abrasion by currents, tidal movements or changes in water circulation.*
- *Erosion or mechanical deterioration due to dredging, fishing or anchoring.*

Physical-mechanical threats can result in objects being removed and displaced. Objects becoming exposed are therefore more vulnerable to deterioration. Surfaces of objects get eroded and parts of the site may disappear.



Mechanical deterioration of a basket near an Iberian jar (BZN 10 wreck, the Netherlands). Within a few hours, due to the abrasive effects of currents caused by the tidal flow, the basket disappears. © RCE

3.2 Biological Threats

The biological threats to *in situ* underwater sites are, for the most part, dependent on the presence of oxygen. Examples of biological deterioration (in decreasing order of severity) include:

- *Marine Borers (especially Teredo navalis or shipworm)*
- *Fungi*
- *Bacteria*

Research in the Netherlands and Australia has shown that shipworm can cause deterioration of wood within a few months. The shipworm is also one of the biggest biological threats in Asia. Research on the *Avondster* wreck in the Bay of Galle in Sri Lanka has shown the disastrous effects of shipworms on exposed wood.

The shipworm is dependent on saline and aerobic water of higher temperatures. The effect of gribble *(Limnoria lignorum*) is generally less destructive than that of *Teredo navalis* (which also requires a similar environment), but over an extended period of time wood strength can be compromised and important archaeological information may be lost.

The most severe attackers of wood exposed above water are fungi: Soft Rot, Brown Rot and White Rot. The underwater environment in contrast, is not favourable for most fungi and it rarely exists, especially in saline waters. However, sometimes Soft Rot does occur. In some instances old fungi that were present in the timbers of a ship at the time of sinking become active again once they are taken from the seabed into the dry, oxygen rich environment.

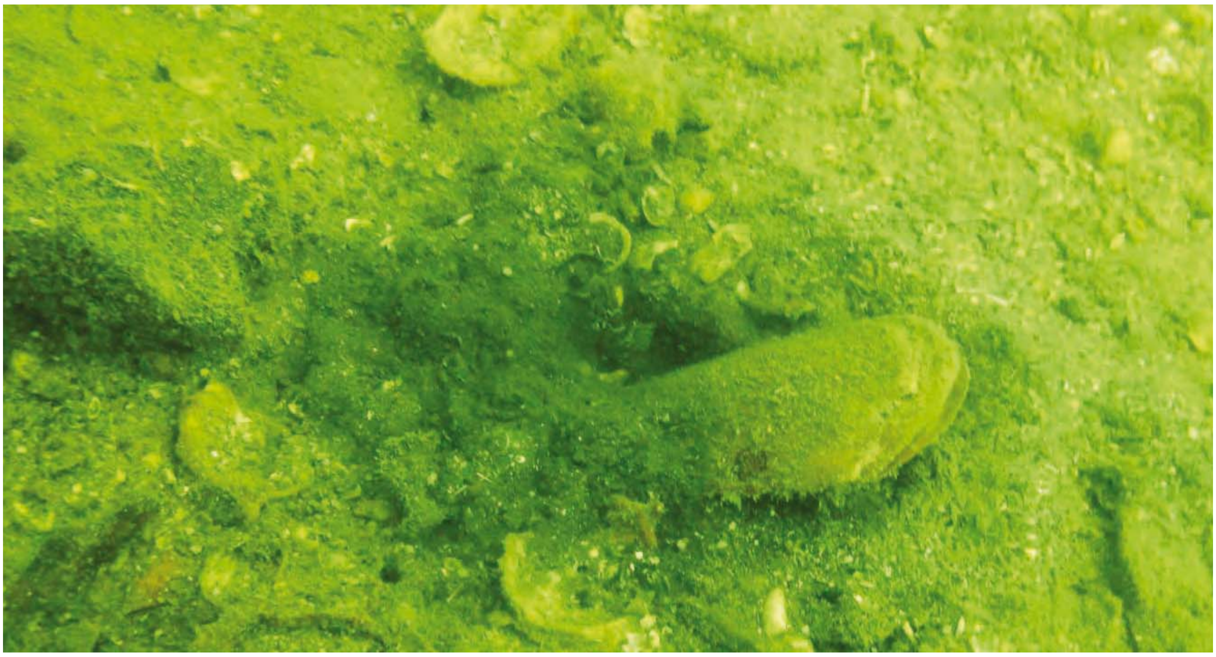
Tunnelling bacteria may attack wood when the conditions are still slightly aerobic. As timbers or parts of timbers become buried in the sediments, they will be degraded by organisms that require less and less oxygen until they are only subjected to the relatively slow action of (near) anaerobic erosion bacteria, in both fresh and marine environments.

The European Union (EU) funded project, Preserving Cultural Heritage by Preventing Bacterial Decay of Wood in Foundation Poles and Archaeological Sites (BACPOLES) revealed that bacterial decay of wood in marine sites is often less than in fresh water environments.

Generally, due to the manner of anaerobic bacterial attack of organic materials, very little archaeological information is lost; it is mainly the strength of the organic structure that is reduced.

Research (MoSS project) investigating the deterioration of modern wood blocks buried in marine sediments, showed that burial 10 cm under the surface of the seabed is usually sufficient to prevent the action of wood boring organisms and fungi. However, shipworm can be 40 cm long and it only needs to have a small part of its body in the open water. In theory therefore, it can attack wood at deeper levels.

At a depth of 50 cm microbiological activity is significantly reduced. In a stable environment, only the first few millimetres of sediment is usually aerobic and below this level more anoxic conditions prevail, but the size of the aerobic/anaerobic range is very dependent on the sediment type. However, irrespective of sediment type, bioturbation, scour, erosion by currents and tidal movements or human action, can expand the aerobic zone and consequently increase degradation. Therefore, burial of a site under at least 50 cm of sediment, where stable, anoxic conditions prevail and which excludes the effect of wood boring organisms, is generally recommended for the long term preservation of underwater cultural heritage sites that contain large quantities of organic structural and artefactual materials.



TOP: Wood from the Avondster *ship (Galle, Sri Lanka) severely attacked by the shipworm. © MAU*

ABOVE: Bioturbation in the first few centimetres of the seabed: the Fan clam digs itself into the soil and therefore causes disturbance of possible find layers (Mannok site, Thailand). © UNESCO

LEFT: The Teredo navalis or shipworm. © David Gregory

Rust is a form of chemical deterioration (Mannok site, Rayong, Thailand).
© UAD, Thailand

Examples of human threats:

- *Treasure hunting*
- *Sports diving*
- *Fishing*
- *Dredging e.g. mineral extraction*
- *Large infrastructural/development works*
- *Pollution*
- *Ship movements*
- *Archaeology*

3.3 Chemical Threats

Chemical processes can also affect the integrity of archaeological objects. One of the most common processes is the corrosion of iron and other metals, which happen especially in oxygen rich environments. Generally, the less oxygen, the less corrosion occurs. However, even under anaerobic conditions, corrosion of iron can occur, producing reduced iron corrosion products, such as iron sulphides. These can diffuse into the degraded structure of organic materials, such as wood, that are lying in close proximity to the corroding iron. Also, iron sulphides and other sulphide species can be formed by sulphate reducing bacteria under low oxygen conditions. Once the organic materials are recovered from a site the incorporated sulphides may be oxidised in the presence of free oxygen. These oxidation reactions produce acidic iron sulphates and other sulphate species, such as sulphuric acid that destroy cellulose, lignin and collagen by assorted chemical reactions. These processes have occurred on several ships recovered from the seabed, such as the *Vasa* in Sweden, the *Mary Rose* in England, the *Batavia* in Western Australia and the BZN 3 and BZN 15 wrecks from the Wadden Sea, the Netherlands. See Unit 10: *Conservation and Finds Handling*.

3.4 Human Threats

The threat of man to the underwater cultural heritage is enormous. A major problem is treasure hunting, which results in loss of much information. Treasure hunting is also promoted in movies and other forms of media, thus sending a wrong message to the public. However, other human threats are just as destructive as treasure hunting.

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Muckelroy, K. 1975. A Systematic Approach to the Interpretation of Scattered Wreck Sites. *International Journal of Nautical Archaeology.* No. 4, pp. 173 – 190

Sandström, M., Fors, Y. and Persson, I. 2003. The *Vasa*'s New Battle: Sulphur, Acid and Iron. *Vasa Studies 19.* Stockholm.

Ward, A. K., Larcombe, P. and Veth, P. 1999. A New Process-based Model for Wreck Site Formation. *Journal of Archaeological Science.* No 26, pp. 561-570

This site is covered with fishing nets, cables and wires (Mannok site, Thailand). © UAD, Thailand

A fish trap placed alongside the Mannok wreck site © UAD, Thailand

In Thailand, approximately 500,000 recreational divers are active each year, constituting a huge stakeholder group. They can pose substantial threats to the underwater cultural heritage, but can also assist in its protection. © Christopher J. Underwood

A fish trap being placed on the seabed. © Christopher J. Underwood

4 Measuring the Extent of Deterioration

4.1 Monitoring

When archaeological sites are preserved *in situ*, they should be monitored to measure changes that might occur to the condition of the site and the effectiveness of the chosen protection strategy and to be able to act on any detrimental changes. Although often forgotten, monitoring is a critical part of the overall management programme.

The extract below was taken from an article written by the author for the EU-MoSS project (See *Additional Information 2*) and illustrates the role that monitoring plays in the management process.

The MoSS project consists of three research aspects: monitoring, safeguarding and visualising. Why was this approach chosen? And what is the value in combining these three aspects? The whole project is designed to find effective ways to preserve our common maritime heritage underwater. This not solely the concern of maritime archaeologists, but is also a much broader public issue. Our heritage is only well protected if it has extensive public support. The public should consist of scholars, decision-makers and the people who consider these shipwrecks as part of their own history. For them it has to be clear what can still be found underwater, how these finds can be used to reconstruct the past, why wrecks are deteriorating, how these processes can be stopped or slowed down, and at what cost. In other words, the shipwrecks on the seabed and their threats have to be investigated and visualized to create understanding and arouse public interest.

If a site is to be successfully protected, it is important to first know what is threatening it. This requires observing and recording what is happening to the site over an extended time period, in order to understand any damaging effects. By systematically observing wrecks (monitoring) it is possible to understand more about the major degradative processes. If, for example, it is possible to mitigate the major factors that degrade wood, it is obvious that the degradation rate would decrease. Safeguarding therefore, depends to a great extent, on the information gained from monitoring wrecks. After safeguarding a wreck it is also important that monitoring continues to keep track of the development of the site and the effectiveness of the protective measures.

Visualization is an important part of documenting and investigating a site. Wrecks underwater are usually not easily accessible and research on these sites is usually concentrated over a very short period of time. The visualization of excavation, monitoring and safeguarding, enables scientists to do research even when they are not physically present on the site. Since archaeological research can take years to complete, visual documentation is essential to keep track of everything that has been carried out. Visualization also enables the opening up an archive of archaeologically interesting shipwrecks to a wider audience. There are many ways to do this. The *Vrouw Maria* wreck (Finland) and the *Eric Nordevall*

ADDITIONAL INFORMATION

2 Manders, M. 2004. Combining Monitoring, Safeguarding and Visualizing to Protect our Maritime Heritage. *MoSS Final Report*, pp. 74-76.

(Sweden) are so well preserved, that although other methods have been utilised, the conventional ways of documenting a site by photography and video registration have been enough to create widespread public interest and to highlight the importance of these wrecks for reconstructing our past.

The Darsser Cog site (Germany) is the oldest of the investigated wrecks, although requires some more work to make the wreck accessible to a wider audience. This particular site has been documented and visualised by photographic mapping. The BZN 10 wreck (the Netherlands) is also well preserved, as at least half of the ship is still protected in the sediment. Despite the fact it has been broken up, the remains can still be reconstructed by the scientists and translated to the public.

Not long ago there was only one kind of visual monitoring. Back then, the only information about the condition of a shipwreck were the written accounts of what had been seen by the researchers. It is still important to register these visual changes, but now there are many more techniques to quantitatively measure the condition of the wreck. These methods, like the use of a data logger to measure the environmental conditions, are potentially more objective and can be more easily compared. It is however, very important that this data is accessible and can be understood by more people than just the researchers working on the site. To do this it is important to illustrate these numbers by using, for example, graphics.

The safeguarding of shipwrecks is a long term process and does not simply stop after physical protection. Over the years, the situation in and around a wreck site can change or protective measures may become ineffective. For example, if there is heavy erosion on a site, the wreck can be physically protected by covering the site in sediment. This has been achieved with polypropylene nets at the BZN 10 and other sites in the Wadden Sea. This method is very effective, however, the erosion in the vicinity of the site continues. After a long period of time, the seabed around the protected wreck can be extensively eroded, so much so, that sand starts to flow away from under the protective nets. Regular monitoring can identify this threat at an early stage and other measures can be implemented to ameliorate this problem.

In conclusion, monitoring helps to select the right measures to safeguard a site. Safeguarding a site is a long term process. This process has to be monitored to ensure that the measures taken are still valid after many years. The monitoring can also provide new information that may force a change to the mitigation strategy applied to protect the site.

Raw data gained from the monitoring can be made visual for a wider audience, such as other scientists, policy makers and the general public. It is important for them to know why and how wrecks are threatened, what kind of measures have been taken to preserve maritime heritage, and at what cost.

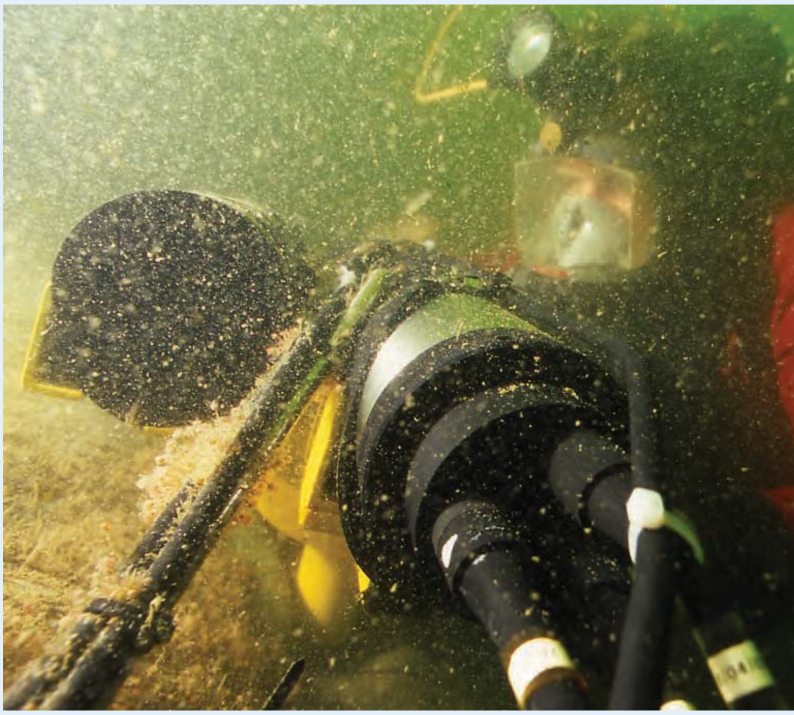
Monitoring should always be compared to baseline data. The most ideal procedure would be to have data prior to undertaking physical *in situ* preservation. Then after installation the same data is collected and a time line for further monitoring is developed. This time line is an indication of how often a site is going to be monitored in the future. However, this can change over time for a number of reasons, (e.g. new information might indicate that severe changes are occurring and the site has to be visited more often).

4.2 Open Seawater

In open seawater, parameters such as dissolved oxygen, salinity, temperature and depth will affect colonisation of exposed timbers by wood borers. However, this data also provides a picture of the environment. When the condition of the site changes, it is necessary to compare that change with the change in the environment.

This data can be obtained from:

- *Technical devices such as data loggers. These are pieces of equipment that may contain several sensors to collect different data (for example salinity, temperature and dissolved oxygen) over long periods of time. A data logger automatically records the data once it is installed and can be retrieved when the data logger itself is collected or through a wireless connection with the device.*



A diver with a data logger on the seabed. This apparatus measures the changes in several parameters such as salinity and dissolved oxygen. It can help us to see the changes in the site environment and detect or predict threats (BZN 10 wreck, the Netherlands). © R. Obst

- *By obtaining information from large (oceanographic) institutes that are measuring useful parameters for other purposes. The advantage of having your own measuring devices is that it can be placed anywhere (e.g. on a wreck site) and the archaeologist can choose what parameters to measure. The disadvantages are that these installations are usually very expensive to buy and especially difficult to maintain. The advantage of obtaining data from other institutes is that it is usually inexpensive (often free of charge) and it establishes cooperation between different stakeholders, however, it is often difficult to influence the positioning of these data loggers and the parameters they are measuring.*

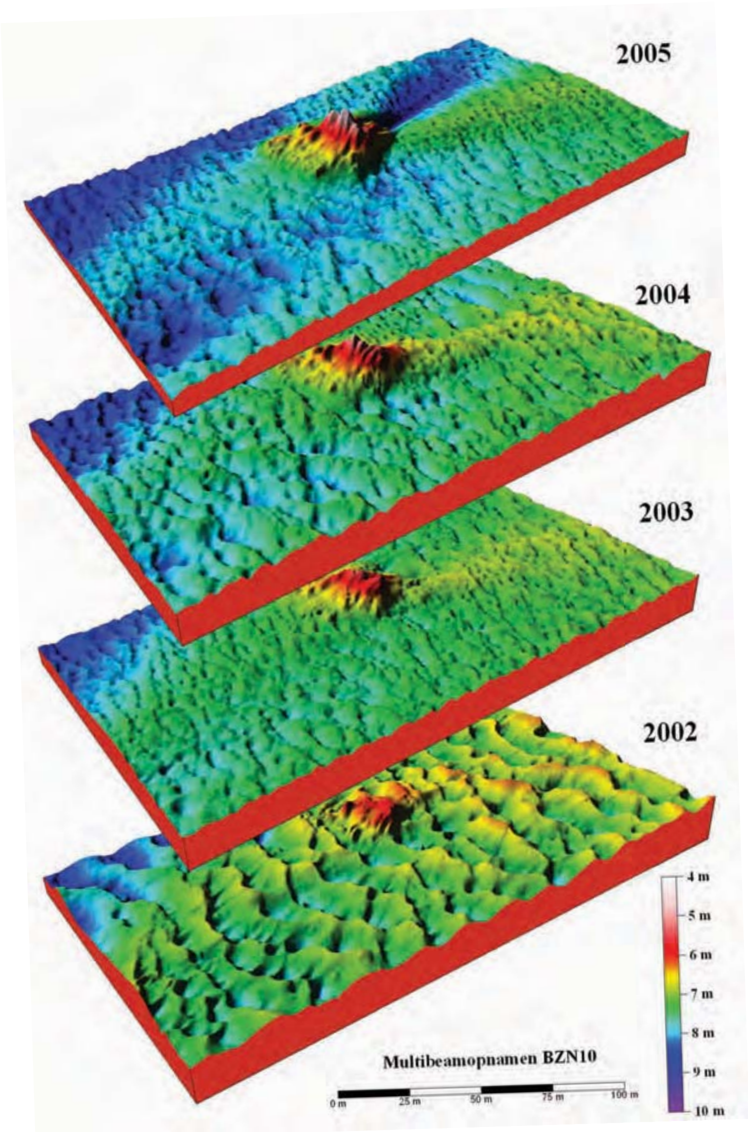
- *Another way to measure the characteristics of the water column is to place sacrificial objects in the water and measure their deterioration rate over time by taking water samples and conducting post recovery analysis.*

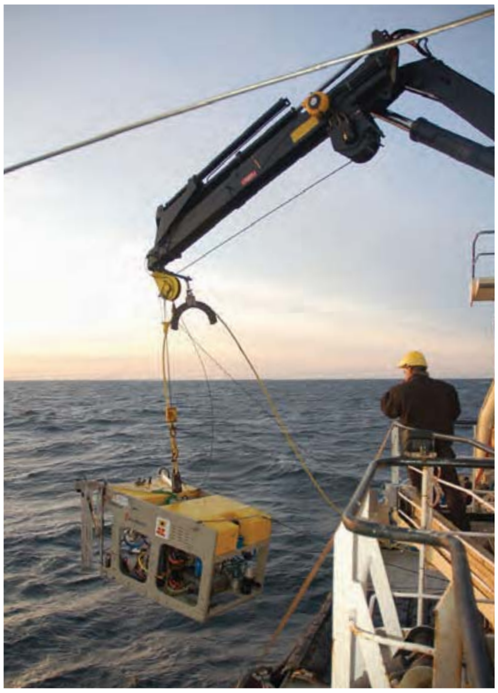
4.3 The Seabed

Erosion or sedimentation of the seabed can assist in determining whether a site is in danger and deciding whether to measure only the site itself or also to monitor the surrounding seabed over a larger area. Both are important to monitor. Measuring a larger area can provide information about the overall seabed changes occurring in an area due to, for example, changes in currents or large infrastructural works in the area. Measuring the seabed at site level can provide information about erosion on the site. Erosion can be caused by the fact that a physically protected site may provide a hard surface, an obstacle on the seabed, from which toe scouring can occur around the edges.

The seabed can be measured in a few ways.

- *Visually, underwater by divers and Remotely Operated Vehicles*
- *From the water surface with geophysical methods like single beam, multibeam, side scan sonar.*
- *From the water surface with traditional sounding (sounding lead).*
- *From the air with laser, aerial photography and satellite.*





ABOVE: Remotely Operated Vehicles or ROVs can be our eyes at great depths (Ghost wreck, Sweden). © Martijn R. Manders

LEFT: A sequence of recordings of the seabed with multibeam sonar helps us to detect and visualise changes in the seabed morphology, for example, due to sediment erosion processes (BZN 10 wreck, the Netherlands). © RCE/RWS/Periplus

4.4 (Marine) Sediments

Marine sediments are usually very low in oxygen except in the first couple of centimetres and this concentration decreases rapidly with increasing sediment depth, until anaerobic conditions are attained. However, due to changes in the seabed, caused by erosion, this may alter. Also, as previously mentioned, deterioration can still occur under close to anoxic conditions.

The effect the burial environment has on the deterioration of materials can be measured by:

- *Placing microelectrodes in the seabed, connected to a data logger*
- *Using sacrificial objects, which are buried in the seabed and measured for deterioration over time*
- *Sampling and analysing original elements, objects and sediments recovered from the site*

In the future, it will be important to develop quality standards for different materials and to make an effort to apply these standards at a universal level. In this way, comparisons crossing administrative borders could be possible as well as assisting in the prioritization of sites in a broader setting. Some standards can be copied from terrestrial archaeology, whilst others will have to be developed specifically for underwater archaeology.

The parameters that have to be measured may differ, however there is some critical data for sediment and water.

Sediment:

- *How easily it changes from oxygen rich to anoxic (redox potential)*
- *pH*
- *Bio turbidity*
- *Chemical pollution*
- *Sulphur content*

Water:

- *Salinity*
- *Water transport*
- *Temperature*
- *Dissolved oxygen*
- *Turbidity*

4.5 The Object

Overtime the object can be monitored in a general way. Archaeologists can consider: is the overall condition of the site deteriorating? Are elements falling apart? Is the relationship between the components weakened?

When monitoring a single object made of different materials, it is important to consider the following indicators:

Wood

- *Measuring the water content as an indicator of the deterioration of the wood*
- *Visual deterioration (e.g. due to borers or abrasion)*

Iron

- *Amount of iron left in the object*
- *Visual deterioration (amount, shape and colour of the corrosion)*

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5 Examples of Techniques used for *In Situ* Preservation

5.1 Sandbags


Sandbags used to stabilise a log boat (Roskilde, Denmark) © WreckProtect Project

Advantages

- *Protection against looters*
- *Probably encourages the formation of an anaerobic environment*
- *Long term preservation*
- *Material easy to obtain*

Limitations

- *High labour costs*
- *Difficult to monitor*
- *Weight on the wreck site*
- *Strong scouring around the protected site*
- *Some types of sandbags might deteriorate easily (e.g. natural materials like canvas)*

5.2 Polypropylene Debris Netting:

Advantages

- *Easy to create anoxic environment*
- *Inexpensive*
- *Easy to install*
- *Nature does the work*
- *Material easy to obtain*
- *Easy to remove with proper equipment*
- *Easy to monitor (in and outside the mound)*
- *Becomes part of the environment*

Limitations

- *Works only in specific environments*
- *Works only on wrecks that don't protrude extensively above the seabed*
- *Can be easily and quickly damaged after installation*
- *Organic growth may make it less effective*
- *Has to be installed in a specific way*
- *Research on the environment has to be carried out in advance*
- *Some scouring may occur around the edges*

*Preparing the polypropylene (debris) nets on the beach before taking them underwater. The ends of the nets are weighted down with partly filled sand-bags (*Avondster *wreck, Sri Lanka). © MAU*

*Preparing the polypropylene nets, rolling partly filled sand-bags in both sides of the net (*Avondster *wreck, Sri Lanka). © MAU*

*A net already partly filled with sand (*Avondster *wreck, Sri Lanka). © MAU*

Advantages:

- *A combination of methods, tailored to that one site*

Advantages (Cuijk example):

- *Good, strong protection*
- *Anaerobic conditions*
- *Archaeological layers and later deposited sediment separated*
- *No organic transport between layers*
- *Easy monitoring*

Limitations:

- *It is tailor made for a specific site so may not be suitable for other sites*

Limitations (Cuijk example):

- *High costs for installation*
- *Scouring around the protected area may be severe*

Layer of geotextile

Layer of clay

Debris nets with strong galvanised wire connected to it

Usually we have to tailor our methodologies to protect sites underwater. We can, however, base our solutions on methods tried somewhere else. Here, a Roman quay in the River Meuse in the Netherlands is being protected with a layer of geotextile (above, left) followed by a layer of clay (above), debris nets with strong galvanised wire connected to it (left) and sandbags. © RCE

5.3 Specific 'Hands On' Solutions

It is important when applying an *in situ* preservation method to focus on the needs of a specific site, considering its relevant parameters, the threats to it and its important features that need maximum protection. A customized or 'hands on' solution is therefore always good to consider. It may be a combination of methods already known or may require the development of completely new methods.

The solution for a Roman Quay in Cuijk in the Netherlands, for example, consists of a combination of established techniques. This particular site is threatened by currents of the river as well as by large river barges that destroy the riverbed with their engines. The site had to be protected for only a maximum of three years, before it was planned to be excavated.

First a layer of geotextile to cover the exposed archaeological layer was placed over the site, then a layer of clay, then a layer of debris netting with galvanized steel entwined in it and finally some sand-bags to keep everything down.

5.4 Sand Deposition

Advantages

- *Inexpensive*
- *Product easy to obtain*
- *Can be deposited in many ways .e.g. water dredge and ship*
- *Natural product*

Limitations

- *The physcial environment remains the same, so in cases of erosion, this method can only be effective for a very short period.*
- *Sand may be eroded (by currents) and deposited somewhere else, where it is not wanted*
- *Sand from another place is introduced on the site*

5.5 Road Barriers

Advantages

- *Strong structure*
- *Possible to get good anaerobic/anoxic environment*
- *Easy to overcome height differences*

Limitations

- *Expensive*
- *Not easy to handle*
- *Not easy to install*
- *With the use of sandbags, is it easy to create an anaerobic environment?*
- *Big threat of toe scouring*

5.6 Artificial Sea Grass

Advantages

- *Works well to create an anaerobic environment*
- *Looks natural, if natural colours are used*
- *Has nature do the work after installation*
- *Can be installed easily*

Limitations

- *Very expensive if bought on the market*
- *Labour intensive when self fabricated*
- *Very sensitive, it may work for a short period until the fronds become overgrown with algae and then settle flat on the seabed*
- *Has to be installed carefully*
- *No possibilities to overcome significant height differences*
- *Scouring may occur under and around the mats*

Artificial seagrass can be bought or made by hand. Here, the UAD in Chanthaburi are making their own seagrass by assembling large (approximately 1 metre) fronds on fishing nets. © UAD, Thailand

Like debris nets and geotextile, it is easier to install the artificial seagrass on the seabed when it is fixed to a heavy iron pole. © UAD, Thailand

Artificial seagrass is being installed on the seabed. This self-made grass is temporary covered with a sheet to prevent the fronds from floating up while installing it. © UAD, Thailand

Artificial seagrass placed on a test site during the In Situ *Advanced Course of the UNESCO field school in Thailand. © UAD, Thailand*

5.7 Covering with Geotextiles

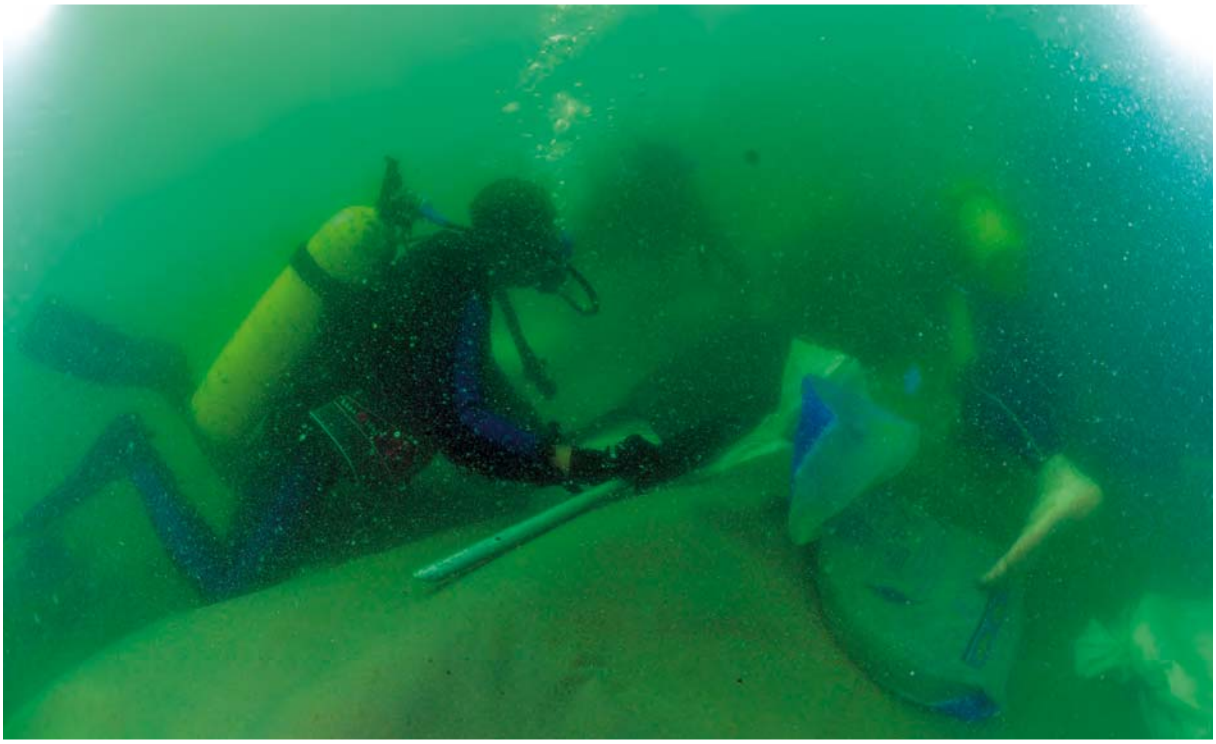
Advantages

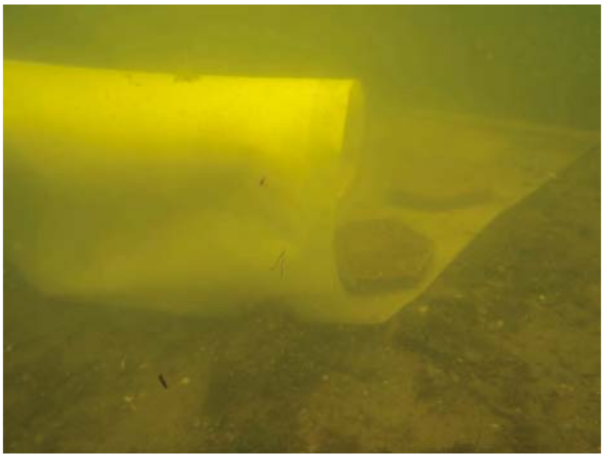
- *Easy to buy*
- *Different types available*
- *Protection against Teredo navalis*
- *Protection against abrasion*
- *Some types of textiles can seal off the site, while some can be penetrated by fine sediment*

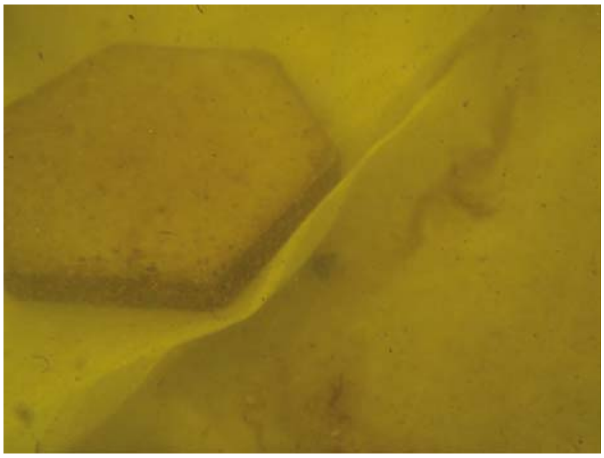
Limitations

- *Expensive*
- *Requires knowledge on suitable types of geotextile for different circumstances*
- *Difficult to install, especially in areas with currents and waves*

Geotextile is being fixed to a heavy iron pole before taken into the water, which reduces the buoyancy. © UAD, Thailand







TOP: Geotextile has been installed on a wreck (Advanced In Situ *Course test wreck, Thailand). © UAD, Thailand*

ABOVE LEFT: Geotextile used on a shallow site of a log boat near Roskilde, Denmark. © WreckProtect Project

ABOVE RIGHT: Geotextile used on a shallow log boat site in Denmark. Due to its buoyancy the textile needs to be weighted down. In this example, a tile is used. © WreckProtect Project

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6 Conclusion

Presently, not many sites in Asia are physically protected. In Sri Lanka a part of the *Avondster* shipwreck (Dutch East Indiaman) has been protected against deterioration covered with polypropylene nets. Protecting effectively an underwater archaeological site is a process of trial and error. By testing out different methods, archaeologists can learn more about the environment and decide which method can be best used in a paticular site. Trial and error implicitly means that mistakes can occur.

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Unit Summary

In situ preservation is the first rule in the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) and is considered as the first option for archaeologists to consider. *In situ* preservation means many things and requires legal and specific physical protection of the site. Deciding to protect a site carries a responsibility to preserve it for a period of time. This may be done for scientific reasons or for popular enjoyment. The reasons for protecting a site often have some bearing on the preservation methods to be used. For enjoyment, we may to see some parts of the site displayed, on the other hand, a site may have to be completely covered as protection for future research purposes.

Different threats also determine the way sites are protected. If the site has to be protected against shipworms, it is necessary to create an anaerobic environment on the site. However, if the site is protected to prevent looting, then the physical protection should be as non-penetrable as possible and legal protection should also be in place and enforced.

Involvement on the site does not end when the *in situ* technique has been applied; periodical monitoring of any changes on site is also required to preserve the heritage site to perpetuity.

Suggested Timetable

15 mins	Introduction
45 mins	Why *In Situ* Preservation? - *Preserve for the future* - *Well developed protection system by law* - *Enormous amount of newly discovered sites* - *Cost effective* - *Time gap between discovery and excavation* - *Lack of conservation knowledge*
	Break
90 mins	Threats to Underwater Archaeological Heritage - *Physical* - *Chemical* - *Biological* - *Human*
	Break
90 mins	Measuring the Extent of Deterioration - *Monitoring* - *Evaluating and acting on it*
	Break
90 mins	Examples of Techniques Used for *In Situ* Preservation
	Break
90 mins	Practical Session
10 mins	Concluding Remarks and Closure

Teaching Suggestions

Students are provided with an introduction to *in situ* preservation, what it means and the techniques that can be used to preserve underwater cultural heritage sites from deterioration. To help deepen student's understanding of the topics presented, a selection of teaching suggestions are included below.

1 Introduction

When introducing *in situ* preservation, it is important to give a brief overview of management of the underwater cultural heritage. Trainers should explore aspects such as surveying, assessment, selecting sites, excavation, etc. See Unit 3: *Management of Underwater Cultural Heritage*.

It is also useful for trainers to present and explain the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001), the ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996), and any relevant local or regional agreements such as the European Convention on the Protection of the Archaeological Heritage (Valletta 1992).

2 Why *In Situ* Preservation?

During this section it is important to provide examples of underwater cultural heritage that the trainer and the students are familiar with.

This section is also particularly useful for connecting conservators to the topic of *in situ* protection. With the knowledge and/or the prediction about the state of the archaeological site and its individual objects, a conservator can develop their conservation plan and select the most effective strategies for removing objects from the seabed.

3 Threats to Underwater Cultural Heritage

This section is best illustrated by a series of visual examples of potential threats in Asia and how they have caused the destruction of particular sites. It is important to emphasize that fishing activities might be one of the biggest threats of all to the underwater cultural heritage.

5 Examples of Techniques Used for *In Situ* Preservation

The techniques discussed during this section are focused primarily on archaeological sites. It may be useful for trainers to expand on this and also discuss aspects such as preserving metal wrecks, objects using zinc anodes (anodizing) or other sacrificial methods.

Practical Session

Students should be given a practical task that utilizes the knowledge gained during this unit. One useful test to set students, used during early foundation courses, was to develop an *in situ* preservation strategy for one of the below archaeological shipwreck sites in Thailand:

The Ruea Mail or Mannok Shipwreck Site near Mannok Island: this is a (river) steam boat. It dates from the early twentieth century and is an iron ship with possible Asian features. It contains material from as well the French Colonial Period as typical Asian artefacts.

The Ruea Rang Kwian Shipwreck Site: this is a fourteenth century Chinese or Thai junk. During the first investigation in 1989, as part of a cooperative effort between the Thai and the Australians (Western Australian Maritime Museum), the ships' hull was recorded. The hull was investigated again at the SEMEO Regional Centre for Archaeology and Fine Arts (SPAFA) training a few years ago.

The Bangkachai II Shipwreck Site: this is a Chinese junk of approximately 400 years old. The site lies at a depth of not more than 8 metres, near the shore and river outlet. There is often bad visibility. The site has been extensively excavated in five years (between 1993 and 1998) and remarkable well preserved (organic) material has been raised. A one to one scale model is present at the maritime museum. The wreck itself, including one of the three discovered wooden anchors, is still in place.

The Samed Ngam Shipwreck Site: this site consists of a 200 year old dockyard and a shipwreck of an Asian junk. The inside of the ship was first investigated in 1982. The second investigation of the outside of the ship took place during the SPAFA training of 1989. The site now consists of a small part of the dockyard that has been restored and within that dockyard, the remains of the wreck just below the water level. It is now part of a community museum which includes a building that holds an exhibition about the site and the archaeological work that has been executed on it.

The second suggested practical test is similar, but completely focused on developing an *in situ* preservation scheme for the Mannok Island wreck site. This shipwreck is used for the diving practical dive session held during Unit 12: *Practical Dive Session of the Foundation Course, Mannok Shipwreck Site, the Gulf of Thailand*.

This site can play an important role in the discussion on *in situ* preservation. Students can be tasked with developing methods for the site in the light of future use. Does it need to be protected against natural deterioration? Or against looting or fishing?

In prior foundation courses the methods developed ranged between making the site accessible for controlled diving only, to avoiding fishing on the site and full covering of the wreck to create an anoxic environment.

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The Protection of the
Underwater Cultural Heritage

UNIT 10

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UNIT 10

Contents

UNIT 10

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Intrusive Techniques in Underwater Archaeology

Core Knowledge of the Unit

This unit introduces students to intrusive techniques that can be used in underwater excavations. Students are provided with an ethical, regulatory and archaeological framework to understand when to use intrusive techniques on an archaeological site and what techniques are available.

On completion of the Intrusive Techniques in Underwater Archaeology unit students will:

- *Understand that intrusive activities are destructive and should only be undertaken with clear archaeological justifications*
- *Be able to discuss the characteristics of underwater excavations*
- *Have knowledge of different intrusive techniques and be able to discuss their utility in various conditions on an archaeological site*
- *Have examined a range of case studies*
- *Understand the responsibilities of an archaeologist associated with an excavation*

Introduction to the Unit

The overall aim of the 2001 UNESCO Convention is to encourage the responsible protection of underwater cultural heritage, with a special focus on *in situ* preservation as the first option to consider. The convention does not preclude excavation. In the Annex of the Convention a framework for project design, funding, conservation and site management are outlined so that when intrusive activities are undertaken a standard can be achieved that maximizes positive archaeological outcomes.

Intrusive techniques can be used in assessment, searching, sampling and excavation. These techniques require skill, knowledge and a thorough understanding of the implications of decisions in the short, medium and long term. Like survey, excavation should be taught and discussed because interventive techniques are the primary tool for archaeologists to uncover new information about the past.

Excavation is a part of the overall management of underwater cultural heritage. The Rules included in the Annex of the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris 2001) state:

> **Rule 1.** The protection of underwater cultural heritage through *in situ* preservation shall be considered as the first option. Accordingly, activities directed at underwater cultural heritage shall be authorized in a manner consistent with the protection of the heritage, and subject to that requirement may be authorized for the purpose of making a significant contribution to protection or knowledge or enhancement of underwater cultural heritage.
>
> **Rule 3.** Activities directed at underwater cultural heritage shall not adversely affect the underwater cultural heritage more than is necessary for the objectives of the project.
>
> **Rule 4.** Activities directed at underwater cultural heritage must use non-destructive techniques and survey methods in preference to recovery of objects. If excavation or recovery is necessary for the purpose of scientific studies or for the ultimate protection of the underwater cultural heritage, the methods and techniques used must be as non-destructive as possible and contribute to the preservation of the remains.

In the history of archaeology it is not difficult to find examples of excavations which have resulted in incomplete reports, sites not being actively managed post the excavation and recovered objects not being well cared for. Whatever the reasons for these outcomes, the results are the same, the loss of part or all of a site and its record for future interpretation and study.

The concept of *in situ* preservation as a first option is in part a response to indiscriminate or poorly conceived, planned, reported and budgeted for excavations. The Rules of the Annex aim to articulate a uniform framework for activities directed at underwater cultural heritage. These rules stipulate not only general principles on how activities should proceed, they also aim to have archaeologists prepare clear project designs and put in place appropriate levels of funding, conservation, site management and reporting outcomes as part of the initial project plan. The aim of this is to minimize the potential of sites not being correctly excavated and reported, while retaining the maximum archaeological information for the future, by effective ongoing post-excavation management and monitoring.

It is important to emphasize that while *in situ* preservation should be considered as the first option, it is not the only option. Excavation and other interventive techniques are vital tools for archaeologists to uncover new information about the past, in order to reconstruct past culture or life and to discover information that will assist in the management of the site. This unit emphasizes that interventive activities should only commence under the right circumstances and with the sound justifications, with the correct budget and framework in place.

1 Excavations: When do you Decide to Use Intrusive Techniques on an Archaeological Site?

Excavating on land is hard enough, but some people like to make things extra difficult for themselves, and working underwater is the archaeological equivalent of standing up in a hammock (*The Bluffer's Guide to Archaeology,* 2004, pp. 31).

As an archaeological site contains unique records of the past which the process of excavation will dismantle (and by so doing destroy), it is essential to understand that excavation can only be justified in certain circumstances. The archaeologist must have a clear understanding of the reasons for undertaking the excavation (be it rescue or for research purposes), an understanding of the techniques and methods that will be used, and the effects these techniques and methods will have on the archaeological record. If the excavation is solely for research purposes, then it is important that the archaeologist is clear on what research questions need to be answered by the excavation. Can these questions be answered differently? Is the excavation necessary? Only when questions such as these cannot be answered by other means, can an excavation be justified. Adequate budget, storage, conservation and work facilities, together with trained archaeological staff to handle the material, are absolutely essential before excavation can be considered (Green, 2004, pp. 235).

1.1 Underwater Excavation

This unit will explore the following aspects of an excavation:

- *When to use intrusive techniques on an archaeological site*
- *Approaches to excavation*
- *Intrusive archaeological techniques*
- *Responsibilities of an archaeologist*

Suggested Reading

Baker, P. 1986. *Understanding Archaeological Excavation*. London, ISBN 0-7134-3632-8.

Baker, P. 1977. *The Techniques of Archaeological Excavation*. London. ISBN 0-7134-2739-6.

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Nautical Archaeology Society. Blackwell, pp. 135-147.

Green, J. 2004. *Maritime Archaeology A Technical Handbook*. Second Edition. Elsevier Academic Press, pp. 235.

Underwood, C. 2011. Excavation Planning and Logistics (HMS *Swift* 1770). *Oxford Handbook for Maritime Archaeology*. USA, Oxford University Press.

1.2 Responsibilities

By choosing to undertake an excavation, certain responsibilities are implicit on the archaeologists. Pre and post-excavation obligations are as important as on-site obligations. The Rules of the Annex of the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris 2001) articulates the responsibilities that an archaeologist must embrace in relation to: project design (Rules: 9, 10, 11, 12, 13); preliminary work (Rules: 14, 15); project objective (Rule 16); methodology and technique; funding (Rules: 17, 18, 19); competence and qualifications of participants (Rules: 22, 23); conservation and site management (Rules: 24, 25); documentation (Rules: 26, 27); safety (Rule 28); environment (Rule 29); reporting (Rules: 30, 31); curation of project archives (Rules: 32, 33, 34); and dissemination (Rules: 35, 36).

Suggested Reading

UNESCO. 2001. *Convention on the Protection of the Underwater Cultural Heritage*. Paris.

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 45.

1.3 Pre-disturbance Surveys

Pre-disturbance surveys are always carried out prior to excavation. A primary rationale for a pre-disturbance survey is to understand the archaeological significance of a site. Pre-disturbance surveys also enable an understanding of the area of the site, depth of overburden, site's condition, extent and material types of the archaeological assemblage (Richards, 2001).

1.4 Test Pits: Exploratory Trenches

A pre-disturbance survey may be followed by an exploratory excavation of a (1 m x 1 m or larger) test pit/trench to confirm the extent of site, depth and material variety of the archaeological deposit. These test pits can be at specific locations such as the bow, stern or even in the midships section, thus enabling the excavation to use the structure as a guide, rather than an arbitrary grid system. This information forms the basis for planning a more comprehensive excavation strategically and from an operational perspective, i.e. how long the work will take, storage and conservation facilities required and budget implications (Atkinson and Nash, 1991).

Suggested Reading

- Atkinson, J. and Nash, M. 1991. Report on the Excavation of the *Hadda. Australian Institute of Maritime Archaeology*. 11.2, pp. 17-24.

1.5 Practical Approaches to Excavation

Green (2004, pp. 237) states that there are two simple approaches to excavation. One is to excavate over large areas of the site, layer by layer and the other is to work the site in small sections (either grid or trenches), layer by layer, repeating section by section across the site. While Green's statement could imply that the whole site will invariably be excavated, it is more common today that the latter technique is used in small areas only, to answer concise research questions. *Mary Rose, Vasa, La Belle* and *Batavia* type excavations are increasingly rare. For example, in the Netherlands, trenches are generally first made around the bow and stern areas of the wreck, then near the middle of the wreck (as near to the main mast step as possible), as part of an extended assessment and/or before excavating the rest of the wreck. This utilizes the pre-disturbance model and provides the potential for being able to escalate it into a full blown excavation if required. Underwood (2011, pers. comm.) feels that there is a third option available for excavation when sediments are so sufficiently compacted that they do not slump. This third option involves beginning excavations with a small trench and then working, layer by layer, to reveal the stratigraphy of the site. This is followed by working in elevation, rather than as a 'plan view' excavation.

Today, time and budget constraints are everyday realities that require detailed planning to maximize restricted opportunities in the available excavation time. This fiscal reality lends itself to the excavation of small areas to address concise questions. Smaller trenches also have the major benefit of leaving the majority of the archaeological deposit undisturbed, as a control for the future study.
See *Additional Information 1.*

ADDITIONAL INFORMATION

1 The Australian Heritage Shipwreck Protection Project commencing in April 2012, is an example of a multi-disciplinary research driven excavation of a shipwreck site. The project addresses research questions on early ship construction in Australia, site formation, developing preservation strategies, reburial, data management and policy guideline development. In conjunction with these clearly articulated research questions, the project has been meticulously budgeted and planned prior to initiating excavation activities. See: www.ahspp.org.au (Accessed March 2012).

Suggested Reading

- Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp.125.
- Green, J. 2004. *Maritime Archaeology: A Technical Handbook*, Second Edition. Elsevier Academic Press, pp. 237-244.

1.6 Grid Systems

Grid systems can be rigid, such as metal scaffolding, or less rigid, such as plastic or rope. They can cover the entire site or comprise of smaller sections that can be moved around. All have the same purpose; to divide the site into areas which provide orientation and defined sectors. On sites where construction is left, the construction may be the main feature to define work areas. Recording where the grids are is very important. Logistically, gridding smaller areas is much simpler and less vulnerable, than the time consuming and expensive total grid system.

Green (2004, pp. 238) states that the use of a particular grid system on a given site needs careful consideration. There are both advantages and disadvantages to rigid and non-rigid systems dependant on environment, construction, staff experience and the knowledge of the site.

1.6.1 Rigid Grid Frames

Rigid grid frames are used on many excavations, including that of the *James Matthews* and HMS *Pandora.*

Grids are usually accurately surveyed into the site plan and the location of loose finds and fragments are approximately recorded inside the grid. The location of more important objects and structures are generally more accurately recorded.

Image of a rigid grid system used on the James Matthews. *Here, a diver is recording the hull alongside part of the cargo of roofing slates. © Jeremy Green*

Advantages of rigid grids:

- *They give orientation to the site and defined work areas, which is particularly helpful in low visibility.*
- *Offer support for the excavators to avoid disturbing the site and mitigate against potential poor buoyancy control of divers.*

Disadvantages of rigid grids:

- *Rigid grid frames can potentially damage artefacts, although sandbags placed beneath the 'feet' of the grid can help to reduce the impact of the weight of the grid.*
- *Are expensive to construct, install and maintain.*
- *The grid frame's legs can be affected by the removal of sediment during the excavation and from scour action on sites where there are strong currents.*
- *Very vulnerable to being moved or damaged by fishing or dredging activity and can be bumped by divers. Unless the grid frame is completely immobile, inaccuracies are likely to occur in the survey result. If this happens and the grid is the basis of the site survey, this will almost certainly negate the previous results. Valuable dive time will then be taken up having to reconstruct and reinstall the grid itself.*
- *Green (2004, pp. 241) notes that rigid grids frames can cause practical difficulties during excavation and recommends the use of large 4 m^2 grids to offset potential problems.*

1.6.2 Non-Rigid Grid System

An alternative to the rigid grid frame is the non-rigid system which is also plotted into the site plan. A series of parallel lines or bars are laid across the site. The lines marking the grid can be scaled so that its relative position can be determined. George Bass used string grid lines on the Tektas Burnu site in Turkey.

A non-rigid grid system in use at the Tektas Brunu site in Turkey. © Jeremy Green

Advantages of non-rigid grids:

- *An experienced team can excavate quickly and efficiently*
- *Green (2004, pp. 243) states that complex structures can be excavated in one piece, i.e. grid lines can be adjusted easily to enable excavation of an entire feature*
- *A bar or tape can be used to keep the excavation moving across the site*
- *Easy to backfill into a previously excavated trench*
- *A good method for sites with little vertical structure (Green, 2004, pp. 243-244)*

Disadvantages of non-rigid grids:

- *The whole site is never shown completely excavated (although a section by section photo mosaic can still be produced)*
- *Positioning the non-rigid grid system and connecting them all together is likely to be more difficult*
- *Recording locations accurately during the excavation is more difficult*
- *More difficult to control excavation without frames*

1.6.3 Excavating Without a Grid (Due to Poor Environmental Conditions)

On sites in the surf zone or where there are strong underwater currents or intense wave action, the use of grids of any type is much more difficult. Some sites are also prone to fishing or nearby dredging activity, which could damage or move the grid. The additional time required to regularly replace or reconstruct due to these factors, makes the use of a grid impractical and costly.

In such conditions, it is likely that the main guide or reference for the excavators is the wreck itself. Consideration can be given to using known points on the structure to guide the excavation. Control points can be placed on the structure itself or depending on the substrate, poles can be placed in the seabed around the site. Temporary baselines can also be positioned between control points to guide the work.

1.7 Caissons and Cofferdams

Caissons and/or cofferdams are watertight structures generally used in shallow waters, that come in a range of formats; from large scale and sophisticated double walled interlocking metal 'sheets' with compacted sand fill between each wall, such as that used in the excavation of *La Belle* (Bruseth and Turner 2005), to single rigid plastic or metal systems, such as those used on the Skuldelev ships excavations in Denmark (Crumlin-Pederson and Olsen, 2002, pp. 34). Caissons come in smaller arrangements such as a small 44 gallon drum (Green, 2004, pp. 243) or the soft sided Pochin enclosure system. Caissons can also be sealed at the top. Most, if not all, cofferdams and caissons so far used in archaeology have been open to the air systems. They have generally employed where visibility was going to be a serious issue or where significant cost reduction and other efficiencies could be created by excavating on dryer land.

In large scale caisson/cofferdams, the area around the site is made water proof through the insertion of barriers into the sea or riverbed, which completely contain the site. Once contained, the water over the site is removed, allowing for excavation *à la* terrestrial archaeology.

A Pochin enclosure system, Hamble River.
© Charles Pochin

An earlier version of an enclosure system. A diver uses a water dredge and utilizes the floating 'grid' for support while excavating.
© Charles Pochin

However, the use of cofferdams does not necessarily mean that water is precluded. In the case of the Yorktown shipwreck, a cofferdam was placed in 7 metres of water, surrounding the site. The rationale for the cofferdam was as a means for improving conditions of the excavation, as the site was located in Yorke River, Virginia and was subject to strong currents and near zero visibility. By using this system, water inside the enclosure could be filtered and clarified to improve working conditions (Broadwater, 1985, pp. 301-303).

In the case of the Skuldelev ships, where a cofferdam was built around an area of approximately 2,500 m^2 (Crumlin-Pederson and Olsen, 2002, pp. 30), water was not removed immediately from inside the cofferdam walls, but was lowered gradually in line with excavation of the site. The rationale for the gradual reduction was to minimize any increased weight by ballast stones on the deteriorated timbers (Crumlin-Pederson and Olsen, 2002, pp. 33). In the case of the *La Belle,* the water was removed completely from the cofferdam to facilitate excavation.

Another variation currently being used in Piraeus Harbour by the Zea Harbour Project, is the Pochin enclosure system. This system incorporates inflated pontoons with a continuous solid but flexible sheet of plastic that can be attached to the seafloor. This soft caisson system, when used in relatively calm waters, enables greater clarity in turbid waters, as sediment can settle to the bottom through reduced agitation in the water column.

Clear water enclosure system being used by the Zea Harbour Project. © Bjorn Loven

Advantages of the dry caisson system:

- *Archaeological processes are not constrained by dive time limitations and dependency on diving logistics*
- *A range of non-diving specialists can be involved in the fieldwork*
- *It is possible to make careful records of the different layers excavated*
- *Ability to get very good visual documentation*
- *Ideal in shallow sites where excavation must proceed quickly, i.e. rescue archaeology*
- *Budgeting for excavations and time management become significantly easier, as weather dependency and environmental/visibility issues are removed*
- *Containment walls can be rented and their installation and deconstruction can be included as a known fixed cost*
- *Research driven excavations can look for corporate sponsorship, as the infrastructure will be eye-catching and newsworthy*
- *As with the Skuldelev excavation, public access for non-divers can be included as a significant feature of the excavation*

Disadvantages of the dry caisson system:

- *Very significant setup and breakdown costs (La Belle's cofferdam cost US$1.5 million in 1996). Note that the archaeological excavation does not really need to own the sheet piling and the material is re-useable. Expenses are associated with setup, breakdown and rental of capital equipment. Furthermore, unlimited access may well make the process cost efficient in particular circumstances, such as large scale excavations or rescue excavations which need to be conducted rapidly, due to development pressures.*
- *Need for a near continuous spraying program to stop the exposed material drying out. There are potential issues associated with spraying and the health of workers, as noted on the Skuldelev excavation.*
- *Limited to relatively shallow waters.*
- *Excavations must be undertaken carefully as archaeologists must try to not damage material while working.*
- *Cofferdams can usually only be effectively used for dry pumping when they can be founded upon an impenetrable layer of sediment.*

Suggested Reading

Broadwater, J. D., Adams, R. M. and Renner, M. 1985. The Yorktown Shipwreck Archaeological Project: An Interim Report on the Excavation of Shipwreck 44Y088. *The International Journal of Nautical Archaeology and Underwater Exploration*. 14.4, pp. 301-314.

Bruseth, J. E., Turner, T. S. 2005. *From a Watery Grave: The Discovery and Excavation of La Salle's Shipwreck, La Belle*. College Station, Texas A&M University Press. ISBN 1585444316.

Crumlin-Pedersen, O. and Olsen, O. (eds.). 2002. *The Skuldelev Ships I. Topography, Archaeology, History, Conservation and Display*, Ships & Boats of the North, Vol. 4.1, pp. 30.

Green, J. 2004. *Maritime Archaeology: A Technical Handbook*, Second Edition. Elsevier Academic Press, pp. 243.

2 Intrusive Techniques

2.1 Probing

Probing is a physical attempt to locate structures beneath the surface layers and is usually carried out in a systematic manner (along a line at fixed distances), to understand the extent of a site and depth of burial. The results of a probing survey are dependent on feel and are difficult to accurately measure.

Prior to the introduction of non-destructive remote sensing techniques, such as sub-bottom profiling, (which does not disturb the archaeological layers), probing was used because it is a simple and relatively effective technique. However, today the technique should be used with caution, due to the potential of damaging artefacts. The inclusion of this intrusive technique in this unit reflects the fact that the Foundation Course caters to a wide range of students, with differing access to remote sensing equipment, and recognizes that in certain circumstances the method remains a useful tool. Two broad questions that can be answered by careful use of this technique are: at what depth is the structure? And where does the site structure stop and start?

2.1.1 Solid Rod Probing

Solid rod probing requires a rod that is thick enough to not bend and thin enough to be able to be pushed into the sediment. Due to the limitations of this method, even when people are being careful, solid rod probing has been known to cause damage to objects.

2.1.2 Water and Air Probes

Water probes consist of a narrow hollow tube, down which low pressure water or air can be pumped. Water and air probes are capable of penetrating sediments more readily than a solid rod and can, in the case of water probes in particular, easily damage organic archaeological material. The aim is to feel contact with an object. Green (2004, pp. 259) notes that experienced users can detect the difference between pottery, wood or metal, through the sound of the contact.

By using this method, oxygen rich air or water is introduced into anaerobic environments which accelerates deterioration in that location for a period of time (dependant on depth, size, shape, composition of the overburden). New South Wales Heritage conducted a water probe survey when searching for the *Hive* shipwreck and their observations regarding the efficacy of the system provide an interesting insight into the technique (Smith, 1995).

Water probe in operation on the Hive site, Australia. © Andrew J. Viduka

Suggested Reading

- Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 135-139.
- Green, J. 2004. *Maritime Archaeology: A Technical Handbook*, Second Edition. Elsevier Academic Press, pp. 259.
- Smith, T. 1995. Probe Surveys of 'Dry' Shipwrecks. *Bulletin of the Australasian Institute for Maritime Archaeology.* 19.1, pp. 19-22.
- Watts Jnr, G.P. 1976. Hydraulic Probing: One Solution to Overburden and Environment. *IJNA* 5.4, pp. 76-81.

2.2 Taking Samples

A sample is a representative amount of material that has been collected from an archaeological or natural context (Bowens, 2009, pp. 139).

Samples are collected for a range of reasons, though usually for material identification of artefacts (Peters, 1996), dating, environmental analysis (biofacts) (Gorham and Bryant, 2007) and comparative background assessment, such as typological analysis.

Like any excavation, the sampling process requires its own plan prior to collection (Gorham and Bryant, 2007). Sampling requires a defined set of objectives that outline what is being sampled and why, so that a plan can be developed. These objectives will form a basis for the sample analysis and the selection of the analytical analysis technique to be used. For example, a metal artefact can be sampled for its metallurgical or chemical composition. Both methods require a physical sample to be collected, however, the sample size is different and preparation processes also vary. Chemical analysis is not only used to identify the parent metal composition for comparative analysis. It may also be used to ascertain the compounds formed on the deteriorated object's surface, which can assist in conservation. Consequently, a clearly defined sampling plan document is vital. No excavation should be undertaken without a detailed sampling plan and either the capacity to undertake the necessary analysis or to store the samples for future study.

2.2.1 Types of Sampling

On-site sampling can be broadly broken down into environmental and artefactual material. A limited selection of objects can be collected as samples for identification, analysis or dating purposes. Sampling also continues once objects are recovered and are in conservation. Recovered objects often contain contents (Peters, 1996) or are themselves sampled and materially analysed (Viduka and Ness, 2004).

On-site environmental sampling aims to give an indication of everything natural or that, that has been introduced into the site by human activity, as well as the actual physical formation processes (stratigraphic, climatic, environmental or ecological data), prevailing on or near the site. Sampling is also used to understand the preservation values of the site (Oxley, 1998; Richards, 2001; Oxley and Gregory, 2002; Jensen and Gregory, 2006) and to obtain dates (Manders *et al,* 2009).

In situ sampling normally takes three forms: spot, core and column.

Spot sampling: refers to small sample sizes. There are numerous publications which refer to the actual methodology, including those by Bowens, 2009 and Gorham and Bryant, 2001. For example, underwater wood spot samples are collected for dendrochronology, to undertake dating and/or for timber analysis with which to answer questions regarding ship construction. Samples are most easily collected by sawing a portion of wood that contains a significant residual core of solid timber for analysis. Wood exposed to an aerobic environment and/or located near the surface or ends of timber pieces, is more likely to be deteriorated from a combination of hydrolysis, bacteria or marine borers. If possible, it is better to select a sample from a piece of structural timber and/or from a larger piece of timber that has been partially or wholly buried.

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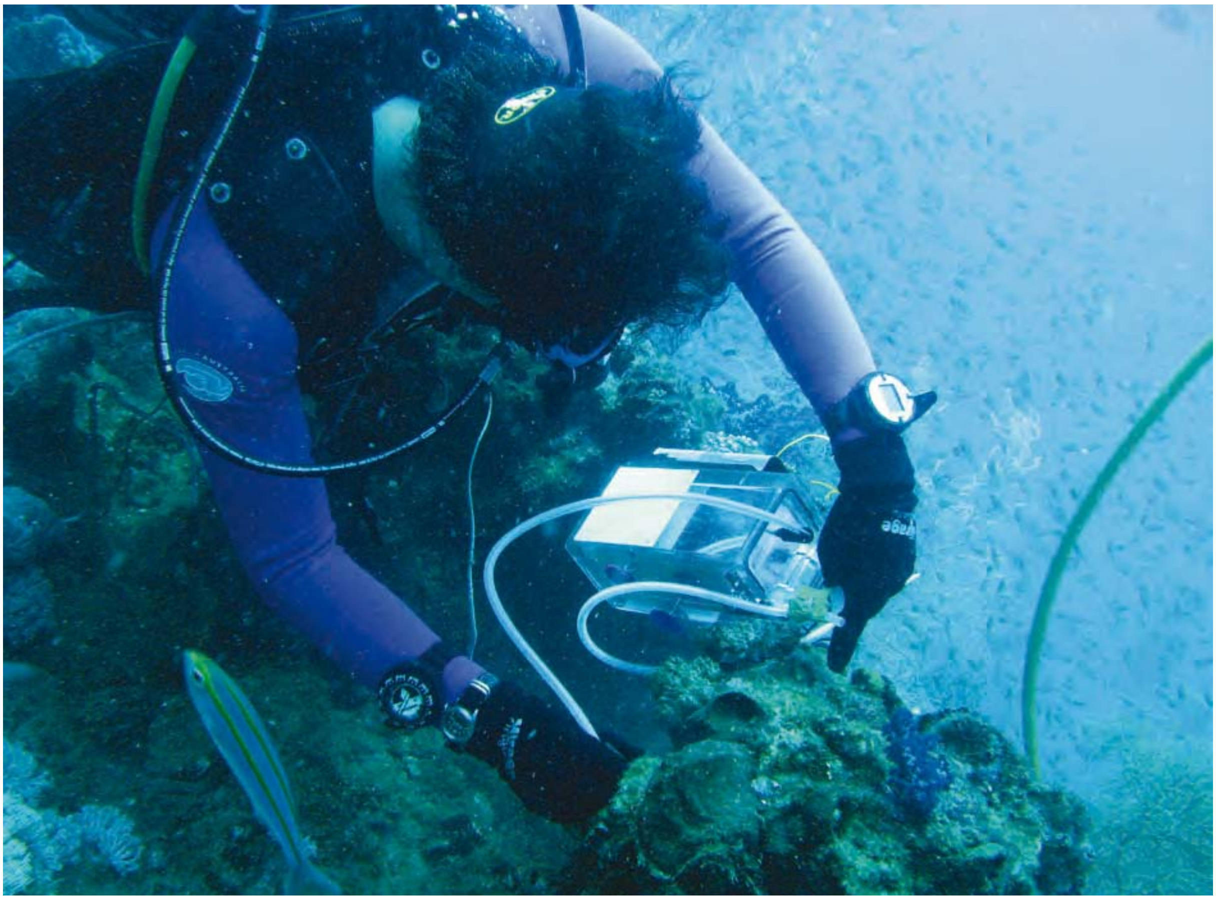
Diver collecting corrosion potential measurements. © Queensland Museum



Core sampling: produces a cylindrical section of whatever is sampled. Due to the huge variety of mediums to be sampled, there are a large range of different coring units and techniques, including the hand held auger. The physical make up of the medium helps identify the technique to be used and core size to be collected. Common techniques of coring include, but are not limited to: vibracoring, gravity coring drilling and rotary side wall coring.

Columns: (or monoliths) involve containers being pushed into sediment. This method requires good profiles to avoid contamination and achieve accuracy. It is a sampling technique used more often on terrestrial sites, than maritime.

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 136-140.

Buglass, J. and Rackman, J. 1991. Environmental Sampling on Wet Sites. *Wet Site Excavation and Survey.* Coles, J. M., and Goodburn, D. M. (eds.). WARP Occasional Paper No. 5, Exeter, ISSN 0950-8224.

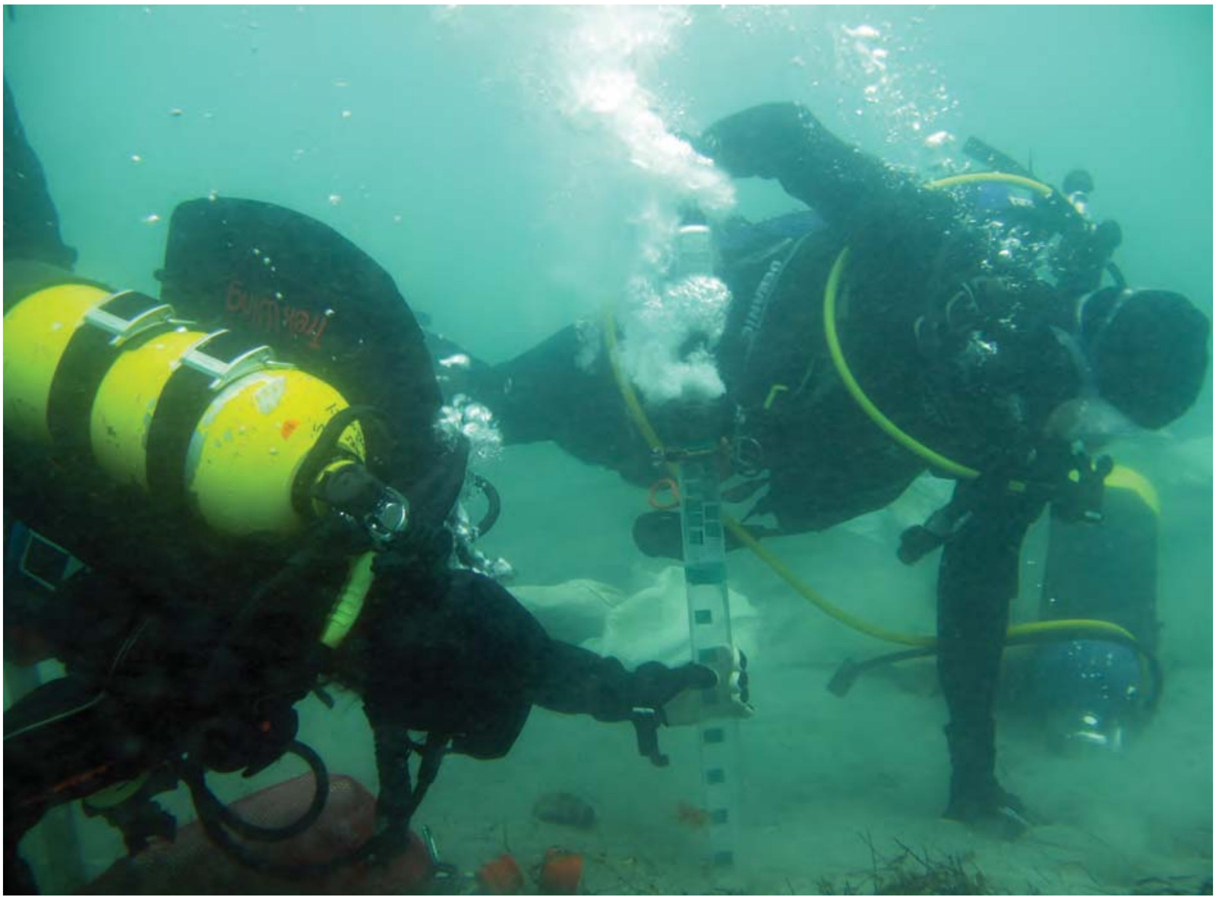
Coles, J. M. 1990. *Waterlogged Wood.* London, English Heritage. ISBN 1-85074-335-5.

Coles, J. M., Coles, B.J. and Dobson, M. J. 1990. *Waterlogged Wood.* WARP Occasional Paper No. 3, Exeter, ISSN 0950-8244.

Eckstein, D. et al. 1984. *Dendrochronological Dating.* Handbooks for Archaeologists No.2, Strasbourg, European Science Foundation. ISBN 2-903148-39-2.

Gorham, D. L., and Bryant, V. M. 2007. Pollen, Phytoliths, and other Microscopic Plant Remains in Underwater Archaeology. *International Journal of Nautical Archaeology,* Vol. 30, Issue 2, pp. 282–298.

Divers collecting core sample on the Clarence site, Australia. © Andrew J. Viduka



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Jensen, P. and Gregory, D. J. 2006. Selected Physical Parameters to Characterize the State of Preservation of Waterlogged Archaeological Wood: A Practical Guide for their Determination. *The Journal of Archaeological Science.*

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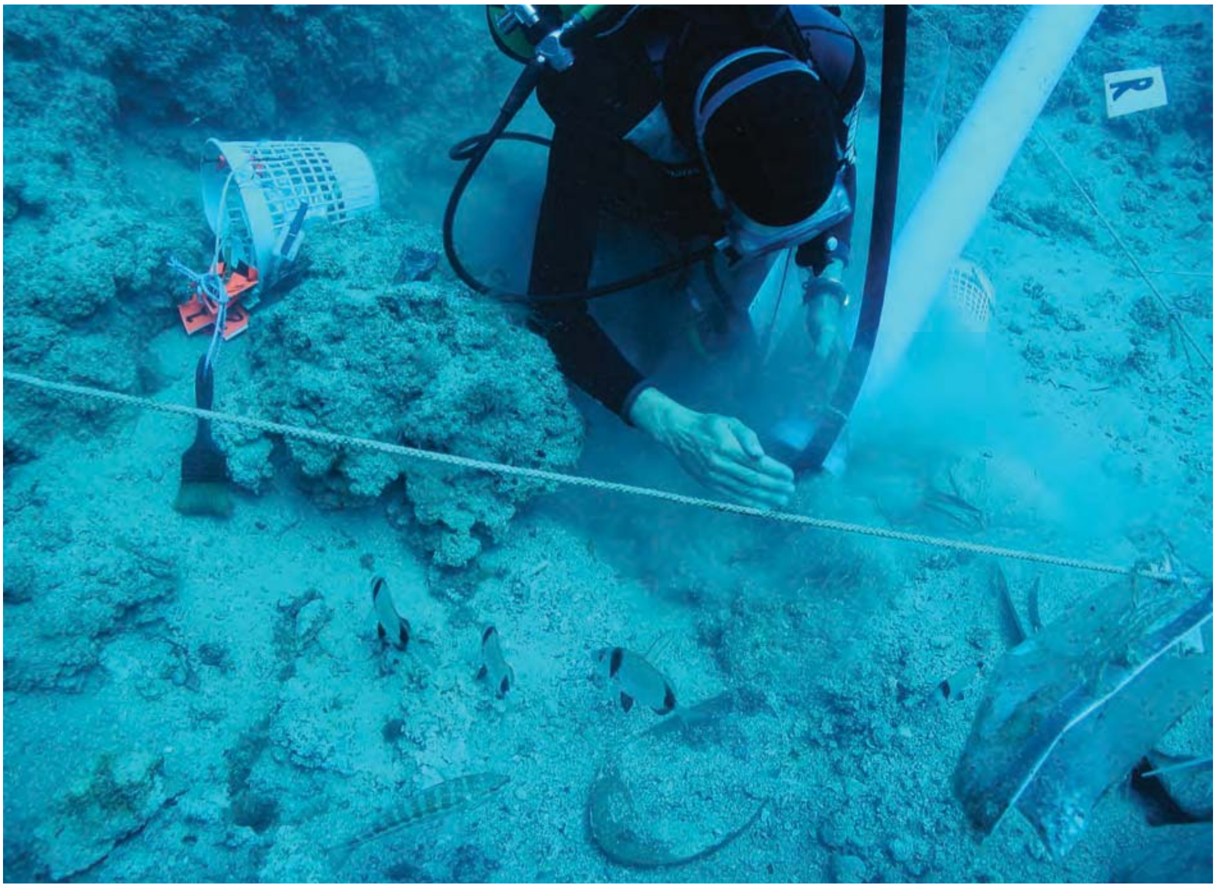
Peters, S. J. 1996. Archaeological Wines; Analysis and Interpretation of a Collection of Wine Recovered from the *William Salthouse* Shipwreck (1841). *Australasian Historical Archaeology* 14.

Richards, V. 2001. *James Matthews (1841): Conservation Pre-disturbance Survey Report.* Department of Materials Conservation, Western Australian Museum (unpublished).

Viduka, A. and Ness, S. 2004. Analysis of Some Copper-alloy Items from HMAV *Bounty* Wrecked at Pitcairn Island in 1790. METAL 2004. *Proceedings of the International Conference on Metals Conservation, Canberra Australia, 4-8 October 2004.* National Museum of Australia Publishers, pp. 160-172. ISBN 1-876944-33-1.

2.3 Loosening or Removing Sediment

The choice of tool to excavate a site depends on the nature of the sediments covering a site, and the condition and material type of objects being excavated. Since the aim of archaeological excavation is to meticulously excavate and document artefacts, the need to rapidly remove sediment (other than sterile overburden) is not a primary concern. Most maritime archaeologists agree that the hand is the most sensitive excavation tool. Hand fanning in conjunction with a water dredge or airlift, enables the controlled removal of many sediments that would cover a site. Apart from in very cold water (less than 10 degrees), the hand should be un-gloved. For example, on the excavation of the HMS *Swift* in Argentina, archaeologists tended to wear gloves with the fingers cut off to provide the sensitivity that is needed in most situations.



Hand fanning at the Tektas Burnu *shipwreck, Turkey. © Jeremy Green*

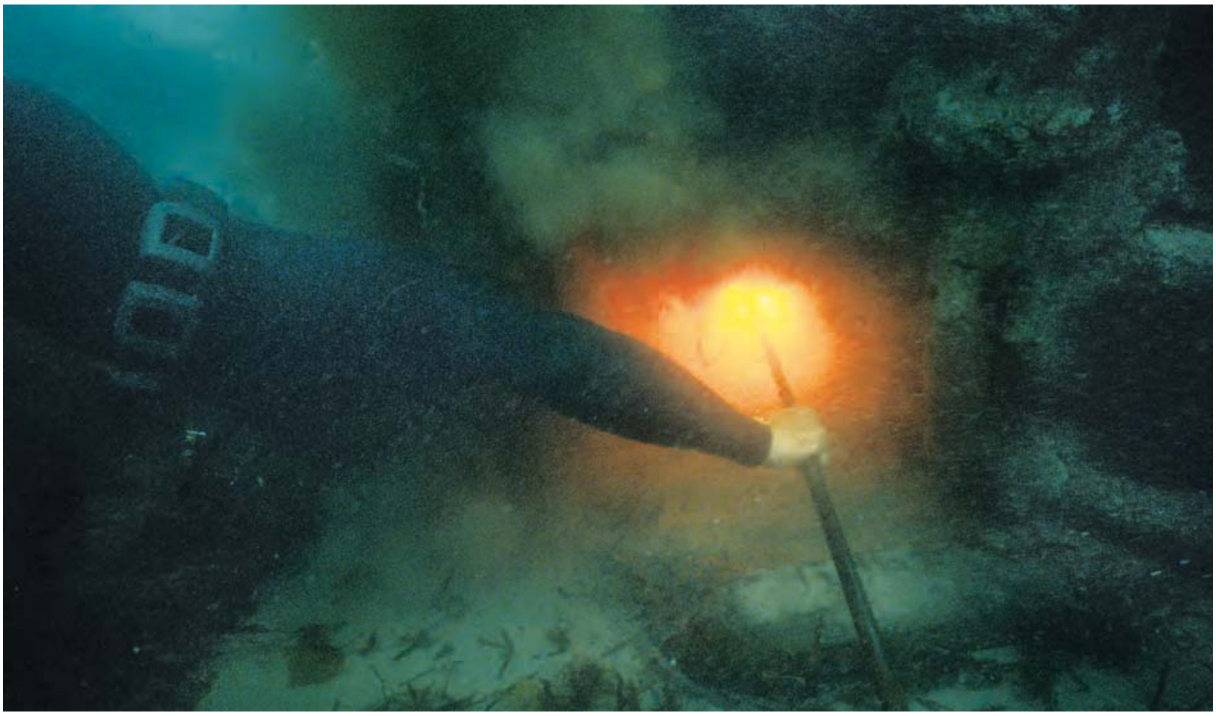
Where it becomes impractical to remove binding sediment using a combination of hand fanning and dredge or airlift, other tools can be used. These tools are generally used specifically for that particular task. Crumlin-Pederson reported that in the excavation of the Skuldelev ships (a cofferdam excavation), they brought a collection of kitchen scrapers and toy shovels to help excavate the ships, instead of the normal archaeological trowels. These were rapidly replaced by garden hoses with a trigger jet nozzle (Crumlin-Pederson and Olsen, 2002, pp. 34).

It is likely that every conceivable hand tool has been used at one time or another and in some circumstances tools have been created with a particular job in mind. Brushes, dental picks, trowels, hammers, chisels, shovels, crowbars, thermal lancers, pneumatic and hydraulic tools have all been used to free an object from its matrix. In exceptional circumstances explosives have also been used to help facilitate an excavation, but these were selected only after careful consideration of the impact on artefacts (Rule, 1982, pp. 128 and Green, 2004, pp. 268).

A gudgeon being hammered out of concretion, Norfolk Island. © Nigel Erskine

A chainsaw being used at the Batavia *site. © Western Australian Museum*

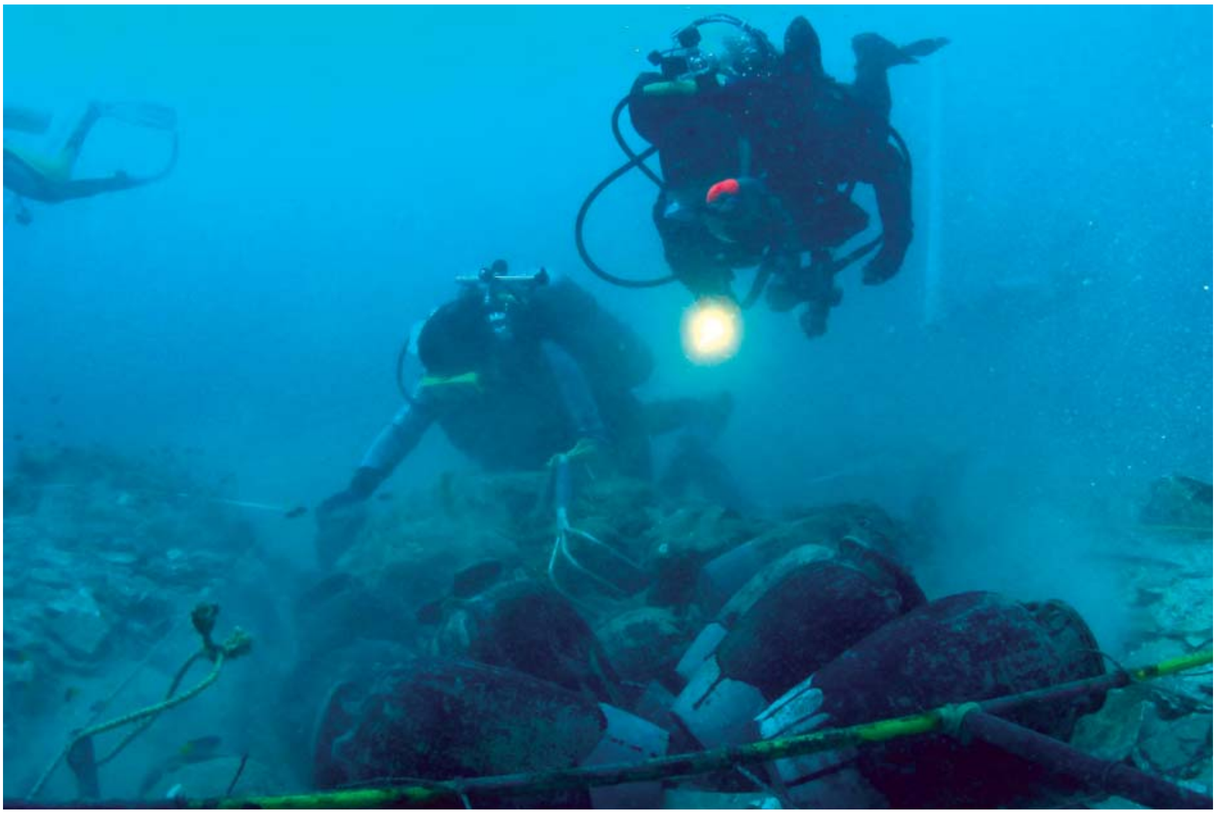
A pneumatic lift. © Western Australian Museum



A thermal lance. Xantho *site. © Western Australian Museum*

Suggested Reading

- Crumlin-Pedersen, O. and Olsen, O. (eds.). 2002. *The Skuldelev Ships I. Topography, Archaeology, History, Conservation and Display*. Ships & Boats of the North, Volume 4.1, pp. 34.



A three pronged hand tool, Koh Kram, Thailand. © UWA

2.3.1 Airlifts

Airlifts can be constructed in various ways. A common feature is a long discharge pipe (usually made of PVC or aluminium) with a diver controlled on/off tap, which can also be used to regulate the airflow and strength of the suction. Regulation of airflow can alternatively be controlled on the surface, but this necessitates good communications between the diver and deck. Other design variations also exist. Martijn R. Manders (pers. comm., 2012) states that in the Netherlands they have, 'developed an airlift that can be regulated on the mouth piece, which is a flexible tube running horizontally over the seabed into the excavation pit. The tube itself is away from the pit. With a special system we can open and close the sides of the tube; hence suck less or more on the mouth piece.'

An airlift design.
© Christopher J. Underwood

Demonstration of operating an airlift.
© Mark Beattie-Edwards

In broad terms, airlift efficiency increases with water depth because the air expands as it ascends. Practical qualifications to this statement exist in that to obtain the increased efficiency, the discharge pipe must reach the surface and with greater depth there is a reduction in air pressure through friction in the air delivery hose. Airlifts are also less effective in water depths of less than 5 m.

The head size of an airlift pipe designed for archaeological purposes can range from approximately 10 to 15 cm in diameter. Airlifts of a larger diameter would require considerably more power to run, which increases the danger of rapid ascent should a blockage occur. As airlifts get bigger, they also can become increasingly difficult for individual divers to handle. Preference for particular bore sizes can be related to the task at hand. Where there is no danger to the site it may be preferential to use a bigger pipe diameter, particularly if you are removing overburden or backfill to a protective layer. A smaller bore airlift may be preferred when exposing small and fragile artefacts.

Divers should expose artefacts by carefully removing the sediments (ensuring that the context is recorded), using a hand, finger or hand fanning in light sediments, or another appropriate tool, such as a brush, for fragile organic materials. Small trowels can be used for more robust inorganic materials. Operation of the airlift requires it's near proximity to artefacts when excavating. The gently disturbed sedimentary material goes into the water column. The airlift suction then pulls the loose sediment into the pipe, removing it from the excavated area. The airlift is not in itself a digging instrument, but acts as a wheel barrow would on a terrestrial site and removes excavated material.

Controlled regulation of airflow, distance of pipe mouth from an excavated area and controlled hand fanning, mitigates the chance of any fragile organic or light objects being sucked up the pipe. Even experienced divers can occasionally lose artefacts up the pipe. On the HMS *Pandora* excavation, several very small intaglios were subsequently found in the spoil heap, consequently it is important that the spoil heap is monitored and checked. Some individuals recommend having a basket or sieve at the other end of the pipe.

The most common problem with airlifts is that large pieces of coral, bedrock or ballast can get drawn into the mouth of the pipe and become jammed as they ascend. If the airlift becomes even partially blocked it will become buoyant, sometimes dramatically. A cross of wire placed across the intake will prevent most blockages. This potential buoyancy hazard can be prevented by anchoring the airlift to the seabed, but this will partially reduce its mobility and care has to be taken to avoid placing the anchors on sensitive archaeological areas of the site.

The power of the suction is also dependent on the difference in depth-related pressure between the top and bottom of the tube, and the amount of air injected. Consequently the size of the compressor will depend on the number of airlifts being used at any one time, the depth of the site and the diameter of suction tube. As a rule of thumb, large compressors need larger platforms to work from.

Similar to water dredges, discharged spoil can affect visibility unless the tidal flow is used to help carry fine sediment away from the site.

Airlifts can pose a threat in that the diver can inadvertently be carried rapidly upwards if an airlift becomes blocked by an artefact or the diver's equipment. An advantage of airlifts is that they carry spoil high up above the site and when utilizing the current, can carry debris even further away (Green, 2004, pp. 258). The downside to this, however, is that the spoil heap is dispersed more widely and, therefore, it becomes more difficult to inspect it for lost finds.

Outflow from an airlift. © Western Australian Museum

Suggested Reading

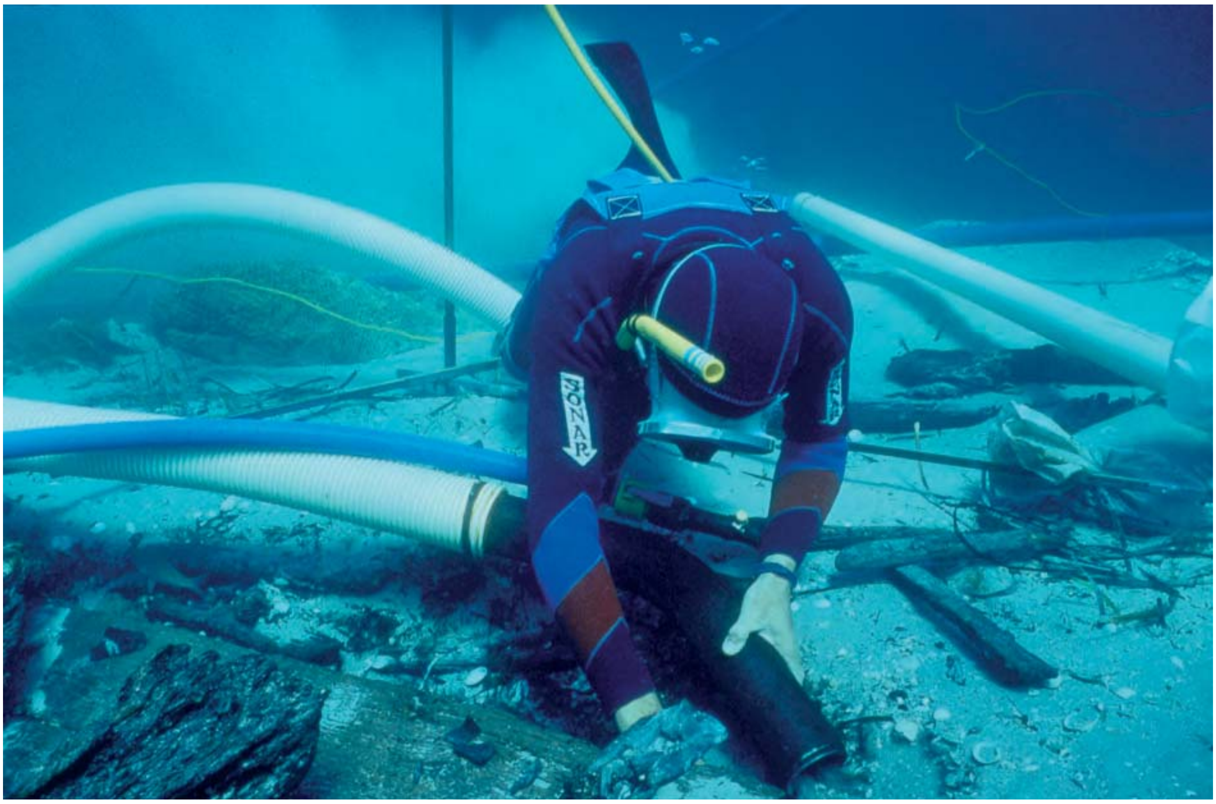
- Bowens, A. (ed), 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice,* Second Edition. Nautical Archaeology Society. Blackwell, pp. 144-145.
- Green, J. 2004. *Maritime Archaeology: A Technical Handbook*. Second Edition. Elsevier Academic Press.

2.3.2 Water Dredges

Water dredges operate on the principles of the Venturi effect. The dredge is designed with a 90° elbow located near either the suction or discharge end, which enables pumped water to enter the dredge pipe through a restriction, creating a Venturi effect. The flow of water increases in velocity as it passes through the restriction, with a corresponding drop in pressure. The practical effect of this is dependant on the position and size of the restriction valve, and the working end of the dredge. Strong suction can be generated, resulting in an intake of water or other material into the dredge.

Water dredge equipment.
© Christopher J. Underwood

A diver using a water dredge to uncover hull timbers on the Sydney Cove shipwreck. © Parks and Wildlife Service Tasmania



Water dredges can be made from a range of materials, though commercial models tend to have stainless steel suction nozzles and a system for ease of handling, such as an arm loop and adjustable handle. The exhaust can be made with flexible hoses or PVC piping and can range in length up to about 15 m. Flexible hoses are easy to pack and transport, and are probably more common. The diameter of the dredges can also range from 7 cm to 15 cm. A hose from a low pressure, high volume water pump on the surface is attached to the Venturi elbow juncture. As with the airlift, material is sucked into the pipe and discharged at the end. This excavation technique is ideal in shallow waters, but is also employable at depths to approximately 50 m, although pressure losses due to hose friction can reduce performance.

One advantage of water dredges is that they are safer to use than airlifts, as there is no risk of rapidly increased buoyancy. Water dredges are also a good tool for shallow sites and have been used effectively at depths of around 30 m to 35 m. Water pumps are also generally smaller and lighter than an equivalent air compressor.

Water dredges, however, also have a number of disadvantages. One of the most prevalent of these is that dredges have no inherent buoyancy and operator fatigue can become an issue. Air filled containers attached to the solid pipe do make it more manageable and anchoring the dredge will prevent it from creeping forward from the force caused by the water discharging. As with airlifts, short hose/pipe lengths means that the discharged spoil from dredging can reduce visibility and tidal flow needs to help carry material away. Green (2004, pp. 258) notes that dredges do not work well when inclined upwards (although this can be resolved by running a flexible tube down into the hole), and that the ability of the dredge to discharge spoil beyond 5-10 m with a medium sized pump can cause problems when excavating a large site. This limitation based on the pump size requires careful planning to work around.

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice*. Second Edition. Nautical Archaeology Society. Blackwell, pp. 145-147.

Green, J. 2004. *Maritime Archaeology: A Technical Handbook*. Second Edition. Elsevier Academic Press, ISBN 0-12-298632-6.

Underwood, C. 2011. Excavation Planning and Logistics (HMS *Swift* 1770). *Oxford Handbook for Maritime Archaeology*. USA, Oxford University Press, pp. 150-155.

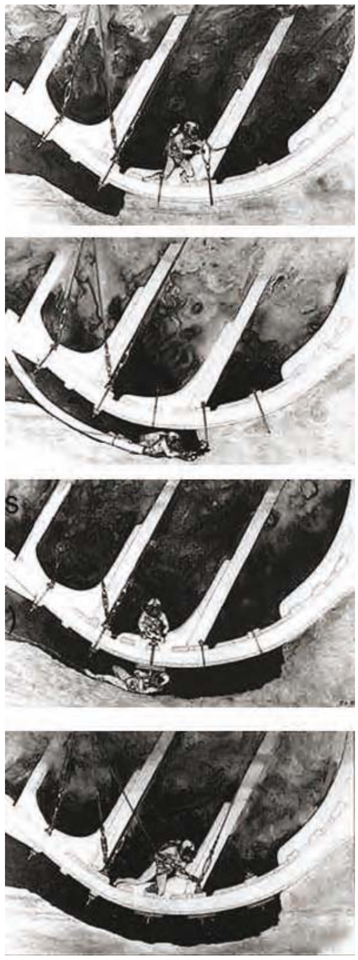
2.3.3 Water Jet

Water jet excavation involves a pump, a hose and a tapered nozzle. The constant volume of water being pushed through a small hole in the tapered nozzle causes the water particles to accelerate, which gives the water a cutting ability. Various industries utilize ultra-high pressure water jets to cut through materials, including metal. For example, in North Queensland, Australia, the technique is commonly used to cut all types of materials (including houses in half), so that they can be easily transported to another site. See: http://www.nlbcorp.com/water_jet_cutting.html (Accessed February 2012).

For archaeological purposes, excavation involves the use of a relatively low-pressure pump (5.5 Hp), with a hose approximately 1.5 times the working depth and a tapered nozzle. The length of the hose is dependent on the strength of currents, which also adds significantly to the drag on the hose and increases the need for seabed anchoring. By adjusting the flow, either at the pump or by using the diver's on/off control, a gentle flow of the water can be controlled that induces a localized current over the excavation area, or alternatively, on full power, the water jet can be strong enough to cut through and remove hard-packed clays and sand (Underwood, pers. comm. 2011).

Its use as an excavating tool in an archaeological sense, is limited to situations where the water jet will not damage artefacts or the integrity of archaeological deposits, before they are mapped. A water jet was used extensively in preparation for the recovery of the hull of the *Mary Rose,* to cut away the sediment under the hull, a relatively benign archaeological area. These 'excavations' revealed the ends of the threaded 'pins' that had been inserted through the ship's hull timbers, to which were affixed the load bearing plates that enabled the successful recovery of the hull. If a full power water jet is used, the nozzle should have small holes for permitting a backward thrust of water. This eliminates the recoil and allows the operator to stabilize the hose.

Despite these advantages, Jeremy Green (2004, pp. 259) finds water jets of limited archaeological use underwater because of their propensity to create zero visibility. In these conditions its continued use would obviously have significant potential to damage the site. Green notes anecdotally that a water jet has an entertainment value, as a water jet (without reverse thrust to balance the backward force of the jet) can cause a diver to move in 'a random, uncontrolled and quite spectacular way around the site'.



This sequence illustrates the process of attaching the eye-bolts (inside the hull) to the backing plates (beneath the hull) of the Mary Rose. *The backing plates were designed to conform to the hull profile which helped to spread the load on the hull during the lifting of the* Mary Rose.

(1-Top) The diver is drilling through the hull structure using a pneumatic wood auger (2) The diver is excavating beneath the hull to locate the threaded bars pre-placed through the drilled holes (3) The diver beneath the hull is holding the backing plates in place while the diver inside the structure tightens the bolts (4) The diver is attaching the supporting cables to the underwater lifting frame that is positioned above the hull of the Mary Rose. *© The Mary Rose Trust*

Raising the Mary Rose *in the cradle.*
© The Mary Rose Trust

Suggested Reading

- Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Nautical Archaeology Society. Blackwell, pp. 147.
- Crumlin-Pedersen, O. and Olsen, O. (eds.). The Skuldelev Ships I. Topography, Archaeology, History, Conservation and Display. *Ships & Boats of the North*, Vol. 4.1, pp. 34.
- Green, J. 2004. *Maritime Archaeology: A Technical Handbook*. Second Edition. Elsevier Academic Press, ISBN 0-12-298632-6.
- Underwood, C. 2011. Excavation Planning and Logistics (HMS *Swift* 1770). *Oxford Handbook for Maritime Archaeology*. USA, Oxford University Press, pp. 153-155.

Unit Summary

Intrusive techniques are used in many aspects of underwater archaeology: to undertake survey and assessment of a site, in searching, sampling and of course, in traditional excavation.

The emphasis of the UNESCO 2001 Convention on *in situ* preservation does not preclude the use of intrusive techniques (see Unit 9: *In Situ Preservation*). *In situ* preservation is to be considered as a first option, however, excavation remains the archaeologist's most important tool to answer specific research questions and for understanding the sites that they are managing. It is only through careful excavation, which includes meticulous documentation and object management, that an artefact can retain its provenance and association with other objects and the site. The range of intrusive techniques outlined in this unit make up the toolbox of methods available to maritime archaeologists, so that their work can be done in the most effective manner.

Without a focus on retaining all contextual information with an object, the line between archaeology and treasure hunting is crossed. It is only through the post-excavation analysis of recovered material and its associated information, that an archaeologist can give insight into past cultures and life.

Excavation is a fundamental and necessary tool for archaeologists, requiring skill and knowledge. The use of intrusive techniques also requires an understanding of the implications of their decisions in the short, medium and long term. Consequently and critically, the rationale for excavation must always be done under the right circumstances and with the appropriate justification.

Suggested Timetable

15 mins	Introduction
75 mins	Introduction to Excavation - *When to use intrusive techniques on an archaeological site* - *Approaches to excavations* - *Techniques* - *Responsibilities*
	Break
90 mins	Intrusive Techniques - *Probing* - *Taking samples* - *Types of samples*
	Break
45 mins	Group Discussion
30 mins	Concluding Remarks and Closure

Teaching Suggestions

This unit provides students with an ethical, regulatory and archaeological framework to understand when to use intrusive techniques on an archaeological site and what techniques are available. It is recommended that the information is introduced to students in the form of a half-day introductory lecture. As excavation has long occurred in many parts of the world, most students will be familiar with a range of techniques and methodologies.

It is recommended that the introductory lectures are followed by active student discussions to help facilitate a deeper understanding of the presented material. Language and culture issues need to be considered by the trainer so that as many students as possible can participate in the discussion.

The group discussion should introduce the ethics in archaeology and the idea that something can be legal, but unethical. The concept of *in situ* preservation as a first option should be discussed in depth as it provides the maximum archaeological potential for information recovery now and in the future.

Group Discussion

A primary aim of this unit is to have students understand the responsibilities that archaeologists have associated with an excavation. Using either small group discussions or a class led approach (or a combination of both), pose the question, when is it necessary or appropriate to excavate?

Alternatively, trainers can examine the Rules of the Annex included in the UNESCO Convention for the Protection of the Underwater Cultural Heritage (Paris 2001) and discuss the implications of the Rules on the archaeologist. It is important to highlight their obligation to prepare project plans, employ as non-intrusive techniques as possible, seek approval from competent authorities, funding, conservation and site management, documentation, reporting, curation and dissemination.

Trainers can also utilize the Ethics Press Kit from the Advisory Council on Underwater Archaeology (ACUA). The press kit can be downloaded from: http://www.acuaonline.org/assets/2011/03/02/e313d3ce2e2ff7dc8f6c55b824ed4060.pdf (Accessed February 2012).

Trainers can discuss the differences between ethics and legality and their relationship to maritime archaeology and pose the question, can treasure hunting and maritime archaeology be reconciled?

Useful Websites

- *UNESCO underwater cultural heritage portal:* ***www.unesco.org/new/en/culture/themes/underwater-cultural-heritage*** *(Accessed February 2012).*
- *The Nautical Archaeology Society:* ***www.nauticalarchaeologysociety.org*** *(Accessed February 2012).*
- *The Australasian Institute for Maritime Archaeology:* ***aima.iinet.net.au*** *(Accessed February 2012).*
- *Institute of Nautical Archaeology, Texas A&M University:* ***nautarch.tamu.edu/academic*** *(Accessed February 2012).*
- *Museum of Underwater Archaeology: www.uri.edu/mua/ (Accessed February 2012).*
- *International Journal of Nautical Archaeology:* ***www.wiley.com/bw/journal.asp?ref=1057-2414*** *(Accessed February 2012).* *See* Additional Information 2.
- *ICOMOS International Committee on the Underwater Cultural Heritage (ICUCH):* ***www.icuch.org/artman/publish*** *(Accessed February 2012).*
- *Commercial company advocating the ability of water jets:* ***www.nlbcorp.com/water_jet_cutting.html*** *(Accessed February 2012).*

ADDITIONAL INFORMATION

2 *The International Journal of Nautical Archaeology* covers all aspects of nautical archaeological research. The journal's themes are seas, ships, cargos, and the sailors of the past; subjects that have excited interest throughout history. The journal keeps readers abreast of the latest explorations, discoveries and technical innovations in the field. Studies about ancient ships, harbours and cargoes, whether from excavations or documentary sources, will be of interest to the naval architect, historian and archaeologist. Information on the well-preserved artefacts discovered through techniques of underwater archaeology is especially valuable since these materials are seldom, if ever, found in excavations on land.

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The Protection of the
Underwater Cultural Heritage

UNIT 11

Author Andrew J. Viduka

Conservation and Finds Handling

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UNIT 11

Contents

UNIT 11

Author Andrew J. Viduka

Conservation and Finds Handling

Core Knowledge of the Unit

This unit provides students with an understanding of on-site conservation processes, including object recovery and first aid for finds. Students will also become aware of long term issues related to object recovery and ethical differences between conservation and restoration.

Upon completion of the Conservation and Finds Handling unit students will:

- *Understand the ethical and financial responsibilities/obligations placed on archaeologists if they want to raise objects from an archaeological site*
- *Have knowledge of different material types preserved in a maritime environment*
- *Have insight into materials and their deterioration* in situ *and within a museum collection storage and display context*
- *Have knowledge of a range of methodologies for lifting materials*
- *Be aware of a range of first aid procedures for underwater finds*
- *Have examined a range of case studies*
- *Be able to discuss the ethical and practical differences of conservation versus restoration*

Introduction to the Unit

The overall aim of the 2001 UNESCO Convention is to encourage the responsible protection of underwater cultural heritage, with a special focus on *in situ* preservation. Although finds handling implicitly focuses on the lifting of objects, both the International Committee of the Underwater Cultural Heritage (ICUCH) and UNESCO realize that excavation is an important part of underwater cultural heritage management. It is, therefore, necessary for students to have an understanding of *in situ* and *ex situ* conservation, so that they may appropriately protect sites and handle finds should they be recovered.

While *in situ* preservation is dealt with extensively in Unit 9: *In Situ Preservation*, it is necessary to include aspects of this knowledge into the context of this unit, yet primarily focus on creating an understanding of materials, how they deteriorate and first aid for finds from the marine environment.

‘Conservation is part and parcel of archaeology; without it much archaeological information is lost or left unexploited’ (Cronyn, 1990).

1 Conservation

1.1 Conservators

To begin understanding conservation, we must first understand what conservation is and what it is that conservators do.

The Heritage Collections Council, in their publication *reCollections: Caring for Collections Across Australia*, (1999) provides a definition of conservation that states,

> *Conservation; seeks to halt the deterioration of an object using chemical or physical means that are ideally reversible. Its purpose is to study, record, retain and restore the culturally significant qualities of an object with the least possible intervention.*

Alternatively, conservation-restoration, also referred to as conservation, is a profession devoted to the preservation of cultural heritage for the future. Conservation activities include examination, documentation, treatment and preventive care. All of this work is supported by extensive research and education.

The traditional definition of the role of the conservator involves the examination, conservation and preservation of cultural heritage using 'any methods that prove effective in keeping that property in as close to its original condition as possible, for as long as possible'.

However, today the definition of the role of conservation has widened and would more accurately be described as that of ethical stewardship.

The conservator applies some simple ethical guidelines, such as:

- *Minimal intervention*
- *Appropriate materials and methods that aim to be reversible and to reduce possible problems with future treatment, investigation and use*
- *Full documentation of all the work undertaken*

The conservator should aim to take into account the views of the stakeholder and to apply their professional expertise accordingly.

Critical points are those of minimal intervention and reversibility, though the ideal of the latter is not always achievable in reality (for example, the *Mary Rose* or *Vasa* removal of Polyetylene glycol (PEG) treatment). All treatments impose a certain degree of alteration to wood. With PEG treated wood, the wood's appearance can change and darken. The wood can take on a waxy appearance if too much PEG has been applied. With archaeological wood that is impregnated with iron corrosion products or still has iron pins or bolts *in situ*, this material usually contains unstable sulphides which can oxidize to sulphates and eventually to sulphuric acid (Sandstrom *et al*, 2002). This leads to the destruction of the timbers.

Conservators are specialists who employ a range of chemical and physical techniques to achieve the preservation of objects. These techniques are selected by conservators based on their knowledge of the materials used in the artefacts construction, the deterioration process of that material in a particular micro-environment and the science behind methodologies used to achieve stability.

Conservators are typically trained at university level and their course requires them to study a significant component of chemistry, which ideally includes analytical chemistry. Many conservators specialize in a range of disciplines. These can be Paper, Paintings, Textiles, Photographic/Digital Media and Objects. Objects are usually broken down into a further range of sub-disciplines that can be split on material lines, such as organic or inorganic. Within inorganic objects, conservators can further specialize into ceramics and glass, iron, copper/alloy or large objects (sculpture or working machinery). Equally, conservators specializing in organic objects can become specialists in areas, such as bark paintings or wood.

Conservators can also specialize in other ways. Some conservators focus on being preventive conservation officers, looking at preserving collections through the management of the environment within buildings. In regards to this unit, some conservators specialize as archaeological objects conservators. Unlike other conservators, archaeological objects conservators need to be competent and capable of dealing with all material types and must equally be focused on the task of preserving the object. This includes the collection of information from the excavated artefact that will add to the pool of interoperable data from the site.

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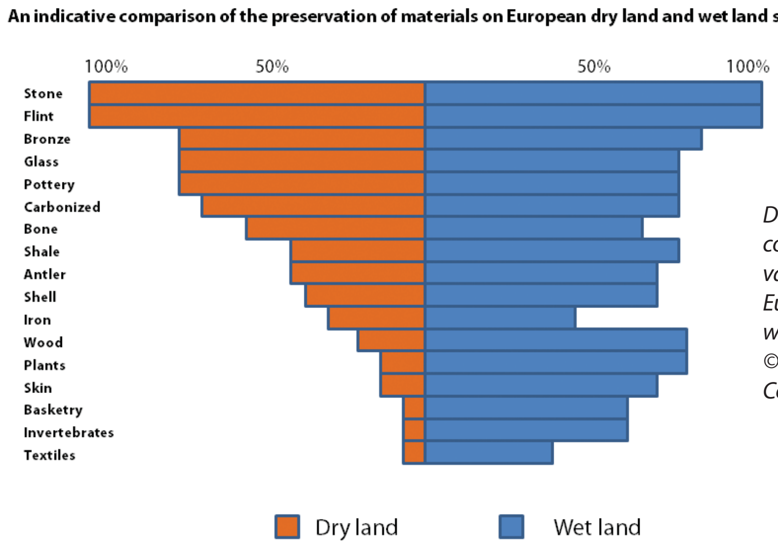
1.2 Deterioration

The susceptibility of a material to deterioration varies according to the nature of the material and its immersion environment. Key factors include:

- *Material composition*
- *Water composition (oxygen and mineral content)*
- *Extent of water movement*
- *Composition of the burial environment*
- *Depth of burial or submersion*
- *Temperature*
- *Development of encrustation*
- *Position and relationship to other materials*
- *Period of immersion*

For archaeologists working in a maritime and underwater environment, the potential for organic finds is significantly higher than that on land. The reason for this is mostly environmental, though the effect of reduced human activities on underwater sites has a very significant impact. For an object at a micro-environmental level, this translates to reduced physical abrasion and mechanical action, reduced anaerobic environmental conditions and a depth of burial that limits or totally precludes access by a marine organism.



Drawing of an indicative comparison of the preservation of materials on European dry land and wet land sites.
© Andrew Viduka after Coles, 1988, fig 5

This chart shows the differences between how well materials are preserved in both dry and wet land environments.

1.2.1 Treatments

Treatments that are carried out on objects by conservators are known as remedial or interventive conservation. Treatments are primarily implemented when objects are so unstable that they cannot be successfully kept in perpetuity through preventive conservation management alone. Interventive treatments are carried out based on a number of criteria, the most important of which are: the significance of the object from an archaeological context, the level of conservation required to stabilize the object and what type of storage or display environment the object will end up in. Selected treatments are, as stated earlier, ideally reversible.

1.2.2 Conservation System for Prioritization

The conservation of objects is predicated on their chemical and physical stabilization, however, archaeological material does not always warrant treatment and in some cases no conservation or the most minimal conservation treatment is awarded. For example, large quantities of ceramic or glass excavated from a particular site may simply be cleaned to facilitate assessment and documentation prior to bagging, storage or backfill. Prioritizing treatments allows us manage and reduce costs in the post excavation process and can potentially allow research findings to be published more quickly. To achieve this, treatment planning must take into consideration the utility of the archaeological object for chemical analysis, typological, historical research or display, within the framework of answering archaeological questions. This helps to maximize both the effectiveness and efficiency of the conservation laboratory. Careful planning using guidelines provided by MoRPHE or Phase III of Management of Archaeological Projects (MAP2 English Heritage) can provide an assessment of potential for analysis.

For more information see English Heritage: http://www.eng-h.gov.uk/guidance/map2/map2-6 htm#sect6 (Accessed February 2012).

Due to the sheer volume of objects that can be recovered from a site and the need to rapidly analyse objects for interpretation and publication, artefacts from an excavation may be divided into five categories. These categories are outlined by Janey Cronyn in her book *Elements of Archaeological Conservation* and included within guidelines published by the United Kingdom Institute of Conservators Archaeological Section (UKIC Archaeological Section, 1982). They are as follows:

1 Display conservation: *further cleaning, additional restoration and cosmetic treatment may be required in addition to category 2.*

2 Full conservation: *work is understood to include photography, X-radiography, examinations and investigation, cleaning, active stabilization and certain reconstruction. Appropriate analytical information to be provided where required.*

3 Partial conservation: *will include work in category 4 and a high degree of cleaning with or without active stabilization. This category may include reassembly of broken or detached fragments, but not reconstruction of missing areas.*

4 Minimal conservation: *this category includes 'first-aid', X-radiography and photography, the minimum amount of investigative cleaning, and suitable packaging or repacking for stable storage.*

5 No conservation: *no work of any kind is undertaken by the laboratory except for handling and checking. (Cronyn, 1990, pp. 12).*

For finds from a marine environment, no conservation is not a realistic option, unless rapid reburial in a marine environment is planned. Duty of care requires that to achieve the minimum conservation standards, the objects must have soluble salts removed before they are repacked for stable storage.

1.2.3 Collaboration

Throughout the process, conservation must be considered an archaeological project designed to maximize outcomes that preserve artefacts and reveal information. It is also important in terms of recognizing the ongoing financial commitment that institutions have to make.

These commitments cover all stages of the conservation process, including planning, excavation and finds handling, condition assessments, prioritizing and undertaking treatments, storage and display, ongoing monitoring, maintenance and additional conservation treatments.

Collaboration in conservation is the only ethical approach. Without it information is lost and time is wasted. The collaboration must be between all those who have interest in the excavated archive, such as the excavators, finds specialists, curators, analytical scientists, and conservators (Cronyn, 1990, pp. 10).

On-site care of finds requires the cooperation of everyone, from the site director to the first season diggers. Artefacts need to be properly treated from the moment of exposure, until their arrival at the conservation laboratory. Thus it is important that transport to the laboratory, as well as stabilization, lifting, restricted cleaning and packing is catered for (Cronyn, 1990, pp. 10-11).

1.3 Conservation Versus Restoration

1.3.1 Restoration

1. The act of restoring or state of being restored, as to a former or original condition, place, etc.
2. The replacement or giving back of something lost, stolen, etc.
3. Something restored, replaced, or reconstructed
4. A model or representation of an extinct animal, landscape of a former geological age, etc.

1.3.2 Conservation

Conservation is about preventing damage and loss to our cultural heritage. Conservation aims to minimize change to collection material, protect items from the adverse effects of climate and chemical deterioration, and to safeguard our heritage not only for ourselves, but for future generations.

Conservation activities may include preservation, restoration, examination, documentation, research, advice, treatment, preventive conservation, training and education.

The term 'preservation' refers to the protection of cultural property through activities that minimize chemical and physical deterioration, such as improved storage conditions and environmental control. The primary goal of preservation is to prolong the existence of cultural material.

'Restoration' involves treatments that enhance the interpretation of cultural heritage, for example, inpainting losses in an oil painting so that the original appearance of the image is maintained. Restoration may also involve the reassembly of displaced components, removal of extraneous matter or integrating new materials or components, in order to stabilize and strengthen the original artefact.

Even when performing restoration work, conservators choose methods of 'minimal intervention', focusing on stabilization and retaining the original material. Conservators also use materials with good ageing characteristics and, where possible, select treatment methods that are reversible. Conservators also document the condition of an object through written reports and photographs, both before and after treatment, in order to retain records of what has been changed for future owners and caretakers.

Unlike conservation which strives for minimal intervention and reversibility of interventive methods, the aim of professional restoration is to return or restore an object back to its original appearance. This often involves what conservators would deem 'destructive', non-reversible interference with the object.

Another illustration of this debate can be found in ceramic conservation. For display purposes, there can be a desire for an object to be made 'whole' by filling gaps completely with plaster. From an archaeological perspective, the object only requires fills if the object needs to be built up for display and/or study, and even then, the fills only need to be structural, so that the object does not collapse. Consequently restoration creates the potential for imposing an interpretation on an object that may not have otherwise existed.

1.3.3 Definitions by International Council of Museums (ICOM) – Committee for Conservation (CC)

Blue transferware bowl after conservation and restoration, HMS Pandora *artefact. © Queensland Museum*

ICOM-CC has adopted the following terms: 'preventive conservation', 'remedial conservation' and 'restoration' which together constitute 'conservation' of tangible cultural heritage. These terms are distinguished according to the aims of the measures and actions they encompass.

The definitions of the terms are as follows:

1 **Conservation:** all measures and actions aimed at safeguarding tangible cultural heritage while ensuring its accessibility to present and future generations. Conservation embraces preventive conservation, remedial conservation and restoration. All measures and actions should respect the significance and the physical properties of the cultural heritage item.

2 **Preventive conservation:** all measures and actions aimed at avoiding and minimizing future deterioration or loss. They are carried out within the context or on the surroundings of an item, but more often a group of items, whatever their age and condition. These measures and actions are indirect – they do not interfere with the materials and structures of the items. They do not modify their appearance.

Examples of preventive conservation are appropriate measures and actions for registration, storage, handling, packing and transportation, security, environmental management (light, humidity, pollution and pest control), emergency planning, education of staff, public awareness and legal compliance.

3 **Remedial conservation:** all actions directly applied to an item or a group of items aimed at arresting current damaging processes or reinforcing their structure. These actions are only carried out when the items are in such a fragile condition or deteriorating at such a rate, that they could be lost in a relatively short time. These actions sometimes modify the appearance of the items.

Examples of remedial conservation are disinfestation of textiles, desalination of ceramics, de-acidification of paper, dehydration of wet archaeological materials, stabilization of corroded metals, consolidation of mural paintings, removing weeds from mosaics.

4 **Restoration:** all actions directly applied to a single and stable item aimed at facilitating its appreciation, understanding and use. These actions are only carried out when the item has lost part of its significance or function through past alteration or deterioration. They are based on respect for the original material. Most often, such actions modify the appearance of the item.

Examples of restoration are retouching a painting, reassembling a broken sculpture, reshaping a basket, filling losses on a glass vessel.

Conservation measures and actions can sometimes serve more than one aim. For instance, varnish removal can be both restoration and remedial conservation. The application of protective coatings can be both restoration and preventive conservation. Reburial of mosaics can be both preventive and remedial conservation.

Conservation is complex and demands the collaboration of relevant qualified professionals. In particular, any project involving direct actions on the cultural heritage requires a conservator-restorer.

See ICOM-CC's The Conservator-Restorer: a Definition of the Profession and ICOM's Code of Ethics for Museums: www.icom-cc.org/242/about-icom-cc/what-is-conservation/ (Accessed February 2012).

2 Materials: Their Deterioration and Conservation

As the aim of this unit is to broadly introduce students to conservation and not make them into conservators, it is inappropriate to include detailed information related to materials and their deterioration. It is, however, important that students understand a little about the materials being treated, so that any first aid treatment that is undertaken on an artefact is selected on informed principles.

As Robinson very correctly points out, this is crucial because some materials may respond well to one type of treatment, while others will not, and if a find has potential for scientific analysis or dating, special treatment (or no treatment at all) might be required. Knowing the particular risks a find might be subject to and how quickly it can be expected to change, will enable the prioritization of treatments and arrange first aid processing to make best use of time and resources (Robinson 1998, pp. 23).

To illustrate materials, their deterioration and conservation this unit will draw upon examples of finds from HMS *Pandora*.

Case Study

HMS *Pandora*

Background

HMS *Pandora* (1791) was a 24 gun frigate sent to pursue the H.M.A.V *Bounty*. The vessel sailed extensively throughout the Pacific at a time when the concept of museums was just beginning, in the form of gentlemen's curiosity cabinets. Objects were collected either directly or by proxy, at a time when social advancement was often connected to patronage. The HMS *Pandora* was unsuccessful in its mission to capture all of the HMAV *Bounty* mutineers and was eventually wrecked in Far North Queensland while trying to navigate through the outside edge of the Great Barrier Reef. The Queensland Museum conducted a number of expeditions to the site; the last excavation was carried out in 1999.

2.1 Inorganic Objects

2.1.1 Stone, Ceramic and Glass

The archaeological excavations conducted on the wreck site of HMS *Pandora* recovered a vast amount of inorganic objects. These objects provide a unique insight about life on board the ship, some of the landfalls of the HMS *Pandora* crew during the search for HMAV *Bounty* mutineers and information about the ship itself.

Some of the objects that have been recovered include:

- *Buttons*
- *A watch*
- *An ink well*
- *Drinking glasses*
- *Dinner plates*
- *Sea shells*
- *Poi pounders*
- *Stone adze heads*
- *Intaglio seals*

The conservation of inorganic materials can be achieved by a number of different methods. The chosen method is usually selected because of the condition of the object, the conservator, the time available, the equipment and materials available to work with, and the final storage or display environment.

There is no one fixed approach to object conservation, though a conservator may prefer one method over another. Inorganic maritime object conservation primarily focuses on the removal of chemically-free (not bound in a reaction) chloride ions from the artefact, generally termed as 'salts'.

Dripstone from HMS Pandora.
© Queensland Museum

Most objects recovered from a marine environment will rapidly degrade in air if no effort is made to remove these salts from the object.

The general treatment processes for both ceramic and glass artefacts may involve deconcretion, stain removal, desalination, rejoining and gap filling (where structural losses exist). Following the completion of the desalination treatment, further chemical degradation of ceramic and glass objects can be controlled by storing them in environmentally stable conditions. Stain removal, assembly and gap filling are only required when they contribute to archaeological interpretation or display. In addition, if the delicate nature of these objects is a concern, specialized display packing or supports are usually required.

Poi pounder from HMS Pandora.
© Queensland Museum

In a marine environment, soluble salts can enter and chemically react with ceramic and glass objects. These salts need to be removed before drying as they will cause the deterioration of objects in air. If soluble salts have entered into the body of an object they cause significant physical damage through a process known as deliquescence. The damage caused by deliquescence is irreversible, leading to cracking and lifting of glazes, or cracking and flaking of the ceramic or glass body itself. Soluble salts are easily removed by washing the object in successive baths of fresh water. The salt levels are usually monitored by conductivity measurements. Desalination is continued by simply changing water baths until the salt levels remain constantly low.

Alkali leaching is the major form of chemical degradation for glass. In a marine environment, this process is significantly faster than in ambient conditions. Glass that has deteriorated in this manner is easily recognised by an iridescent, flaky surface that is often easily damaged by handling. This process can continue out of water if relative humidity levels fluctuate and can be recognised by the presence of 'sweat' droplets on the surface of the object.

One example is a transfer printed earthenware dish from the HMS *Pandora* which was discovered as pieces embedded in the concretion, adjacent to a six-pounder cannon. The pieces were separated from the concretion mechanically using a pneumatic drill and dental tools. Vestiges of concretion that remained adhered to the surfaces were removed chemically with an acidic solution to avoid mechanically damaging the fragments.

Some staining which had occurred from contact with the corroding iron cannon, was 'removed' using a bleaching agent. Chelating agents, such as Ethylenediaminetetraacetic acid (EDTA) or oxalic acid can also be used to remove organic and inorganic stains.

Once desalination was completed and the ceramic pieces dried, the pieces were reassembled using a reversible acrylic adhesive. The plate was then in-filled with plaster of Paris to provide structural support and to achieve an aesthetic finish.

Blue transferware plate from HMAV Bounty, Pitcairn Island excavation, undergoing conservation. © Queensland Museum

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2.2 Metals

2.2.1 Iron

For metals, washing an object free of salts is a significant step towards stabilization, however, most metals also require a corrosion inhibitor and coating systems to further promote stability. The corrosion inhibitor locks up metal ions that could react with the environment to form stable corrosion products.

The coating system impedes the access of oxygen and water to the metal surface, which limits the rate at which corrosion can occur. Depending on the material and its condition, other steps may be needed before an artefact is exhibited, stored or studied.

An example of a metal object that was conserved utilizing this methodology was a gun from the HMS *Pandora*. The HMS *Pandora* as a 24 gun frigate was armed with three types of cast iron gun: six pounders, eighteen pounders and swivel guns (half-pounders).

A six pounder gun was selected for recovery after an *in situ* assessment of its condition revealed that the gun was suitable for conservation. Assessment involved measuring the depth of corrosion and the thermodynamic state of the object. This data, when combined with other site specific information, enabled an appreciation of the object's rate of annual deterioration to be determined.

The gun was winched onto the back deck of the work boat and then registered and packed wet for the return boat trip to Townsville. It was vital for the conservation treatment process that the gun did not dry out during transport, as new corrosion would increase the chances that the gun's surface which holds all the historical detail, such as foundry markings, would later disbond during or after treatment.

Concreted six pounder gun from HMS Pandora *on a treatment cradle. © Queensland Museum*

Upon arrival at the Museum of Tropical Queensland, the gun was documented in detail, drawn and photographed, before mechanical deconcretion was started.

It was not possible to acquire an X-ray image of this six pounder gun, but an X-ray image of a much smaller half pounder swivel gun was acquired, in part to get a general understanding of the corrosive nature of the microenvironment.

Andrew Viduka working on boring out the barrel of a six pounder gun from HMS Pandora *prior to electrolysis treatment. © Queensland Museum*

Once the exterior of the gun was mechanically deconcreted, the barrel had to be cleaned of concretion, otherwise it would harbour significant quantities of chloride ions that would later promote deterioration.

To release the chloride ions trapped in the graphitized corrosion product layer of the gun, the object was connected to an electrical circuit. The electrical circuit reduced the iron corrosion products to a different electrochemical state, which assisted in the removal of chloride ions by diffusion in alkaline solution.

After deconcretion, the gun was sampled to get a baseline understanding of the chemically bound and free chlorides. This chloride concentration data is used in calculations to provide an approximate time frame for the duration of treatment and the mass of chloride ions to be extracted through an electrolysis/diffusion process.

Once sufficient chloride ions were released, the object was washed to remove all vestiges of the sodium hydroxide solution. After this, the object was taken out from the tub and excess water was chemically removed, before the gun was sprayed with an inhibitor that reacts with chemically available iron ions, to create a stable compound. The gun was then placed into a stable environment to slowly air dry, before being wax consolidated.

The process of wax consolidation involves immersing the gun in a bath of hot microcrystalline wax, which is solid at room temperature. The wax permeates the porous corroded (graphitized) surface of the cannon and consolidates the surface, as well as acting as a barrier to moisture.

2.2.2 Copper alloy

Significant quantities of copper and copper-alloy objects were also recovered from the HMS *Pandora*. Objects made from these materials were used in various applications:

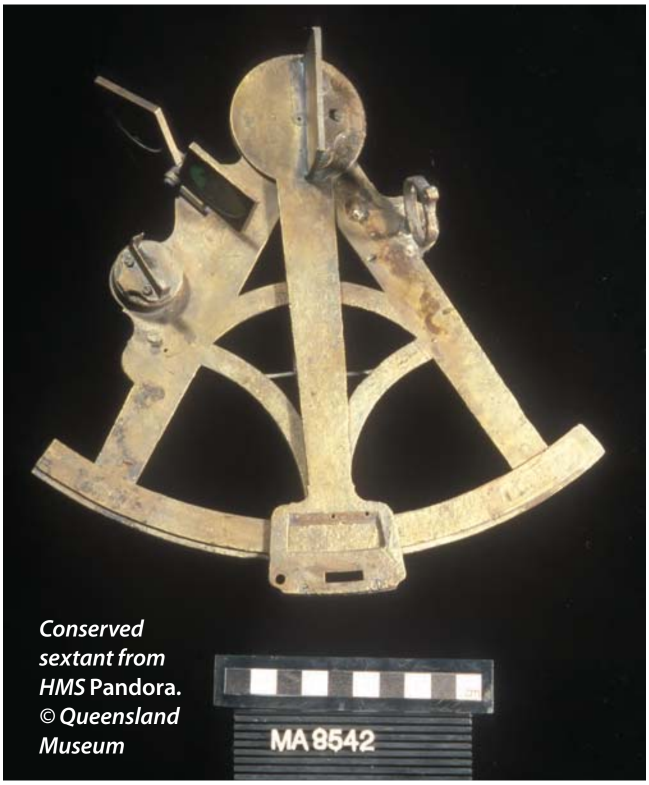
- *Ship parts*
- *Furniture and fittings*
- *Weapons*
- *Tools*
- *Instruments*
- *Domestic equipment*
- *Utensils*
- *Clothing*
- *Accessories*

A sextant was also found during the 1999 expedition. The navigational instrument is a composite object primarily made of brass (a mixture of copper and zinc), with glass optical components. After the concreted sextant was recovered on-site, it was registered, photographed and then wrapped to keep it wet and protect it from any physical damage during its return voyage to the museum.

Initial observations of the concretion of this artefact revealed that there were a number of objects associated in the one concretion. What appeared to be a sextant was heavily concreted, with the 'bulky end' of the concretion appearing to contain both wood and corroded iron. There were three areas on the sextant proper where metal was exposed and each of these areas appeared to be in good condition. There was also a section of a wooden handle exposed.

Before starting to deconcrete the object, it was necessary to take a number of X-rays. The X-rays made it possible to identify separate materials in the concretion, their number, condition and associated location. They also revealed that the sextant was complete. With this information to guide the process, it was possible to successfully deconcrete the artefacts using a small pneumatic pen.

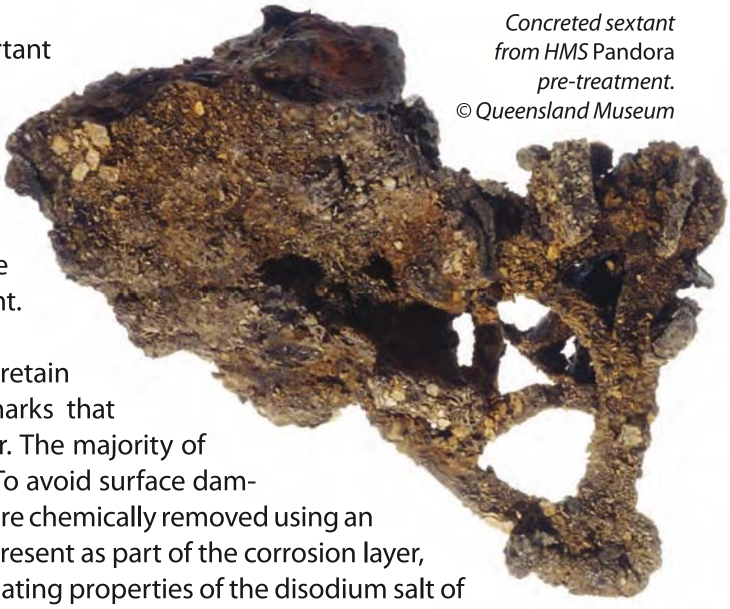
After deconcretion, the brass components of the sextant were placed into a solution containing a corrosion inhibitor for copper, commonly called BTA (benzotriazole). The chloride ion release was monitored until a level was achieved that indicated the process was complete. The brass components of the sextant were then immersed in acetone to dry the metal quickly, removing any vestiges of water that could initiate corrosion. Finally, the object was air dried.



Conserved sextant from HMS Pandora. *© Queensland Museum*

2.2.3 Lead

Lead objects from the HMS *Pandora* include musket shot, touch-hole covers and various types of weights. In comparison with other metals, lead is fairly resistant to corrosion in a marine environment and is usually only covered in a thin layer of concreted matter. Lead is prone, however, to physical damage



Concreted sextant from HMS Pandora *pre-treatment.*
© Queensland Museum

due to its softness. For this reason, it is important that lead artefacts be carefully retrieved to avoid further surface impacts. On-site, lead is stored in seawater which is then replaced by normal tap water, sometimes with the addition of other salts, such as sodium sulphate, back at the laboratory. This prevents the material from deteriorating during treatment.

The primary focus for lead conservation is to retain any historic information, such as maker's marks that may be retained in the corroded surface layer. The majority of concretion is usually mechanically removed. To avoid surface damage, any remaining small traces of concretion are chemically removed using an acidic solution. If no historical information is present as part of the corrosion layer, the object can then be stripped using the chelating properties of the disodium salt of EDTA (Ethylenediaminetetraacetic acid). If historically important surface detail is revealed, the corrosion product can be reduced to metallic lead by electrolysis and then consolidated.

An alloy of lead and tin, pewter is harder than lead. Pewter is used to manufacture different types of objects, commonly decorative and household items.

The pewter pot from the HMS *Pandora* featured a 'pustuled' surface, typical of pewter corrosion in a marine environment. This effect occurs as corroding metal tries to force its way through a surface layer of tin oxide. Most of the surface concretion was removed very carefully under a compound microscope, using wooden picks and a scalpel. The pustules are kept intact, as removal only reveals a gaping hole. The pot was then covered with microcrystalline wax, not only as a barrier against moisture, oxygen or pollutants, but also to help consolidate the fragile surface.

Pewter pot from HMS Pandora.
© Queensland Museum

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2.3 Organic Materials

- *Wood*
- *Other plant materials*
- *Leather*
- *Bone, shell, ivory*
- *Horn, tortoise shell, baleen, hair*

The archaeological excavations conducted on HMS *Pandora* have revealed that approximately 30 per cent of the ship's timbers remain. Found within the hull remains were a significant number of small organic objects associated with either the function of the ship or the possessions of the crew.

Examples of the organic objects recovered from the HMS *Pandora* include:

- *Food condiments*
- *Wine*
- *Essences*
- *Spruce beer*
- *Coconuts*
- *Wood*
- *Ethnographic artefacts*
- *Leather*
- *Rope*
- *Cork*
- *Teeth*
- *Ivory*
- *Bone*

Whilst there is no one fixed approach to organic object conservation, the basic stabilization process can be divided into three separate stages:

- *Cleaning and documentation*
- *Consolidation and/or desalination*
- *Drying*

All of these activities are regulated by the need to maintain a dimensionally-stable object. Failure to treat an organic object correctly, results in the loss of its original shape and an unacceptable level of damage caused by internal drying stresses. Damage usually manifests as cracking, warping, checking or collapse of the original surface.

Like most other conservation laboratories conserving wet organic materials (National Museum of Denmark Skudelev ships, *Mary Rose*, *Vasa*, Bremen Cog), the Queensland Museum used a synthetic polymer called Polyethylene Glycol (PEG) and Hoffman's two step method of PEG consolidation (Hoffman, 1985, 1986 and 1996).

Objects treated with this consolidation material are dried either by vacuum freeze-drying (VFD), freeze-drying or controlled air drying depending upon the object's size and significance. VFD reduces or removes internal stresses caused by conventional drying and helps to keep an object's shape and condition. Controlled air drying does not work for wooden objects that have suffered significant degradation. Internal stresses are caused by the most careful of procedures and only an object's inherent condition will save it from deterioration. As a result, controlled air drying should be reserved solely for wet wooden artefacts which are in very good condition and feature only minor surface deterioration.

Another method for consolidation of particularly fragile organic objects and for composite objects is a consolidation treatment called the Cellusolve Method. This method was developed by Inger Bojesen-Koefed, Ion Meyer, Poul Jensen and Kristiane Straetkvern from the National Museum of Denmark. Due to the potentially carcinogenic nature of the chemicals used in this method, only initial trials on corks recovered from the HMS *Pandora* were carried out.

2.3.1 Wood

All of the wood recovered from the HMS *Pandora* required consolidation to avoid loss of the historical shape and surface detail. In the 1999 season, a waterlogged wooden fish hook was recovered. This artefact is one of many ethnographic 'curiosities' from the South-Pacific Islands collected by the crew of the HMS *Pandora*. The fish hook was defined as being waterlogged, meaning that the wood's cellulose structure had been degraded and replaced with bound water. While the water held within the cell walls provided temporary support to the weakened cells, it created a false impression that the hook was in a stable condition. If the fish hook was allowed to dry without consolidation, its cell walls would have collapsed from internal stresses, causing irreversible damage, such as dimensional shrinkage, cracking, checking and delamination.

Following documentation, treatment began with basic surface cleaning. The hook was gently washed and brushed under running deionised water. After wet cleaning, the hook was placed into a solution of synthetic wax called Polyethylene Glycol (PEG) which replaces bound water by osmotic diffusion. This was a long process in which various grades of PEG (a grade is determined by the length of the polymer chain) were progressively added in increasing concentration, to avoid osmotic shock and possible cell collapse. By filling the lumens and cell cavities of the wood with PEG, the hook was given greater structural support.

Following consolidation, the hook was frozen and then vacuum freeze-dried, a procedure that involves the conversion of water from its frozen state into a gaseous phase. This type of procedure is used to avoid drying stresses that would cause damage to the deteriorated object. Once dry, excess PEG that had solidified on the surface was mechanically cleaned. Fragments of the object were joined and rope strands were consolidated using a chemically stable and reversible adhesive. Finally, the object was packed so it could be viewed for study without necessarily handling it.

The desalination wash treatment of an organic object is an identical process to that performed for glass and ceramic objects.

Fish Hook from HMS Pandora *after treatment.*
© Queensland Museum

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2.4 Composites

One of the largest finds of the 1999 season was an earthenware ceramic olive oil jar. This was the fourth 'Ali Baba jar' recovered from the HMS *Pandora*.

Large rough earthenware jar from HMS Pandora.
© Queensland Museum

This earthenware jar, however, was quite different from its three predecessors. After the olive oil had been consumed, this jar had been reused as storage for a number of objects: tacks, roves, nails, rivets and hammer heads.

An artefact with parts made from a number of material types is termed a 'composite object'. In this case the object was made up of ceramic, leather, fibre, wood, iron, copper and stone. Until excavation in the laboratory could separate the individual artefacts, the contents of the jar had to be stabilized as a composite object.

The conservation treatment to stabilize a composite object is generally a compromise between what would be ideal for each material type individually, and what is ideal for the whole. Upon arrival at the museum, the first step in the conservation process for the Ali Baba jar was to place the entire object into a solution with a near-neutral pH, in conjunction with a number of corrosion inhibitors.

The objects located inside the jar had not been exposed to any physical damage during their 200 year burial and had a reduced corrosion or biological deterioration rate, because of the lack of oxygen in the burial environment. Chemical deterioration of the internal iron and leather objects was primarily caused by sulphate-reducing bacteria. This type of deterioration, for example, is significantly slower than corrosion of iron in an oxygenated environment. As such, the inorganic artefacts inside the jar were in good condition and the organic artefacts were still preserved.

Due to the density of the object, no X-ray images of the jar's contents or their arrangement was possible. Since the first priority in the treatment of a composite object was to separate the object into parts and treat each material individually when possible, excavation of the jar was immediately required to simplify the conservation process and extract the maximum archaeological information from the artefact.

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3 Finds Handling 'First Aid'

3.1 General Artefact Processing

Conservators are responsible for recovered artefacts on site at all times. A conservator's job on an excavation is to minimize the shock experienced by an object as it moves from a stable environment where it has come into some form of equilibrium, to one where it is exposed to rapid deterioration potential by excavation. If it is wet, keep it wet. If it has come from the sea, put it into sea water; if from a fresh water lake, put it into lake water. Ianna and Richards (1996) give a very good summary of the roles and responsibilities of the on-site conservator and much of the information in this section is drawn from that document.

Lifting objects is often a collaborative affair. Dependant on the environment where the object is being recovered from, the lifting techniques can vary significantly. It is sufficient to encourage people to work from first principles and remember that the aim is to mitigate shock, vibration and movement, as the object moves to the surface. It is best if objects are placed into containers that are 'snug fits', i.e. if the container is slightly too big for the object, it is advisable to put some sand in with it.

General assumptions are often made about material types recovered from the excavation to promote effective processing in the lab. Objects deemed fragile could include glass, ceramics, bone, ivory, rope, leather, textile, parchment, pewter, silver, gold and any extensively corroded small objects. Wood can be fragile (a classic example of much deteriorated wood is timber from the bog site of Nydum Mose, Denmark), however, all wooden surfaces are usually fragile. Sound objects are generally inorganic objects, larger metal objects, stone, shell and concreted masses. Wood can be sound, but the surface can also be marked easily and should be treated as fragile.

Divers recovering large earthenware jar from HMS Pandora in 1999. © Queensland Museum

Artefacts should only be handled and packed once. Those artefacts that are in pieces should be kept together in one bag. Packing for transport back to the laboratory should be carried out straight away and it is imperative that objects (even if in crates) are not left out in direct sunlight. Objects should only be handled by the designated person, i.e. during their removal from crate or container, into storage or a solution. This gives clear lines of responsibility and removes the potential for mistakes.

Sea water is acceptable as the storage medium (always for lead). There are a number of storage solutions for particular material types. The basic aim of all these storage solutions is to help stabilize the object. For example, an iron object is placed into a solution that passivates the metal by increasing the alkalinity of the sea water from approximately pH8 to a pH11+.

Artefacts, especially organic materials, should be kept moist with a spray bottle of water during photography, sketching, publicity and assessment for analysis potential. Fragile artefacts should be photographed quickly and packed for transport.

If possible, the majority of marine organisms from objects should be removed, this reduces excess weight and enables for more objects to be collected with limited supplies.

Light and heavy artefacts should be stored separately. It is important to differentiate between material types and store accordingly, as some objects actively promote deterioration of others. If in doubt of an object's material type, it is best to store it separately. Metals should not be stored with organics, except in the case of composites.

Objects impregnated with metal corrosion products (wood) should not be stored with objects not impregnated. Look for staining (generally a reddish iron oxidation colour or green for copper) on the object's surface as an indicator of contamination with corrosion products. If unsure, treat as impregnated. Biocides should be used in the storage solutions of organic materials (0.05 per cent Panacide is an example of a biocide and the low concentration needed to control fungal activity). This is particularly the case in the tropics.

Label both the artefact and the storage container, and then label the contents of all storage solutions on the containers.

Larger timbers can be stored in tanks or holes in the ground lined with plastic. If this is not possible then wrap them in Hessian that has been soaked in sea water and a biocide, and seal the object in a plastic bag. Additional water should be added prior to sealing.

Leskard (1987) and Kimpton (1985) focus on lifting, supporting and packing for transport large deteriorated timbers. Other good examples of lifting timbers can be found from the excavation of the Skudelev ships and La Salle's *La Belle* by Texas A&M.

Do not pack heavy artefacts with light artefacts. All artefacts require wrapping to help retain a high humidity around the object during transit (usually a combination of paper cloth/towel with bubble wrap on the outside). Do not use tissue, cotton or wool that is likely to leave fibres. Exfoliating glass or ceramics can be wrapped in fine gauze (Stabilex) to keep the surface intact or to contain disbonded surface pieces.

To achieve minimum movement in storage container, wrap the artefact in wetted cloth and place in a sealed plastic bag as soon as possible. Do not add additional water to bag prior to sealing. Small objects can then be further put into small sealable boxes and finally into larger plastic bins (50 litre sized bins).

Jon Carpenter (1987) from the Western Australia Museum very successfully used Agrosoak as another medium in which to transport objects from the field. Agrosoak not only helped keep objects, but also offered support to small glass and ceramic objects. This is particularly useful when working from a dive platform as sea conditions can be variable.

Conservator working on the back deck during the HMS Pandora *expedition. © Queensland Museum*

Onsite conservation HMS Pandora*, 1999. © Queensland Museum*

UNIT 11

Some finds, such as Mercury, are dangerous to your health. When handling finds on site, particularly if the archaeology/history suggests that such finds are likely, use gloves at all times. If the object is a liquid, keep the bottle or container upright, pad to avoid breakages and keep the object fully immersed. All material that has come into contact goes into the container. Containers should be sealed with tape and labelled very clearly, before being placed into cold storage.

If bone or ivory finds are recovered and there is capacity on site, pack objects and place into a cold environment (cooler chest with freezer blocks) or a fridge. A target steady temperature of 10 ^{0}C is suitable.

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4 Casting

In archaeological conservation, the main purpose of casting is to obtain a three-dimensional record of an object or arrangement of objects that could be lost through excavation, deconcretion or treatment. Casting is also used to provide replicas for display or education purposes. Casting is a very useful tool for revealing information hidden within concretions. The on-site conservator needs to be able to cast so that valuable information is not lost.

Over a period of time on the seabed, calcareous matter can grow over an object, often obscuring it and creating what is known as a concretion. Iron objects covered by concretions continue to corrode, and the corrosion products move into the surrounding concretion. If there is sufficient time and the environmental conditions are conducive to promoting corrosion, an iron object can corrode away completely, sometimes leaving a nearly perfect negative of the original form. This negative space is called a pseudomorph.

For concretions in which pseudomorphs have formed, casting is the only way the shape can be revealed in the positive. It is important that the casting is done well as it is often the case that the concretion has not been sectioned prior to casting, so it will need to be destroyed in order to remove the cast form. Typically, wrought iron objects, rather than cast iron objects, corrode away entirely within a concretion, producing a pseudomorph suitable for casting. Taking an initial X-ray of the concretion can help to ascertain how much of the original metal still remains and whether casting may be the best option. Often X-raying concretions does not reveal a lot of information as the strength of the X-ray is too limited for the industrial application at hand. Fine detail, such as makers' marks, broad arrows and other engravings, can often be revealed from casting.

There are a variety of materials and methods that can be used to cast concretions. At the Queensland Museum, a two part silicone-based product (base and catalyst) was used, which provides good working and setting properties, and is chemically stable long term. The flexible silicone cast can be recast with hard epoxy resins if required. When recast with an epoxy resin, appropriate colours can be added to resemble the original object.

The silicone casting mixture is poured into the top of a concretion, which has had all other exit holes blocked. The silicone cast, which cures in 24 hours, is removed by simply pulling it free of the concretion. For more complex forms, the concretion needs to be broken to free the cast.

It is also possible to cast a concretion in two parts and then join them together afterwards to produce the entire form. This is a helpful technique when the form is complex. The advantage of this method is that the concretion can be retained for further casts or used for display purposes.

Cast of a wrought iron object from a pseudomorth found on the HMS Pandora. *© Queensland Museum*

Unit Summary

Conservation can be defined as all measures and actions aimed at safeguarding tangible cultural heritage, while ensuring its accessibility to present and future generations. Conservation embraces preventive conservation, remedial conservation and restoration. All measures and actions should respect the significance and the physical properties of the cultural heritage item.

Conservation is a specialization that has its own ethical parameters. It is important to understand the concept of conservation ethics and the difference between conservation and restoration, with reference to the ICOMOS – CC definitions.

On-site conservation requires planning and coordination to be carried out effectively. There is a need for conservators and archaeologists to follow excavation planning processes regarding the types of objects to be recovered and the sampling methodologies to be employed on-site and above water. The need for sampling procedures and methodologies has to be established pre-excavation to ensure the maximization information is recovered. Following this, the above water first aid treatments for a range of organic and inorganic objects that are typically recovered from shipwreck sites can also be outlined.

Careful consideration must be given to an artefact's potential for preservation *in situ* and any conservation issues that may arise once recovered and stored in particular environments.

The conservation of objects is predicated on their chemical and physical stabilization, however, archaeological material does not always warrant treatment and in some cases no conservation or the most minimal conservation treatment is awarded. Prioritizing treatments allows us manage and reduce costs in the post-excavation process and can potentially allow research findings to be published more quickly. To achieve this, treatment planning must take into consideration the utility of the archaeological object for chemical analysis, typological, historical research or display, within the framework of answering archaeological questions.

Suggested Timetable

15 mins	Introduction to Finds Handling and Conservation
75 mins	Materials, their Deterioration and Conservation
	Break
90 mins	First Aid for Finds
	Break and Transfer to Next Site
90 mins	Site Visit 1 *In Situ* Archaeological Site or Conservation Laboratory
	Break and Transfer to Next Site
90 mins	Site Visit 2 Museum - Group Activity and Discussion
20 mins	Concluding Remarks and Closure

Teaching Suggestions

This unit introduces students to conservation and finds handling techniques. Trainers should present the information in a series of lectures, followed by field visits and practical group activities as outlined in the suggested timetable.

Discussions can be useful way for students to share knowledge and perspectives, further enhancing their understanding of the material. Language and culture issues need to be considered by trainers so that as many students as possible are included in the discussion.

Since the vast majority of students will be underwater cultural heritage managers or maritime archaeologists, it is important that the trainers do not attempt to turn them into conservators, but instead should focus on communicating with the audience in an engaging way. The best way to do this is to explain what conservation does for archaeology; essentially the capture and preservation of information that can then be interpreted. It is also useful to highlight where this specialization may contribute to planning fieldwork and what responsibilities a conservator will undertake in the field as well as in a museum context.

Please note that there exists a cultural difference in the concept of conservation and restoration, and these differences are often embodied in the training given to conservators from different countries. Trainers will need to be sensitive to these differences and be able to modify their lectures accordingly.

Practical Sessions

Site Visit 1

Students should visit an archaeological site or conservation laboratory where they can see a range of archaeological material types in different conditions. Ideally these materials should not be conserved or going through conservation. The aim of this site visit is to get students out of the class room environment so that they can apply and re-iterate information given to them in the lectures. If a conservation laboratory is available and specific treatments are currently underway, trainers should take the opportunity to discuss with students the object, the treatment methodology being used and the rationale behind these choices.

Site Visit 2

During the second site visit, students should be divided into small groups. Each group should be asked to walk around the displays and using the knowledge provided in the series of lectures, assess the condition of objects, the display cases and their location within the building space and the museum environment.

The aim of this exercise is to get students to look at objects and apply some of the conservation principles that have been discussed throughout the unit. Trainers should also encourage students to also look at objects as a responsible archaeologist and propose a methodology that could be used to recover certain materials from a given site. It is important that students take into account issues related to location, depth, available bottom time, current, sea conditions and weather.

Students should also look for fragile or large organic and inorganic objects, and consider their conservation needs from the site to the Museum. Students should be able to demonstrate an understanding of the logistics and approximate costs required for recovering items of that nature. Remember to highlight an archaeologist's ethical responsibilities, at all times.

Conservation Preparation Planning Exercise

This additional exercise can be given to students as an overnight activity.

Trainers should provide students with a scenario that outlines a particular site, ideally related to the site selected for the practical diving project. The scenario should describe the nature of the site, the likely material culture to be found, environmental conditions, depth, current, accessibility and visibility.

Students should form small groups and be given the task of preparing a conservation plan for that site.

The plan should include the following sections:

- *Site*
- *Expertise/personnel*
- *Planning/Managing*
- *Project processes*
- *Infrastructure*
- *Equipment*
- *Materials*
- *Workspaces/tasks*
- *Long term issues arising from recovered materials*

Due to the diverse nature of training groups and the fact that English is not necessarily the first, second or third language for some students, use assessment through group participation where possible.

Additional Individual Exercise

Using your knowledge of site formation, think about what types of materials you have seen in high energy sites (waves breaking on shore) and in low energy sites (like deep lakes). Is there a difference? Why? Look at the key factors above and think about it from the perspective of those parameters and their inter-relation.

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Useful Websites

- *Australian Institute for Conservation of Cultural Materials:* ***www.aiccm.org.au/index.php?option=com_content&view=article&id=6&Itemid=4*** *(Accessed February 2012).*
- *Bibliographic Database of the Conservation Information Network (BCIN):* ***www.bcin.ca/English/home_english.html*** *(Accessed February 2012).*
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United Nations
Educational, Scientific and
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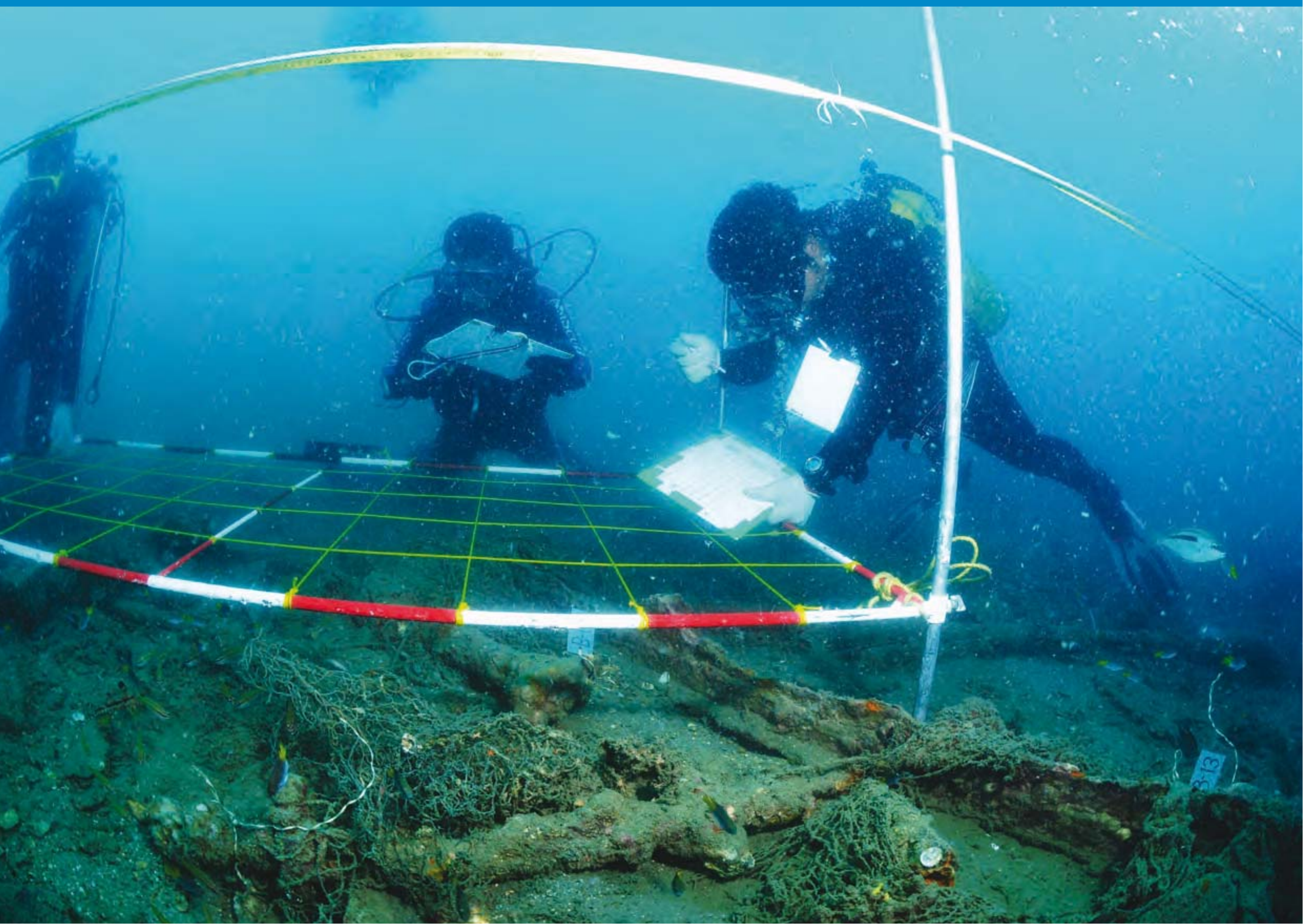
The Protection of the
Underwater Cultural Heritage

UNIT 12

Author Christopher J. Underwood

Practical Dive Session of the Foundation Course

The Mannok Shipwreck Site, Gulf of Thailand



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UNIT 12

Contents

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Author Christopher J. Underwood

Practical Dive Session of the Foundation Course

The Mannok Shipwreck Site, Gulf of Thailand

Core Knowledge of the Unit

This unit provides students with the opportunity to use the knowledge they have gained during the Foundation Course and participate in a practical diving project on the Mannok Island shipwreck.

Working as a team, students will have to:

- *Undertake an assessment of the wreck site*
- *Create a site plan and site archive*
- *Develop a management plan*
- *Collect information for the story boards*

On each day of the diving project students can expect to:

- *Receive a daily pre-diving safety briefing*
- *Receive a daily pre-diving task briefing*
- *Receive a daily post-diving project update*
- *Review any diving safety or medical issues*
- *Process data and planning for next dives*

Introduction to the Unit

Similar to most types of fieldwork, the two weeks of diving are more complicated to organize than the units that precede or follow it. There are a number of variables such as the weather and underwater visibility over which the trainers have no control, but nonetheless must be taken into account when planning the day to day tasks. The unpredictable nature of this type of fieldwork means that for trainers, flexibility is the key to achieving their goals.

For some students, taking part in a diving project might be a new experience. Most will be looking forward to the challenges, but some may well be anxious about the diving and how they will perform in front of their peers. For others, the two weeks will be a test of their physical limits.

With this in mind, at no point must any of the students be encouraged or persuaded to do something that is beyond their level of experience or fitness. Those responsible for the diving must be aware of the student's physical well-being and where necessary, be ready to take appropriate action such as suggesting additional breaks between dives. The project has scheduled rest days to provide time to catch up with administrative tasks and provide recuperation. Both trainers and students should feel fit and sharp right up until the last day of diving. Tiredness can lead to a lack of concentration and mistakes, which could easily result in a diving accident with potentially serious consequences.

The organization of the project is a team effort between the trainers who advise and assist the students in achieving the project objectives, and those who provide the essential logistical and safety support. The overall success of the field project depends on the combined cooperation of everyone.

1 Mannok Shipwreck

The wreck site selected for the diving project is the Mannok shipwreck, which is situated in the Rayong Province of Thailand. Discovered in 1992 by Mr Vichien Singhatothong of *Toy Tours* (a local dive operator), the wreck was once a steamship that operated between various ports along the coast of the Gulf of Thailand. Artefacts recovered from the site during the Underwater Archaeology Division's (UAD) original survey suggest that the vessel sank after 1917, although the precise details of the sinking are not known.

As well as the characteristics of the wreck site, the prevailing environmental conditions are an important consideration in the choice of the site. However, the details of the discovery and description of the wreck site itself (other than what is necessary for dive safety) are not provided to the students prior to the project. It is expected that students will assess the condition of the site based on their own observations, as well as learning about the discovery and likely origin of the wreck from local sources. Students should use Appendix E: *Management Plan for the Mannok Wreck Site* as a guide to the information required.

2 Environmental Conditions and Site Description

The wreck lies in 20 metres of water, several miles off the coast of Mannok Island in the Gulf of Thailand. As the site is located in unsheltered waters it is subject to sea swells and although the underwater currents are not strong, some students have commented that they experienced difficulty staying in position over the drawing grids (planning frames). Visibility is usually between 5 and 10 metres, although this has been reduced on a few occasions.

The Mannok shipwreck (sometimes also called *Ruea Mail*, which means 'Mail Boat') is approximately 41 metres long, 6.5 metres wide and is relatively two dimensional, rising from the sea bed at a height of no more than 1.5 metres.

The bow section of the vessel is clearly visible and forms a 'triangle' of integral structure from the stem to a bulkhead running across the vessel and is largely covered with fishing nets. There are frames running down both the port and starboard side and side plating is also visible, particularly on the starboard side.

Between the bow and the middle section of the site, there are substantial breaks in the side outline of the vessel on both port and starboard sides up until approaching midship, at which point the framing and side plating resumes.

Although the main structural features are metal, in the flat section of the wreck, between the bow and the boiler, there are parts of what is likely to be the original wooden deck, as well as evidence of possible cargo and the ship's fixtures and fittings.

At the approximate centre of the Mannok shipwreck there is the remains of a single steam boiler, the top of which has been badly damaged, revealing what is left of the steam pipes and stays. Although the circumferences of the boiler ends are incomplete, it is still easy to identify them when approaching from bow or stern, but not so easy when directly overhead.

To the stern and sides of the boiler there are scattered parts of the engine, as well as other parts of the vessel and cultural objects. Behind the boiler on the starboard side, there is evidence of a lower metal deck or engine room walkway.

The vessel's stern frame and arch above the propeller are visible, as is the top few centimetres of the rudder, the back edge of which faces forward on the port side. The propeller is not visible, so its presence cannot be confirmed without some excavation.

Throughout the shipwreck there is evidence of damage caused by salvage and fishing activity. There are numerous clusters of rocks netted or tied together, acting as net weights or as simple anchors. Large fish traps have also been found. The site is also a popular recreational dive site, but the direct impact of this activity is difficult to quantify.

The partly two and partly three dimensional nature of the wreck site, recognizable structural components, ship's fixtures, cultural material and the impact of the activities noted above, all combine to provide a realistic challenge for students.

3 Project Organisation: Selecting Teams

On previous courses it was convenient to divide the students into three teams, with each of the teams being given the task of assessing, either the bow, middle or stern sections of the wreck. However, this decision is dependent on the number of diving students and their level of diving experience and, therefore, shouldn't be assumed to be the only option.

As well as the student's diverse professional backgrounds, their diving experience is also varied. Typically the courses have included those who have only recently completed their diving training, scuba diving instructors, ex-military divers, experienced underwater archaeologists and archaeological technicians.

Prior to the diving project, the only opportunity to assess individual diving abilities (apart from what is recorded in their resumes) is during the practical session held in Unit 2: *Back to Basics: Introduction to the Principles and Practice of Foreshore and Underwater Archaeology*. Therefore trainers and technicians need to be observant and to make a provisional assessment during this exercise. During the previous Foundation Courses in Thailand the Underwater Archaeological Division (UAD) of the Fine Arts Department was responsible for the logistics of and safety during the diving.

The aim of the team selection is to achieve a balance of diving and professional skills within each team, while also taking into account the possibility of language issues, bearing in mind that the level of proficiency in English is also variable. It has been necessary to keep nationals together to enable better team communication, but selecting teams by nationality is not a priority criteria.

During the initial two diving days of the project, students are given the opportunity to familiarize themselves with their diving equipment and the wreck site. Students are encouraged to make initial observations or sketches of parts of the wreck site, (dependent on their level of diving skill and confidence), but the task loading is kept deliberately low. During the previous courses, each student buddy pair has been accompanied by a UAD dive technician, providing safety backup.

It is recommended that the team selection is made definitive after the first two days of the project when there has been an opportunity to see everyone in action.

If the option to divide the wreck site into sections is adopted, it is important to remind the teams that they need to coordinate their tasks with each other, to ensure that the surveys can be joined together to form a single site plan.

3.1 Non-Divers

It is expected that there will be at least one non-diving course student. Non-divers can be given several tasks, nominally under the title of 'Data Manager'. The main and most important task is to ensure that each day the archaeological logs are completed, collated and added to the site archive. The logs can either be completed on the diving vessel or in the evening, but must be completed the same day.

Other tasks assigned to non-divers include:

- *Be the liaison between the teams and the support team*
- *Helping colleagues prepare for diving and the underwater tasks*
- *Learning about scuba diving*
- *Log keeping*

4 First Day Project Briefing

Each day (usually before leaving the quayside) there is a safety and project briefing. It is essential that all those associated with the project are present, including students, trainers and those responsible for the diving.

The briefing on the first day includes a few additional points and is, therefore, likely to be longer than normal. The briefing enables all relevant topics to be explained in detail and gives everyone the opportunity to ask for clarification of any point that is not fully understood.

The following points are specific to the first day briefing:

- *Introductions to the diving support vessel's crew*
- *Responsibilities and roles of students, trainers and those responsible for the diving*
- *Introduction to the on-board medic*
- *On-board routines, e.g. safety equipment and the use of water for showers*
- *Meal arrangements*

Safe diving practices (reminders are also given during the daily briefings):

- *Kitting up*
- *Buddy checks*
- *Signals*
- *In water safety routines, such as what to do if separated from a buddy or in the event of equipment failure*

4.1 Daily Briefing

Ideally, a white board is used to display the expected surface conditions and dive parameters that are updated daily by the dive supervisor. A sketch of the site on the white board is used to illustrate the main features of the wreck site to help orientation.

The daily briefing includes:

4.1.1 Environmental Conditions

- *Wind speed*
- *Sea state*
- *Underwater current*
- *Dangerous marine animals*
    - *Spiny sea urchins*
    - *Moray eels*
    - *Jelly fish*
    - *Stone fish*

4.1.2 The Diving Routine

- *Maximum bottom time*
- *No stop time*
- *Safety stop*
- *Buddy dive teams (students, trainers and safety teams)*
- *Minimum surface interval time*
- *Position of ascent and descent lines*

4.1.3 Project Briefing

The trainers are responsible for providing students with both a general update for the benefit of the entire team and any additional advice to the teams that may be required. They must also ensure that individual team surveys are coordinated, so that they can be merged into one overall site plan.

LEFT: Project briefing. © Martijn R. Manders

ABOVE: Diver informing the dive supervisor and log keeper before diving. © Christopher J. Underwood

BELOW: Dive log keeping: an important task for non-divers. © Christopher J. Underwood

TOP LEFT: Diver using a drawing grid to record the site source.
© UAD/A.Kiewmas

TOP RIGHT: Divers fixing the baseline for the survey of the Mannok Island wreck. © UAD/Apakorn Kiewmas

ABOVE: Divers recording structure of the Mannok Island wreck.
© UAD/Apakorn Kiewmas

Other daily reminders and considerations:

- *Daily medical issues and checks*
- *Do not dive if feeling unwell, anxious or for any other reason*
- *Notifying the dive supervisor and log keeper before diving and on returning to the dive boat after the dive*
- *Dive times and dive tank contents (bars) are recorded*

Depending on the day to day requirements of the team, it may be necessary to mention additional factors, such as the use of a small boat that is sometimes required.

Each team should provide:

- *A daily update on the progress of each team*

4.1.4 After Diving

Once the daily dives are complete it is essential that each of the students do the following:

- *Disassemble the dive equipment*
- *Wash dive equipment in the freshwater tubs*
- *Store the dive equipment in the changing area on the rear deck*
- *Complete the daily project dive log*
- *Relax*

4.2 End of Day Debrief

At the end of each day spent diving, it is important that the trainers debrief the students. This usually takes place at the quayside before leaving the boat.

4.2.1 Summary of the Project Progress

The debrief should summarize the progress made on the project and remind students about the daily tasks that include:

- *Complete project logs (personal dive logs and description of tasks done)*
- *Develop the management plan*
- *Plan the next day's tasks*
- *Organize buddy teams*
- *Practice using equipment, such as the survey software (Site Recorder)*
- *Country presentations (a short presentation about the cultural heritage of each country represented on the course)*

4.2.2 Planning the Following Day's Dive Tasks

Once debriefed, the dive tasks for the following day should be planned. Decisions must be made regarding:

- *What tasks need to be done*
- *How many divers are required for each task*
- *Role of each diver*
- *If anybody is needed to help with the task*
- *What equipment is required*
    - *Measuring tapes*
    - *Drawing boards, pencil (dive slates)*
    - *Drawing grids (planning frames)*
    - *Profile bars*
    - *Who is going to carry the equipment*

5 Setting up the Site

Although other options are possible, in previous Foundation Courses a baseline has been laid from the stern frame to the stem to facilitate the survey. The baseline also provides a convenient method of orientation around the site. Usually the dive technicians are responsible for laying the baseline and where necessary, placing and recovering other equipment on the site.

6 Project Task and Skill Development

Students are provided with an opportunity to continue to develop their professional skills and to gain valuable diving experience on a wreck site, under the guidance of the trainers and dive technicians.

During the project students will practice:

- *Freehand drawing*
- *Offset survey*
- *Ties and trilateration survey*
- *Direct Survey Method (DSM)*
- *Vertical profiles*
- *Drawing grid (planning frame)*
- *Wreck site assessment*
- *Interpretation of structural components of a metal shipwreck*
- *Use of Site Recorder*

7 Project Archive

Each diver is expected to complete an archaeological log, recording the objectives and results of the dive. This log creates a project archive for each section of the site, which will be merged together at the end of the project.

8 Introduction to the Storyboards

One objective of the diving project is to create storyboards that can be used for display purposes. By creating storyboards, students make the transition from using data and information gathered by them for scientific use, to bringing the story of the site to life for the wider public. From the information gathered during the diving project, the group has to prepare a series of storyboards and final presentations about the wreck site they have been working on.

Unit Summary

The diving project is a major component of the Foundation Course and objectives, such as the development of the management plan and museum storyboards, are dependent on its success.

Trainers need to help students remain focused on these goals, particularly as the daily diving routine is tiring. Despite the rest days, some students will struggle to dive every day and complete all of the associated non-diving tasks. The project follows the trajectory of a normal archaeological project, with the daily changes to environmental conditions on the wreck site contributing to the ebb and flow of the project's progress. Occasionally days are lost through bad weather or when the underwater visibility becomes poor, which inevitably has an impact on the work schedule.

The project is also important in continuing the development of teamwork, which is such an important aspect of fieldwork. During previous courses students have generally excelled in this area, but nonetheless trainers need to be vigilant and ready to intervene if team relationships show signs of strain.

Students tend to enjoy this part of the Foundation Course, as its realistic challenges and experiences give them a tremendous base on which to build when they return to their respective countries.

Suggested Timetable

Time as arranged	Meet on the project vessel
30 mins	Briefings - *Safety briefing* - *Medical issues* - *Task briefing* - *Other as required*
	Leave for the dive site - *Breakfast* - *Teams prepare their dive equipment and review their dive plans.*
	Arrive on site - *Ascent/descent lines are attached to the wreck by the supporting team*
120 mins	First dive by each of the student teams
90 mins	Surface interval - *Lunch*
120 mins	Second dive by each of the student teams
	Leave the site and arrive at the harbour
30 mins	De-brief - *Student teams give updates of their day's progress* - *Trainers give a review of the day's activities* - *Review of medical issues* - *Reminder about the evening tasks* • *Complete project logs* • *Develop management plan* • *Plan the next day's tasks* • *Organise buddy teams* • *Practice using Site Recorder* • *Country presentations*

Teaching Suggestions

Prior to beginning of the practical diving, trainers must provide students with a one hour introductory lecture. The lecture must cover the following broad topics:

Objectives of the fieldwork

- *Practice site assessment and survey techniques*
- *Development of a management plan for the Mannok wreck site*
- *Collect information and images for storyboards*

Introduction to the wreck site

- *General site characteristics, such as environment (depth, normal range of visibility, dive times, etc.)*

Daily routines

- *Dive equipment*
- *Briefing, dive planning, etc.*
- *Safety considerations*

Suggested Reading: Full List

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UNESCO. 1996. *Scientific Diving: A General Code of Practice,* Second Edition. Flemming, N.C. and Max, M.D. (eds.). Best Publishing Co.

United States Naval Sea Command. 2008. *United States Navy Diving Manual, Revision 6,* 5 Volumes.

Useful Websites

- *Divers Alert Network (DAN):* ***www.alertdiver.com***
- *Scientific Diving Supervisory Committee:* ***www.uk-sdsc.com***

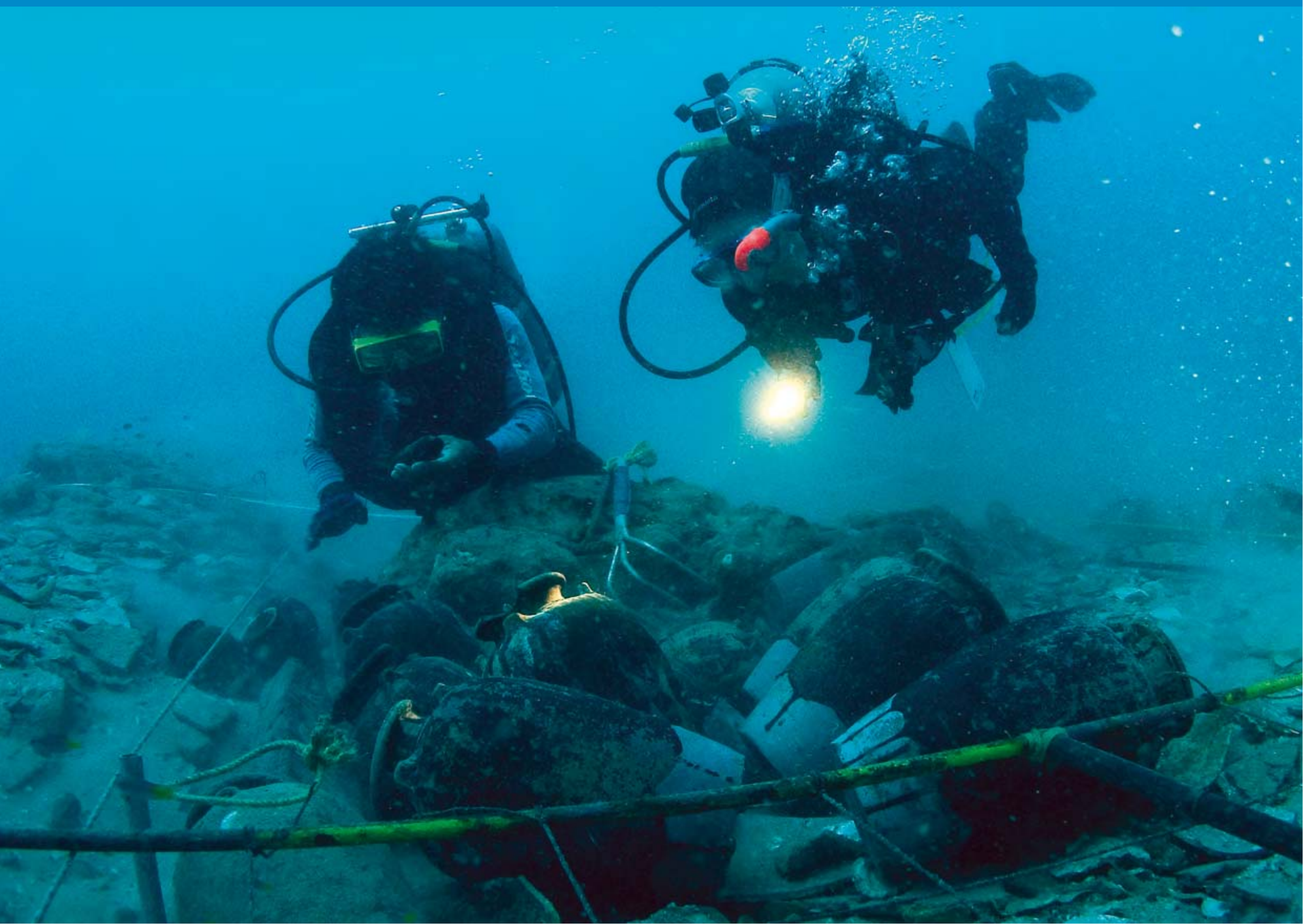
United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 13

Author Bobby C. Orillaneda

Asian Ceramics



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UNIT 13

Contents

UNIT 13

Author Bobby C. Orillaneda

Asian Ceramics

Core Knowledge of the Unit

This unit provides students with an introduction to the subject of Asian Ceramics and its importance in understanding maritime trade in the South-East Asia region.

Upon completion of Asian Ceramics unit, students will:

- *Understand the definition and basic classification of ceramics*
- *Be able to distinguish the types of Asian ceramics*
- *Understand the importance of ceramics in the interpretation of underwater archaeological sites*
- *Be familiar with the different types of shipwrecks in South-East Asian waters carrying ceramic cargo*

Introduction to the Unit

Although this unit focuses on Asian ceramics, it is important to note that some examples of the shipwrecks that contained Chinese and South-East Asian ceramics were not excavated following modern archaeological procedures, and priority was often given to the recovery of ceramics for commercial purposes. This has led to a considerable loss of contextual information, not only about the ceramics themselves, but also of the ship's other equally important, non-commercial cargo and the ship itself. This lost information could have helped to further elucidate the overall story of the ship and its role in maritime history. Hopefully, to prevent this being repeated, future maritime archaeology projects in the Asian region will focus more on the entire ship and its material assemblage, and follow the guidelines set out in the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001).

1 What are Ceramics?

The term ceramics is believed to be derived from the Greek word *keramikos*, which is said to have originated from the Indo-European word *ker*, meaning heat. It is produced as clay is transformed through heat, producing hard and durable products. The earliest ceramic artefacts in the archaeological record were fired clay figurines, found in the site of Dolni Vestonice in the Czech Republic some 26,000 years ago. It is hypothesized that the production of ceramics is related to the transition of humans from mobile, wandering societies, to increased sedentism and food production in most parts of the world.

Although there are many types of ceramics found in different archaeological sites, this unit will focus only on four types of ceramics that are generally found in underwater sites in Asia.

Terra Cotta: fired to temperature of less than 900 ^{O}C, coarse and porous, usually red.

Earthenware: fired to temperature of 900 - 1200 ^{O}C, porous, often brown or red.

Stoneware: fired to temperature of 1200 - 1350 ^{O}C, porous, often brown or red.

Porcelain: fired to temperature above 1350 ^{O}C, with vitrified bodies, usually white and translucent.

2 Why do we Study Ceramics?

There are numerous reasons for studying ceramics:

- *In most archaeological sites ceramics represent the most abundant material remains, hence the primary type of artefact collected by archaeologists*
- *Past societies with different complexities have used ceramics as utilitarian items, such as food preparation, cooking and storage vessels*
- *Ceramics reflect human behaviour, as objects often are an expression of human creativity, craftsmanship, ceremonies and rituals*
- *Ceramics are also used for exchange, trade and other commercial activities*
- *In some societies, ceramics are symbols of power and economic prestige*
- *Ceramics are important barometers for establishing temporal chronology and determining geographical distribution*
- *For maritime archaeology, ceramics reveal an abundance of information on many aspects, such as maritime trade patterns, maritime routes and migration*

To obtain the most comprehensive data on ceramics, archaeologists perform four types of analysis:

2.1 Experimental studies: these consist of controlled experiments used to replicate how ancient ceramic objects were produced. From these studies, archaeologists gain valuable information on firing techniques, firing temperatures and the properties of various tempers, glazes and paints. In addition, archaeologists also make ethnographic observations of pottery production by extant societies to understand the manufacture, use and reuse of pottery.

2.2 Form and function analysis: studies the various ceramic shapes and how they were used. It is based on the assumption that form follows function. However, there are many factors that need to be considered, which make this analysis very complex. Despite these considerations, this type of analysis can be very effective in learning the production, consumption and distribution aspect of human economic behavior when conducted well.

2.3 Stylistic analysis: examines the different decorative styles of ceramic vessels in the form of under and over glaze painted designs, pre and post-firing incising, pre-firing embossing, appliques and other surface treatments. One of the results of this kind of study is the formulation of classification systems that can trace social change through time.

2.4 Technological analysis: focuses on the materials from which ceramic objects are made. The clay's chemical composition and tempering materials are studied. The objective for this type of analysis is to know the provenance or source of the clay used, to determine origin, production, use, route and the final destination of ceramic vessels. This is important, as they were often used as utilitarian, exchange, and trade vessels by different early societies. The technological analysis examines the trace element of the clay and temper and is conducted in a number of ways using different techniques, such as neutron activation analysis, X-ray diffraction and ceramic petrology.

Suggested Reading

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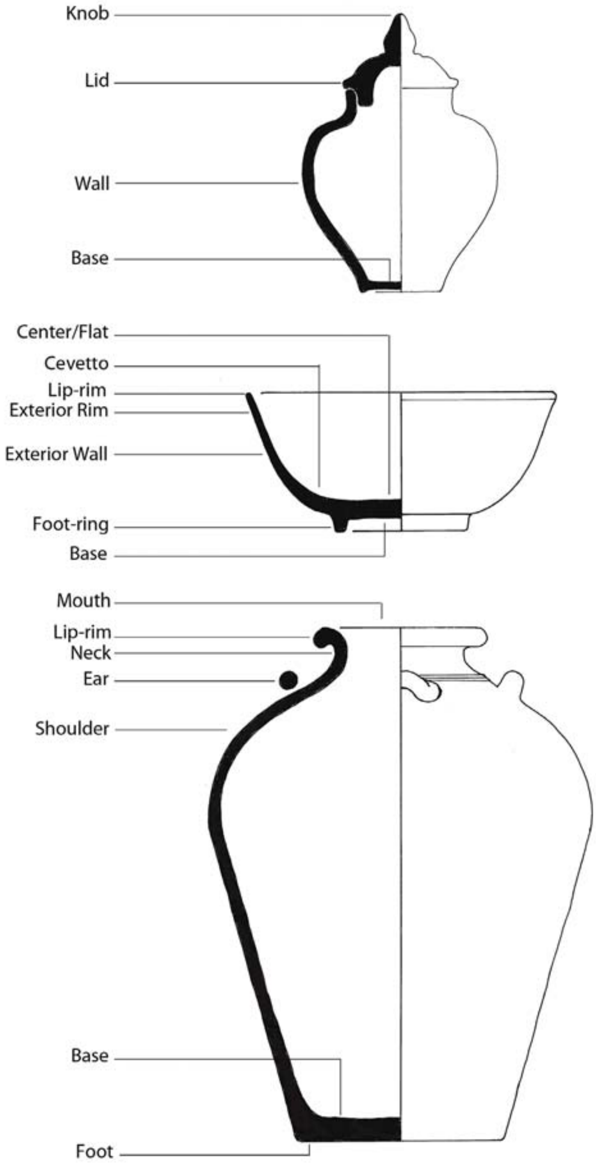
3 Ceramic Shape Terminology



Ceramic typology.
© Eduardo D. Bersamira

4 Ceramic Kiln Sites

There are four ceramic producing countries whose products are found in shipwreck sites in South-East Asia: China, Viet Nam, Thailand and Myanmar.

4.1 China

Ceramic artefacts have been produced in China since the Neolithic Period (5,000–2,200 BC) in the form of hand molded earthenware that were used as utilitarian and ritual vessels. Archaeological evidence shows that glazed pottery appeared during the Zhou Dynasty period (1,100–771 BC), but are most common during the Han Dynasty (206 BC–220 AD). High quality celadon wares in both glaze color and body clay were introduced during the Six Dynasties period (265–588 AD), alongside the production of glazed proto-porcelain.

The earliest types of Chinese ceramics discovered in shipwrecks in South-East Asia belong to the Tang Dynasty (609–960 AD). Most of the export wares were produced from the kilns in Changsha and Yueh, in the north of the country. During this period, three coloured (yellow, green and white glazes) wares of different forms (bowls, vases and figurines) were made. High quality greenwares or celadons with bluish green glaze were also perfected and attracted a great demand from overseas.

By the ninth and tenth centuries, new manufacturing sites in the Guangdong province supplied the overseas trade. Guangdong wares then dominated the market until the thirteenth century, when whiteware from Fujian and celadon wares from Zhekiang (Longquan kilns included) were also exported and competed for popularity. Thirteenth century cargoes also carried small amounts of ceramic wares from the inland potting centre of Jingdezhen, Jiangxi province, where the imperial porcelains of the Ming and Ching Dynasties would eventually be produced.

The blue and white porcelains were believed to have been first produced during the Yuan dynasty (1280-1367 AD), although early examples recovered from the Belitung shipwreck in Indonesia dated to the early ninth century. Early blue and whites were of poor quality due to the scarcity of imported cobalt from the Middle East. This culminated in the much appreciated blue and white wares produced in the Jingdezhen kilns in Jiangxi, during the Ming Dynasty period (1368–1644 AD) and the succeeding Ching Dynasty period (1644–1918 AD), that are found in so many archaeological sites and museum collections worldwide.

Ceramic production reached its peak during the seventeenth century, due to an increase in demand in Europe and an observed improvement in all types of ceramics, including the blue and whites, celadon, polychrome (multicoloured) wares, as well as the stoneware vessels. As the Qing Dynasty collapsed and trade patterns shifted, the production and export of Chinese ceramic wares decreased.

4.2 Viet Nam

The Vietnamese produced pottery as early as the first century BC in the Tonkin, Annam and Cochinching areas, during the Han conquest. However, Vietnamese ceramics only began to be exported sometime in the fourteenth century. Archaeological evidence from Japan shows that Vietnamese bowls were already in use there by about 1350 AD and these examples are similar to the type excavated from the Turiang shipwreck in Malaysia. At some point, Vietnamese potters introduced underglaze blue, perhaps in the late fourteenth century, during the early years of the Ming ban where the Chinese government internalized and forbade overseas trade, or else in the early fifteenth century when Viet Nam was annexed by China (1407-1427 AD).

There are currently two known kilns sites that produced ceramics found in various underwater archaeological sites outside Viet Nam. The Chu Dau kilns in the North and the BinhDinh kilns in central Viet Nam. The Chu Dau kilns are located in Hai Duong province and fourteen production centres have been archaeologically identified since 1983. A number of underglaze blue decorated wares have been produced in these kilns that have been found in a number of South-East Asian shipwrecks, starting from the late fourteenth century. The blue and whites are similar to Chinese design which suggest a Chinese influence or, as some scholars believe, the migration of Chinese potters into Viet Nam.

Archaeological surveys in the 1990s along the Con River in the BinhDinh province, identified five kiln complexes of which two kilns were excavated. These kilns were believed to have operated during the fourteenth and fifteenth centuries and only ceased production when the area was invaded by Viet military forces in 1471 AD. Examples of BinhDinh ceramic wares have been found in significant quantities in the Pandanan shipwreck and in burial sites in the Philippines, during the fifteenth and sixteenth centuries.

4.3 Thailand

The origin of glazed pottery in Thailand is still obscure. By the fourteenth and fifteenth centuries, however, sizeable potting centres were scattered across northern Thailand, most of them associated with former Thai states of that region. The Sukhothai kingdom supported two major export-oriented potting centres. Sukhothai, located in the ancient city of the same name and Sisatchanalai or Sawankhalok, located north of the city. Two other groups, from the Suphanburi and MaenamNoi (or Singburi) potting centres are known primarily from shipwrecks. Both of these kiln sites are located in central Thailand, not far from the former capital of Ayutthaya (1351-1767 AD). The Suphanburi potters made large majestic jars with stamped decoration round the shoulder. The MaenamNoi produced a variety of storage jars along with other sorts of utilitarian items. The Suphanburi kilns were active in the fourteenth and early fifteenth centuries, before they apparently closed. Only jars from the MaenamNoi complex are found on shipwrecks from the mid-fifteenth century onwards. A date for the end of production is elusive, but by the beginning of the seventeenth century neither Sukhothai nor Sisatchanalai ceramics appear in archaeological sites. The last of the kilns in the old Sukhothai kingdom may have finally closed during an invasion by the Burmese in the 1580s.

4.4 Myanmar

Archaeological excavations at Beikthano and Sri Ksetra in central Myanmar have yielded unglazed earthenware pots and jars dated between the fifth and ninth centuries. The earliest use of glaze was mentioned in the ninth century Chinese text *Man Shu* (Book of the Southern Barbarians), which referred to the seventh century kingdom of Piao, the capital of which was enclosed by a circular wall, faced with green-glazed bricks. This claim, however, has been disputed by a Chinese scholar who believes the reference has been misinterpreted and that the mentioned architectural objects were not glazed.

Buddhist structures dated from the tenth to late thirteenth centuries provide, the earliest archaeological evidence of glazing. Bricks and plaques with green-glaze adorning the exterior walls of these structures can be found in Bagan, in central Myanmar. By the fourteenth to fifteenth centuries, however, Myanmar potters had begun producing high fired stonewares in the form of big, brown-glazed storage jars commonly known as *martabans*, which were traded to South-East Asia and even the Middle East.

In the late 1990s, archaeologists unearthed hundreds of ancient kilns in the Twante District. Based on the green-glazed stoneware shards, misfired wares, discards and firing supports, it was concluded that the kilns produced greenwares. These are more commonly known as celadon. The wares were previously unidentified in terms of provenance and were thought to have been produced in Thailand, China or Viet Nam. Many of these wares have been found in South-East Asian shipwrecks, such as the Brunei, Lena Shoal and Santa Cruz shipwrecks.

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5 South-East Asian Shipwrecks with Asian Ceramic Cargo

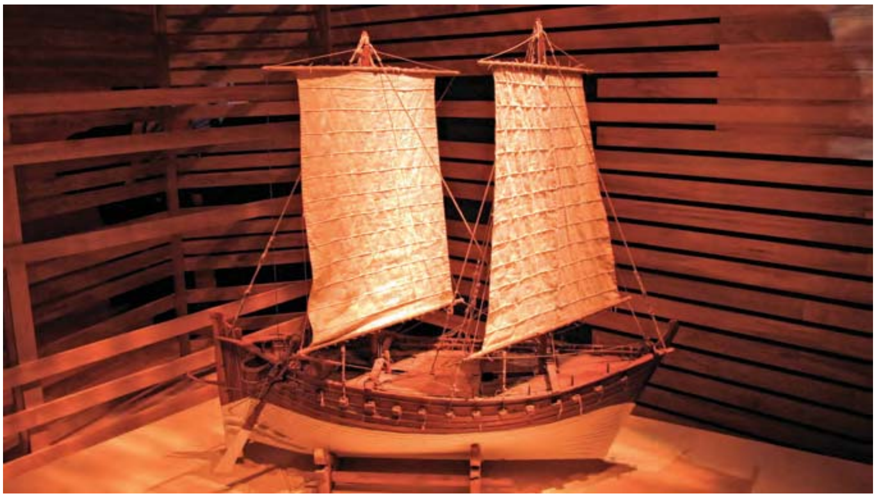
The remainder of this unit examines a selection of shipwrecks that were found in South-East Asia and carried significant amounts of ceramics as part of the ship's cargo. These wrecks have contributed knowledge on the production, trade and distribution of ceramics that forms a vital part of the maritime history of the region.

The list of shipwrecks is organized chronologically to track the current knowledge of entry and distribution of Asian ceramics, as they became part of international maritime trade. The number of shipwrecks included in this course is by no means complete and exhaustive and there are other shipwrecks that have been excavated that are not included. Furthermore, the summaries are very general and students are encouraged to read more on the appended references.

5.1 The Belitung Shipwreck *(826 AD), Indonesia*

The earliest shipwreck found that carried Chinese tradeware ceramics in substantial quantities is the Belitung shipwreck. The site was accidentally discovered by a sea cucumber diver in 1998, at a depth of 17 metres, just off the shore, north of the main town and port of Belitung Island, Tanjung Pandan. Excavations and salvage were carried out in 1998 and 1999 by a private company.

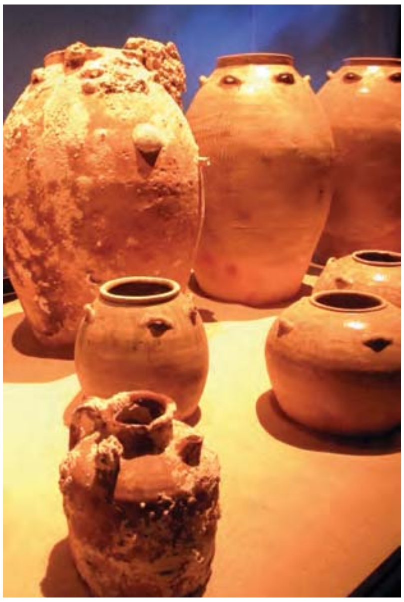
Based on the (limited) analysis of the ship construction, the Belitung wreck is similar to an Arab or Indian ship, as evidenced by the lashed and stitched boat construction, which contrasts the use of wooden dowels by South-East Asians and iron fastening typically used by Chinese. The ship was rendered watertight through extensive caulking, had a sharp bow with little rake, through beams stitched to the hull, removable ceiling planks, a keelson, stringers and the use of a composite iron and stone anchor. This is the first Arab or Indian ship to have been discovered in South-East Asia.



Belitung shipwreck model. © Bobby C. Orillaneda

The cargo comprised of some 60,000 trade goods. The majority of the cargo (98 per cent), comprised of Chinese glazed ceramics (that represent the major types of wares produced during the ninth century): Changsa wares from Hunan province, Yueh wares possibly from either Hunan or Zhejiang provinces, white wares possibly from Hebei province and green-splashed wares and coarse green stonewares from Guangdong province. The majority of the ceramics consisted of Changsa bowls that were produced in the kilns of Tongguan, Shizhu and Gucheng in the Hunan province. These wares were made during the latter part of the Tang Dynasty (618–906 AD), with the earliest piece bearing an inscription, 'the third year of Kaicheng', which is the equivalent to 838 AD. Chinese characters decorating one of the Changsa bowls have been interpreted as 'the 16^{th} day of the 7^{th} month of the 2^{nd} year of the reign of Emperor Jingzong' (or 16 July 826). Another bowl has three characters which interpret as 'the year 826'. Also recovered were the earliest examples of porcelains with underglaze blue decoration and a number of Chinese coins, produced between 618 and 626 AD, at the beginning of the Tang Dynasty.

Besides the ceramic cargo, gold and silver objects of high quality were also recovered that represent Tang period metal working examples. There were ten gold and twenty four silver vessels, eighteen inscribed silver ingots and thirty bronze mirrors.



LEFT: Belitung shipwreck green-splashed stoneware cups. © Bobby C. Orillaneda
MIDDLE: Belitung shipwreck stoneware jars. © Bobby C. Orillaneda
RIGHT: Belitung shipwreck Changsa bowls. © Bobby C. Orillaneda

LEFT: Belitung shipwreck blue and white dish.
© Bobby C. Orillaneda

BELOW: Cirebon shipwreck stoneware bowls.
© National Committee of Indonesia

BELOW MIDDLE: Cirebon shipwreck stoneware vase.
© National Committee of Indonesia

BOTTOM: Cirebon shipwreck stoneware boxes with lid.
© National Committee of Indonesia

This ship provides a very strong archaeological evidence for direct trade between the western Indian Ocean and China during the latter part of the first millennium, proving early Chinese and Arabic texts that mention the direct trade between China and the East.

5.2 The Cirebon Shipwreck

(1100s AD), Indonesia

In 2001 or 2002, local fishermen caught a number of ceramic pieces in their nets about 110 nautical miles off the coast of Cirebon, West Java. Preliminary investigations revealed a shipwreck with ceramic cargo. In 2004 and 2005, the site was salvaged by a Dubai based firm in collaboration with an Indonesian commercial company.

Approximately 500,000 pieces consisted mostly of Chinese ceramics (est. 75 per cent) dated to the Five Dynasties period, along with Near East and Indian glassware, gemstones (sapphires and rubies), a pair of gold daggers, utilitarian and ceremonial objects and other raw materials. The ceramic inventory consisted of Yueh bowls, plates and dishes, white wares, porcelain jars, vases, basins, boxes and ewers. A bowl with a date of 968 AD and coins from the Nan Han Period (917-942/971 AD) suggest that the ship sunk during the tenth century.

The Cirebon ship measured 31 metres long and approximately 10 metres wide. The ship was identified as a 'lashed-lug' vessel, based on a boat construction technique that uses wooden dowels and frames lashed onto *tambugu* lugs. The wood of the ship was identified to be found only in Sumatra and West Kalimantan and indicated the ship was locally built.

5.3 The Nanyang Shipwreck *(ca. 1380 AD), Malaysia*

The Nanyang shipwreck was found 10 nautical miles from Pulau Pemanggil, at a depth of 54 metres below sea surface level. The wreck was found to be carrying the earliest examples of Sisatchanalai celadon plates from Thailand. The plates have distinctive spur marks on the centre, which is a characteristic of early Sisatchanalai plate production. The spur marks are scars in the glaze caused by the tiny feet of disc-shaped spacers that were used to separate stacked plates in the kiln. Besides the Sisatchanalai celadon plates, there were large storage jars from the Suphanburi kilns, as well as celadon bottles, jars, jarlets and small jars from the MaenamNoi kilns. Both kilns are located in central Thailand.

The ship (which measures 18 metres long and 5 metres wide) is an early example of hybrid South China Sea shipbuilding traditions and incorporates both Chinese shipbuilding techniques (bulkheads), with the South-East Asian technique of using wooden dowels in joining planks. The construction of the ship suggests the possible migration of Chinese shipbuilders to South-East Asia as a result of the Ming ban.

5.4 The Longquan Shipwreck *(ca. 1400 AD), Malaysia*

The Longquan shipwreck belongs to another South China Sea shipbuilding tradition. It was found at a depth of 63 metres, approximately 23 nautical miles from the nearest landmass of eastern Malaysia. The ship measures 30 metres long and 8 metres wide.

Discovered in 1996, the wreck was subjected to a preliminary investigation that revealed a ceramic cargo mixture of Chinese celadon and Sisatchanalai celadon, underglaze black Sukhothai wares and storage jars from Suphanburi kilns of Thailand. Initial estimates were 40 per cent Chinese, 40 per cent Sisatchanalai and 20 per cent Sukhothai. The ceramic cargo is notable for its high quality and the absence of underglaze blue and white porcelain.

The shipwreck was not fully investigated due to its great depth and the similarity of the ceramic wares to those found in other Malaysian shipwrecks investigated earlier (Turiang and Nanyang). In 2001, the site was visually rechecked by scuba divers, which revealed the site's total destruction by fishing trawlers. This shows the priority often given in the Asian region to investigate and recover ceramics and other objects with commercial value, while less attention is paid to the ship's construction and its historical and archaeological significance. This is partly due to the immediate human threat from looting and the destruction arising from the worldwide demand for Asian ceramics.

LEFT: Longquan shipwreck Thai celadon bottle. © Sherman Sauffi
RIGHT: Longquan shipwreck Thai dish with underglaze black. © Sherman Sauffi

5.5 The Rang Kwien Shipwreck *(1400–1430 AD), Thailand*

Also known as the Chinese Coin wreck for its large amounts of Chinese coin cargo, the Rang Kwien wreck was found 21 metres below sea surface level in the KoKhram Channel. The wreck was located about 800 metres from the Rang Kwien islet which is 10 kilometres west of the Bangsare district in the Chonburi province.

Rang Kwien shipwreck Chinese celadon bowl. © Bobby C. Orillaneda

The site was archaeologically excavated by the Fine Arts Department of Thailand from 1978 to 1981. The South-East Asian Ministers of Education Organization Project in Archaeology and Fine Arts (SEAMEO-SPAFA) sponsored another excavation in 2003 as a training venue for an underwater archaeology workshop for South-East Asian archaeologists. Besides the Chinese coins that dated to 1398, the wreck contained elephant tusks. Approximately 264 ceramic pieces were recovered, of which 50 per cent possibly came from Thai kilns. About 28 per cent are Vietnamese transitional ceramics and 10 per cent are Chinese wares that include storage jars. Ten Suphanburi storage jars, nine Sawankhalok vessels and one plate from the northern Thai Sankampaeng kilns were also recovered.

The wreck's wooden remains included the keel, planks from the hull, ribs and the carved decorated pieces for the after deck. The vessel was constructed using the even-edged-joined technique and contained roundhead wooden pegs to fasten planks to ribs. No bulkheads were observed that would indicate a South-East Asian vessel.

5.6 The Ko Khram Shipwreck *(1450–1475 AD), Thailand*

Alternatively called the Sattahip site, this wreck was found in the Ko Khram Channel that faces Sattahip Bay, Chonburi province, at a depth of 38 to 43 metres. Systematic underwater archaeological surveys and excavations in 1975 and 1979 were carried out by the Fine Arts Department of Thailand in cooperation with the Royal Thai Navy.

Structural remains included wooden planks from the hull that contained thirteen bulkheads and ribs. The vessel was built using an even-edge-joined building technique with a double-planked hull. Wooden pegs and bolts were used to hold the planks together. The cargo walls were fastened to the wooden floor planks with iron nails, while split bamboo flooring lined the floor. Presumably, the Sattahip vessel is a flat junk and has no keel. Radiocarbon analysis yielded two conflicting dates: 1520±140 and 1680±270.

Thai ceramics from the Sukhothai and Sawankhalok kilns account for almost two-thirds of the cargo. These included celadon bottles, bowls, dishes and jarlets from Sawankhalok and underpainted fish plates and bowls from Sukhothai. A smaller number of Vietnamese wares, such as a blue and white jarlet and green-glazed saucers with an unglazed ring in the inside centre, were identified in 1975 by Roxanna Brown, a noted South-East Asian ceramic specialist, as probable Cham.

LEFT: Ko Khram shipwreck Thai celadon dish. © Bobby C. Orillaneda

RIGHT: Ko Khram shipwreck Vietnamese celadon bowls. © Bobby C. Orillaneda

5.7 The Pandanan Shipwreck *(ca. 1450 AD), Philippines*

A pearl farm diver accidentally discovered this wreck at a depth of 40 metres, some 250 metres from Pandanan Island, southern Palawan. A preliminary survey was done in 1993 and subsequent archaeological excavations were carried out from February to May 1995. The entire archaeological project was realized through a joint effort between the National Museum of the Philippines and a private company, Ecofarm Resources Inc.

ABOVE LEFT: Pandanan shipwreck Vietnamese bowl in storage. © National Museum of the Philippines

ABOVE RIGHT: Pandanan shipwreck blue and white bowl in storage. © National Museum of the Philippines

LEFT: Pandanan shipwreck Vietnamese blue and white dish in storage. © National Museum of the Philippines

The excavation recovered 4,722 archaeological materials. The ceramic assemblage of the Pandanan shipwreck consisted of a vast array of Vietnamese, Thai and Chinese wares. Vietnamese export wares in the form of celadon bowls, blue and white bowls and dishes, cups, saucers, blue and white jars and stoneware jars, made up more than 70 per cent of the ceramic load. Most of these were manufactured in the BinhDinh region, central Viet Nam, while a lesser number were produced in northern Viet Nam. Most of the blue and white porcelain pieces were identified as belonging the Chinese early Ming period, specifically to the Interregnum Period (1436–1464 AD). The Thai wares were from the Sawankhalok and Sukhothai kilns. Other archaeological materials included glass beads, earthenware pots, a stove, metal artefacts, such as bronze gongs, iron cauldrons, small cannons and sharpening or grinding stones.

On the basis of a Chinese copper coin ascribed to the Yong-Le period (1403-24AD) and the latest ceramic pieces, a fifteenth century date for the Pandanan shipwreck was assigned. It is also believed to be a South-East Asian trading ship (probably Indo-Chinese), measuring approximately 25 to 30 metres long and about 6 to 8 metres wide.

5.8 The Royal Nanhai Shipwreck *(ca. 1460 AD), Malaysia*

ABOVE LEFT: Pandanan shipwreck Vietnamese stoneware jar in storage. © National Museum of the Philippines

ABOVE RIGHT: Pandanan shipwreck Vietnamese blue and white jar in storage. © National Museum of the Philippines

BELOW: Royal Nanhai shipwreck Thai celadon dish. © Sherman Sauffi

In 1995, a shipwreck measuring 28 metres long and 8 metres wide was discovered 40 nautical miles off eastern Malaysia, at a depth of 46 metres. This South China Sea shipbuilding tradition type of vessel was named Royal Nanhai, after Nanhai, the old name of the South China Sea. Sisatchanalai celadon in the form of bottles, dishes and jars comprised the bulk of approximately 21,000 ceramics, along with lesser quantities of brown-glazed Chinese bowls, jarlets and black-glazed storage jars from the MaenamNoi kilns of central Thailand.

The date of the Royal Nanhai was based on five Chinese blue and white bowls that were found in a hidden compartment beside the keel. The blue and whites were identified as belonging to the reigns of Chinese emperors Jingtai and Tiensun of the Interregnum period (1450–1464 AD). Besides the blue and white porcelains, a green-glazed Chinese bowl, two Vietnamese blue and white covered boxes, as well as a red and black lacquer box, an ivory sword handle and a bronze seal were also found.

5.9 The Ko Si Chang III Shipwreck *(1460–1487 AD), Thailand*

The Ko Si Chang wreck measured approximately 20 metres long and 6 metres wide, and was found at a depth of 24 metres, about 5.9 nautical miles from the northern end of the island of Si Chang. Members of the Australian Institute of Maritime Archaeology (AIMA) and the Underwater Archaeological Division (UAD) of the Fine Arts Department of Thailand, systematically excavated the wreck in 1986. Trainees of the SEAMEO Project in Archaeology and Fine Arts (SPAFA) also participated in the excavation as part of their training in underwater archaeology. Results revealed a small trading vessel transporting mainly provisions, such as resin, eggs, etc. A radiocarbon date 1410±70 was given to the wreck.

The ceramic cargo retrieved comprised mostly of Thai ceramics, followed by Vietnamese and Chinese wares. The main ceramic items found on this site were Thai stoneware storage jars, lids, possible Sukhothai bowl, a brown-glazed jarlet from Sisatchanalai, an ovoid bottle, kendis and jarlets of probable Chinese or Vietnamese origin. Earthenware pots and a stove were also recovered. Other associated materials include metal objects, such as copper and lead ingots and bronze lime pots, Areca nuts and elephant tusks.

TOP LEFT: Ko Si Chang III Thai large stoneware jar. © Bobby C. Orillaneda
TOP RIGHT: Ko Si Chang III Thai stoneware jar. © Bobby C. Orillaneda
ABOVE: Ko Si Chang III stoneware lids photo. © Bobby C. Orillaneda

5.10 The Santa Cruz Shipwreck *(1488–1505 AD), Philippines*

The Santa Cruz shipwreck is a late fifteenth century trading vessel discovered off the waters of Santa Cruz municipality, Zambales province, Northwest Luzon. Subsequent underwater archaeological excavation in 2001 by the National Museum of the Philippines and the Far Eastern Foundation for Nautical Archaeology (FEFNA), a private research outfit, revealed a wooden vessel in a remarkable state of preservation with a predominantly ceramic cargo. Blue and white wares, celadons and stoneware jars from China, Viet Nam, Thailand and Myanmar constitute about 98 per cent of the total cargo. Stylistic analysis of the ceramics puts the date of the Santa Cruz wreck during the Hongzhi period of the Ming Dynasty (1488-1505 AD). Other materials recovered include earthenwares, iron cauldrons and iron and bronze implements, glass and carnelian beads, ornaments, such as glass and bronze bracelets, weaponry, such as guns and small cannons, and organic and inorganic remains.

Research on this shipwreck and its ceramics was conducted by the author for his master's thesis. The research revealed the ship's importance in addressing questions regarding long distance ceramic trade during the end of the fifteenth century, an important period immediately preceding the European arrival in South-East Asia. It provides background on the Chinese and South-East Asian ceramic trade during the early period of the Ming Dynasty (1368–1644 AD), where foreign trade prohibitions restricted the outflow of Chinese export ceramics and also shows the participation of other South-East Asian ceramic producing countries, such as Thailand and Viet Nam and Myanmar in the regional ceramic trade. Finally, it also elucidates the role of the Philippines in this vibrant maritime trade.

TOP: Santa Cruz shipwreck site. © FEFNA/Franck Goddio
MIDDLE: Santa Cruz shipwreck site. © FEFNA/Franck Goddio
ABOVE: Santa Cruz shipwreck ceramics from China. © FEFNA/Franck Goddio

5.11 The Lena Shoal Shipwreck *(1488 – 1505 AD), Philippines*

The Lena Shoal wreck was discovered in February 1997 by a group of fishermen on the northwestern side of Busuanga Island, northern Palawan. The wreck and its cultural deposits lie 48 metres below sea surface level. Using the local hookah system, the fishermen looted the site, retrieving porcelain blue and white wares and stoneware jars that were sold to antique dealers in Manila.

After preventing further looting activities and reconnaissance dives at the site, archaeological excavation commenced with the National Museum as the lead proponent in collaboration with the Far Eastern Foundation for Nautical Archaeology (FEFNA).

BOTH IMAGES: Lena Shoal ceramics and Chinese celadon on-site.
© FEFNA/Franck Goddio

The site yielded 6,958 archaeological specimens, including a significant portion of ceramic cargo dated to the Chinese Hongzhi Dynasty period (1488–1505 AD). Blue and white porcelain, celadon and stoneware jars of different morphology and styles were found alongside earthenware, bracelets, bronze gongs, elephant tusks, lead and iron ingots. The hull, measuring 18.3 metres long and 5 metres wide, was remarkably intact due to the accumulation of iron ingots and the sand overburden that protected the wood from further deterioration. Examination of the ship building technology revealed the Lena Shoal wreck to be a trading vessel that was constructed using an edge-pegged plank measuring approximately 24 metres long, with a tonnage of 100 tons.

Lena Shoal Chinese celadon. © FEFNA/Franck Goddio

5.12 The Brunei Shipwreck *(1488–1505 AD), Brunei*

The Brunei shipwreck was discovered by Elf Petroleum Asia during an oil exploration survey in 1997, some 40 kilometres off the coast of Brunei. Systematic archaeological excavations were conducted from May to August 1998, involving more than 130 specialists from all over the world.

The excavations yielded about 13,500 artefacts composed mainly of high-fired blue and white and stoneware trade ceramics from China, Thailand and Viet Nam, that were dated to the Hong-zhi period (1488–1505 AD) of the Chinese Ming Dynasty. It is interesting to note that no physical remains of the wreck were unearthed. This is the first wreck found inside the territorial waters of the Sultanate of Brunei and are exhibited in the country's only maritime museum. Together with similar ceramics that have also been archaeologically recovered on coastal and terrestrial sites in Brunei, it provides some inconclusive evidence that Brunei was a trading centre during the fifteenth century.

Brunei shipwreck blue and white ceramics on exhibit at the Brunei Maritime Museum. © B. C. Orillaneda

5.13 The Xuande Shipwreck *(ca. 1540 AD), Malaysia*

The Xuande site was named after five blue and white dishes and one blue and white ewer found as part of the ceramic cargo that bore reign marks of Chinese emperor Xuande (1426–1435 AD). The wreck was found in 1996, approximately 60 nautical miles from the nearest land. Besides the blue and white porcelains, covered boxes in underglaze black, jarlets with brown-glazed spots from the Sisatchanalai kilns were found, alongside bowls decorated with chakra and starburst motifs from Sukhothai kilns. This shipwreck illustrated the reappearance of blue and white Chinese porcelains in the South-East Asian trade and the corresponding decline of Thai and Vietnamese ceramic exports.

After further research of the ceramics and other shipwreck related objects, such as the cannons, it was revealed that the shipwreck was 100 years younger than previously assumed. The porcelains from the Xuande reigns were actually copies made by potters who worked during the reigns of later Chinese emperors. The cannons were thought to have been produced no earlier than 1520 AD, which dates the Xuande site to the middle of the sixteenth century.

It is remarkable to note that no shipwreck fragments were found at the site, although it was estimated based from the mound, that the shipwreck could have measured 28 metres long and 8 metres wide.

5.14 The Wanli Shipwreck *(1573–1620 AD), Malaysia*

This shipwreck was named after its predominantly Chinese ceramic cargo that consisted of blue and white porcelains produced during the reign of Chinese emperor Wanli (1573–1620 AD). A fisherman inadvertently discovered this wreck in 1997, after a large blue and white bowl was snagged in his trawler net. The site was investigated in 2004 and resulted in the discovery of the shipwreck at 40 metres below sea surface level, approximately 6 nautical miles off Tanjong Para, in the state of Terengganu.

Extensively damaged by fishing trawlers, nine tons of broken ceramic pieces were recovered from the site. The porcelains were identified to be 'Kraak' wares, manufactured in the kilns of Jingdezhen. Further research in Jingdezhen discovered similar ceramic wares in the Guanyinge kiln site.

The ship itself was approximately 17 metres long and constructed with a ribbed framework, suggesting a European style of shipbuilding. However, the wood used was a tropical type most frequently found in the Philippines and India. The outermost planks were made from a temperate species that grows in China or Europe. Therefore, it appeared that this is a European type vessel which had been built in South-East Asia or India and had later additional 'sacrificial' planks added in China to compensate for woodworm damage.

Wanli shipwreck Chinese blue and white dish. © Sherman Sauffi

The Wanli ship sailed during an interesting period in history. It was during this time that Europeans actively participated in Asia's maritime trade, distributing an array of products for different markets. It is believed that the Kraak wares were primarily destined for Europe, while others could be traded in local South-East Asian markets.

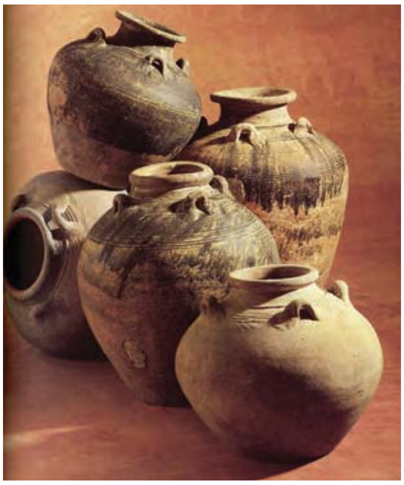
Wanli shipwreck Chinese blue and white double guarded bottle. © Sherman Sauffi

5.15 The *San Diego* Shipwreck
(14 December 1600 AD), Philippines

The *San Diego* was a Spanish warship that sunk during a battle with the Dutch vessel *Mauritius* on 14 December 1600, off the waters of Nasugbu in the Batangas province, southwest of Luzon. The survey and excavation of this shipwreck has been a seminal undertaking between the Underwater Archaeology Section of the National Museum of the Philippines and the European Institute of Underwater Archaeology (IEASM).

Wanli shipwreck Chinese blue and white kendi. © Sherman Sauffi

Archival research on the possible location of the site was conducted in the libraries and archives of Spain, Holland, Italy and France. In April 1991, exploration activities commenced. Due to the conflicting historical accounts regarding the exact location of the sinking, the survey took longer and covered a lot of area before the shipwreck was discovered. The actual wreck site was only determined after a series of verification dives on one of the numerous anomalies detected. The wreck was finally discovered approximately 1 kilometre northeast of Fortune Island, lying 54 metres below sea surface level, on a mound of stoneware jars and cannons, which covered an area of approximately 40 by 200 square metres.



TOP LEFT: San Diego *shipwreck blue and white dish. © FEFNA/Franck Goddio*

BELOW LEFT: San Diego *shipwreck blue and white vases. © FEFNA/Franck Goddio*

TOP MIDDLE: San Diego *shipwreck Chinese blue and white bowls. © FEFNA/Franck Goddio*

CENTRE: San Diego *shipwreck Burmese stoneware jars. © FEFNA/Franck Goddio*

BELOW MIDDLE: San Diego *shipwreck Thai stoneware jars. © FEFNA/Franck Goddio*

ABOVE: San Diego *shipwreck Chinese stoneware jars. © FEFNA/Franck Goddio*

The first excavation season was conducted from 10 February to 28 April 1992, while the second excavation season commenced in 1993. The second excavation season focused on the recording of the shipwreck's wooden vestiges.

More than 34,000 archaeological specimens were retrieved and accessioned including ceramics (porcelain, stoneware and earthenware), armaments (cannons, samurai swords and katanas, swords, muskets, ammunitions), silver coins and silver wares, metals anchors (helmets, buckles, lead weights and ingots, bells, etc.), glasswares, jewelry and personal ornaments, gold objects (seal, coin, neck and finger ring and rosary), necklace, kitchenwares, wooden objects and implements, rope, floral and faunal remains and other unidentified objects.

Significant archaeological objects recovered include: navigational instruments (astrolabe and compass) and implements, fourteen bronze cannons, Chinese blue and white porcelain (Kraak and Zhangzhou wares), more than 750 Chinese, Thai, Burmese and Spanish or Mexican stoneware jars and over 70 Philippine made earthenware potteries.

The *San Diego* was the first galleon to be systematically excavated in Asia. It is a tangible evidence of the fabled galleon trade that lasted for 250 years, making the Philippines one of the world's central trading hubs during that period. The *San Diego* is also important in elucidating the inter-island trading activities during the early days of European influence.

5.16 The *Griffin* Shipwreck *(1761 AD), Philippines*

The *Griffin* foundered in the Sulu Sea in 1761. The vessel was part of a convoy sailing to the Sultan of Jolo to negotiate the treaty leading to the creation of a trading post by the Honourable East India Company (HEIC). The wreck is related to the expansionist aspirations of the HEIC to establish a trading post that would serve as a support base for the development of trade for the English Empire.

The search for the *Griffin* commenced with the examination of the archival documents in England, Paris, Madras, Brunei, St. Helena and Manila to gather a comprehensive and accurate historical picture of the vessel, before and during the sinking.

Magnetometer surveys that were carried out in 1986, led to the discovery of the *Griffin* inside the Pilas group of Islands in Basilan, southern Philippines. The on-site excavation period lasted 420 days, covering two excavation years.

The ship's cargo consisted of Chinese porcelain, silk and tea destined for Europe. The porcelain numbered more than 7,000 pieces. There are sets of blue and white octagon 'crab' plates, a set of cups with floral decorations, a set of saucers and bowls in the 'tea house' patterns and a set of punch bowls, as well as mugs and vases that were produced in the kilns of Jingdezhen. There are also whitewares in the form of figurines that were manufactured in the Dehua kilns in Fujian province.

The ship was classified as a merchant ship, measures 29 metres long and was perfectly preserved under 6 metres of sand. It was built in Blackwall, England and officially had a tonnage of 499 tons, but in actuality it could have been between 600 to 690 tons, based on similarities of boat building technology of the period. The ship has three masts and a massive hull to accommodate a substantial cargo.

FROM TOP: Griffin *shipwreck Chinese blue and white 'crab' plates in situ. © FEFNA/Franck Goddio*
© FEFNA/Franck Goddio

Griffin *shipwreck Chinese blue and white table wares. © FEFNA/Franck Goddio*

Griffin *shipwreck Chinese blue and white vases. © FEFNA/Franck Goddio*

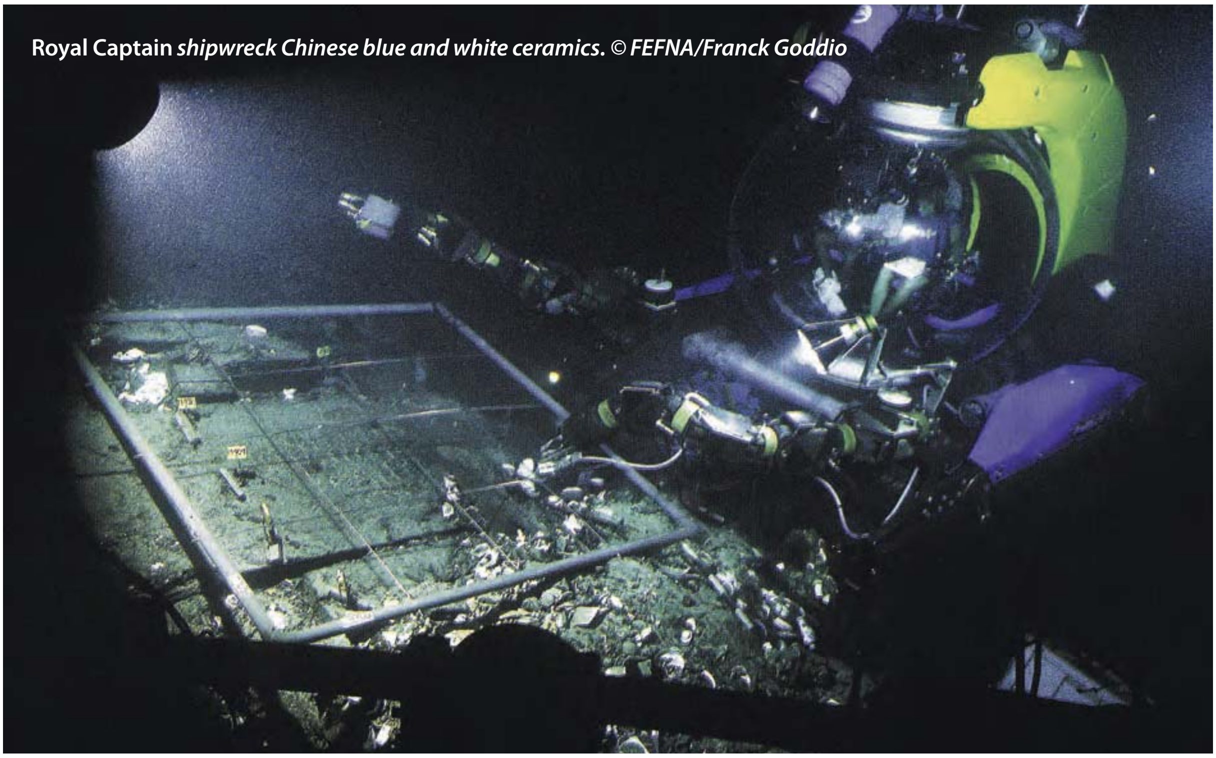
Griffin *shipwreck figurines. © FEFNA/Franck Goddio*

Royal Captain shipwreck Chinese blue and white ceramics. © FEFNA/Franck Goddio

5.17 The *Royal Captain* Shipwreck *(17 December 1773 AD), Philippines*

On 17 December 1773, the *Royal Captain*, another HEIC ship, struck a reef and sunk. She was part of a convoy of three ships that traveled from China to Balambagan, Borneo, an HEIC settlement, carrying more than 4,000 tea chests, bundles of silk, Chinese porcelain, barrels of Arrack and three chests of silver dollars.

The *Royal Captain* was located based on archival research of the ship's log that detailed the sinking of the ship. In 1985, a magnetic survey was carried out by the National Museum of the Philippines and the European Institute of Underwater Archaeology (IEASM) that discovered metal objects related to



Royal Captain *shipwreck Chinese blue and white ceramics. © FEFNA/Franck Goddio* the vessel, but the wreck itself was not found. It was believed that the vessel sunk in deeper waters or floated away from the reef. Another investigation was carried out in 1995, this time with Remote Operated Vehicles (ROVs) and submarines. The wreck was found 350 metres below the sea surface level and the ship's bell was located 110 metres deeper than the site.

After a failed investigation in 1996 due to technical difficulties of excavating such a deep site, systematic excavation was finally conducted in 1999. A state of the art high-precision acoustic system, laser measurement system and special photographic equipment was used to map the site. A customized elevator operated by submersibles was used in the recovery of the artefacts. The objective of the endeavor was to systematically excavate a limited area and leave the rest of the wreck intact for future research.

About 1,847 artefacts, constituting approximately 5 per cent of the entire shipwreck cargo were recovered. Along with the Griffin shipwreck, the two vessels were instrumental in explaining the history of the HEIC and its attempt to establish a free port in South-East Asia to attract Chinese trade.

5.18 The Desaru Shipwreck *(ca. 1830 AD), Malaysia*

In 2001, a shipwreck was discovered about 2 nautical miles from Desaru Beach, on the east coast of Johor, in 20 metres of water. A preliminary investigation was conducted in April of the same year, while mapping and site measurements were completed in 2002. A plan to do further research on the site in 2003 was not fulfilled due to the total destruction of the site by fishing nets.

Based on the presence of traverse bulkheads, it is believed that the Desaru shipwreck was constructed using Chinese ship-building technology based on the presence of transverse bulkheads. More than 7,000 artefacts were retrieved, of which the majority comprised of large stoneware storage jars produced by the Maenam Noi kilns of Thailand. These storage jars occupied all except two of the bulkheads which contained porcelains, including 53,000 blue and white spoons and other blue and white wares of excellent quality. It is interesting to note that many of the storage jars contained Yixing teapots and small stoneware pieces, including covered boxes, bowls and beakers.

TOP: Desaru shipwreck Chinese blue and white dish. © Sherman Sauffi

LEFT: Desaru shipwreck Chinese blue and white jar photo. © Sherman Sauffi

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Unit Summary

The unit provides a general introduction to the subject of Asian ceramics and its importance in understanding maritime trade in the South-East Asian region. Each South-East Asian shipwreck containing ceramic cargo discussed in the unit has provided important archaeological information in terms of temporal sequence, delineation of different trade practices and distribution of trade goods.

Suggested Timetable

30 mins	Introduction to Asian Ceramics - *What are ceramics?* - *Why do we study ceramics?* - *Ceramic shape terminology* - *Ceramic kiln sites*
60 mins	South-East Asian Shipwrecks with Asian Ceramic Cargo
	Break
80 mins	Visit to the open storage of the National Maritime Museum's ceramic collections
10 mins	Concluding Remarks and Closure

Teaching Suggestions

To supplement student knowledge, it is recommended that trainers organize a visit to a ceramic storage in a museum to look at actual ceramic specimens from shipwreck sites. The students should be encouraged to identify pieces and describe the type of ceramics, provenance and its possible use, e.g. utilitarian, ceremonial, etc.

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UNIT 14

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UNIT 14

Contents

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Author Charlotte Minh-Hà L. Pham

Asian Shipbuilding Technology

Core Knowledge of the Unit

This unit introduces students to shipbuilding technology around the world, with a particular focus on South-East Asia. The unit will explore boat traditions in the region (basic boat types, terminology and construction methods) and examine how they evolved over time.

On completion of Asian Shipbuilding Technology unit, students will:

- *Be familiar with specific shipbuilding terminology*
- *Have knowledge of a variety of boat traditions around the globe, particularly in South-East Asia*
- *Be able to identify main features of specific boats, shipbuilding traditions or cultures*
- *Be able to understand a shipwreck or boat remains, interpret and relate its features to known traditions*
- *Appreciate the importance of preserving traditional boats and how much work is required to increase existing knowledge*
- *Be able to apply knowledge into a 'practicum' on traditional boat recording*

Introduction to the Unit

The study of watercrafts, vessels or boats is part of the academic discipline of maritime archaeology. It is important to remember that such studies are not exclusively related to shipwrecks and are in fact based on various aspects of humanity's past activities on or near water (Muckelroy, 1978). Traditional crafts that take place along the coast, local boatyards, ports and harbours also form part of the study area for a maritime archaeologist. By exploring these key areas, we can gain a more complete understanding of past maritime activities, may they be as a result of trade, war, exploration or subsistence.

A boat is not constructed only according to its environment, but is also dependent on the materials available or functional factors that are at the heart of these maritime activities. The actual construction and use of a boat are essential components of a society's economic and social organization, and to understand the boat in its broader context is just as important as understanding the practical and technological aspects of it.

This unit, therefore, will examine technological aspects that will provide tools for describing and interpreting boat finds, as well as offering a broad overview of boat traditions in the region to provide context and infer comparisons. Looking at or studying a boat goes further than only describing the number of masts or the types of fittings contained, nonetheless, a mastering of the diversity of different boat types and of the terminology and of regional traditions is essential to understand this technology in a broad setting. Acquiring knowledge of boat technology also helps to pinpoint data, such as cargo sizes, distances travelled, seaworthiness or speed that are elements only seldom used in building arguments in history.

Students should also refer to Appendix B: *Basic Terminology of Shipbuilding*, for a description of the basic components of watercraft referred to in the text.

1 General Boat Technology

Ancient seafaring, navigation methods, construction technologies, boat origins and evolution, ports, harbours and boatyards are all intimately related to our understanding of archaeological boat remains. By studying each of these different aspects we can build a clearer and more complete picture of the past. The boats that we can study, under or above the water, have a deeper meaning that 'is much broader than timbers and technology' (Adams, 2006, pp. 6) and are tightly intertwined with all of these different aspects.

ADDITIONAL INFORMATION

1 The vocabulary and definitions included in this section are essentially compiled based on Steffy, 1994 and McGrail, 2001. Descriptions of the main South-East Asian boat traditions are based on McGrail, 2001 and Manguin, 1985 and 1993 (see Suggested Reading).

Boats are mirrors of culture. They reflect a wide array of aspects of our maritime (and non-maritime) ancestors' daily lives. Nowadays, traditional boats and boat remains can be studied for what they can reveal not only about technological features, transfers and achievements, but also about social organization, material resources, ideology and traditional beliefs, symbolism (Crumlin-Pedersen and Munch-Thye, 1995; Ballard et al, 2003), political intentions or economical systems (Hasslöf et al, 1972; Adams, 2003; Blue, 2003).

Maritime archaeology, as Westerdahl states, '…includes the prominent interests of water transport technology, trade and exchange, water-borne industries, seafaring, coastal settlements, harbours and water-fronts, ritual and funerary deposits…and arguably, the whole entity forming the 'maritime cultural landscape' (Adams, 2002, pp. 328).

The breadth of maritime archaeology enables us to examine the different aspects, linkages and connections to other disciplines, and to stimulate interdisciplinary study in order to get a bigger, better and more precise image of the past. This also brings a unique insight into the realities of humanity's activities on the sea.

1.1 The Basics of Boats, Ships, Vessels and Watercraft

What is the difference between a boat and a ship? According to Richard Steffy (1994, pp. 7) a boat is a small, open vessel, whereas a ship is a large sailing vessel (with a bowsprit and three to five square-rigged masts). But it is more practical to classify boats as small vessels designed for operating in sheltered waters and ships as large vessels designed for deepwater navigation. Sometimes duty rather than size controls the designation.

Boats, ships and watercraft all float. Following the concept of Archimedes, they float because they are not as dense as water and displace an amount of water that is equal to (or greater than) their own weight. To summarize, Steffy (1994, pp. 9) states,

> *the weight of a ship and all it carries, pushed downward by a force known as gravity, is supported at all submerged parts of its hull by an equal force; buoyancy. But that is an ideal condition that exists only in still water! As soon as a wave or gust of wind causes the hull to list and thereby changes the area of distribution of water against its surface, the centres of buoyancy and gravity also change, and the hull becomes unstable.*

How a ship is constructed and the different features incorporated into its design are meant to keep hulls stable in dynamic waters. A vessel not only has to be buoyant and steady, it also needs to be strong enough to withstand the worst weather it is likely to encounter.

Each feature of each type of boat is designed for a different purpose that do not just relate to functional or environmental factors. The design of a ship, its concept, overall purpose and construction sequence are dictated by the people who construct and use them, by the materials that are available and also the political, social and economical backdrop of the time.

1.2 Basic Boat Types

How different boatbuilding traditions developed and in what order in different parts of the world, is still an area of controversial debate, with many development models being presented by different archaeologists and historians. Although these models can not all be covered in this introductory unit, more information can be found by the books presented in the Suggested Reading at the end of this section.

For simplicity, this unit will use the model developed by Basil Greenhill. In proposing the 'roots of boatbuilding' (1995, pp. 74-101) he suggests that boat diversity originates from four main models from which all other kinds derived (the raft, the skin boat, the bark boat and the log boat) and that they evolved differently according to the properties of their construction material.

Although these types are at the basis of most of the large ships present in the contemporary record, most of these 'primitive' types still survive and can be found today in South-East Asia.

1.2.1 Bark Boat

In a bark boat or canoe, the bark is the main strength member that determines the shape of the boat. It is then supported by an internal framework. This type of construction is called 'shell first' and is particularly associated with Native Americans who are known to have built particularly sophisticated crafts. The ones used in Australia, South America and Africa were often simpler.

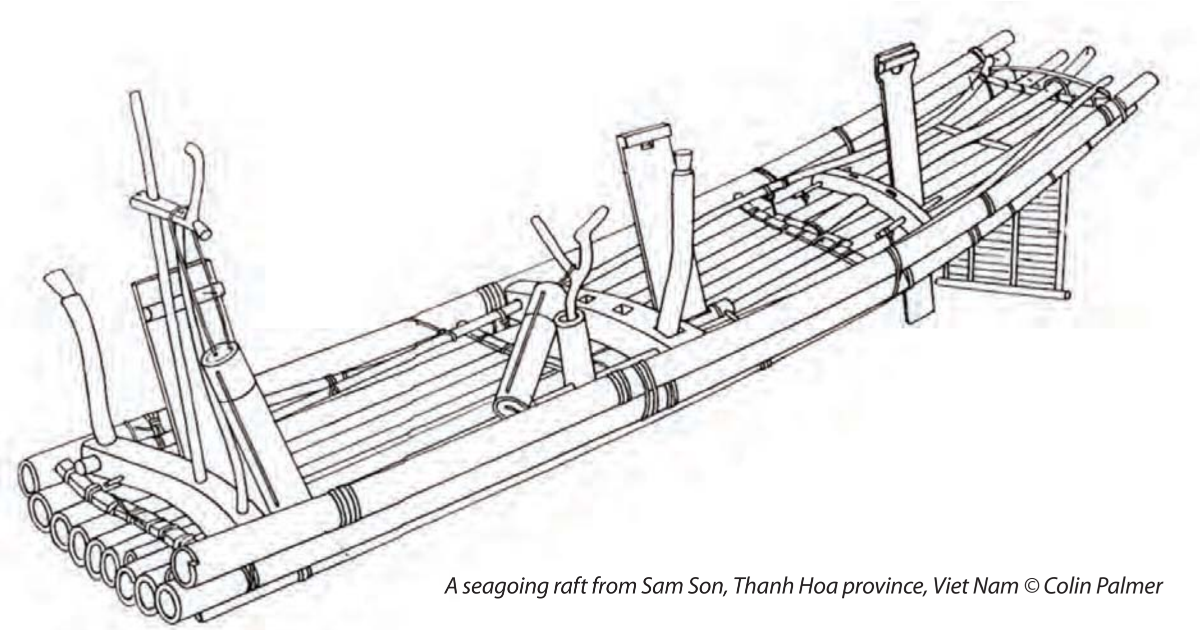
1.2.2 Raft

A raft is any structure with a flat hull that floats on water. It is one of the most basic types of boat design. Rafts can be made of logs, bamboo poles or reed bundles.

Usually, the bamboo poles or the logs are set in parallel, braced and lashed together with bamboo strips, rattan or husk. Rafts are quite flexible as their structure allows water to flow through the deck, which makes them relatively stable when navigating through swells and heavy waves.

Rafts are known to have existed since c. 3500 BC and although basic in terms of construction, they were developed for the sea, fitted with a mast, sails and centreboards (for controlling leeway). This type of seagoing raft still exists along the coast of thee Thanh Hoa province in Viet Nam, but are quickly disappearing (Burningham, 1994).

These Vietnamese rafts appear to be similar to the rafts of Formosa as described by Needham in 1971. If following the proposal that an Austronesian speaking group crossed from China to Taiwan aboard such a kind of raft, and that North Annam is its initial point of distribution (Paris, 1942, pp. 423), then these rafts may relate to the earliest Austronesian speaking groups who dwelled between central and northern Annam.



A seagoing raft from Sam Son, Thanh Hoa province, Viet Nam © Colin Palmer

In 1994, Tim Severin explored the legend of the Chinese general Xu Fu, who is said to have crossed from Asia to America on a huge bamboo raft between 219-210 BC. As part of his study, Severin reconstructed a very large oceangoing sailing raft to demonstrate that it is possible that such a vessel could have physically sustained a voyage of 5000 miles in the open sea (Severin, 1996).

In China, where the earliest boats were riverine and later evolved in seagoing junks, Greenhill (1995, pp. 80) suggests that many of the complex patterns of boats on the coasts and rivers of China may have evolved from plank-built copies of rafts of the Formosan type, formerly used on the coasts of China and from where they were probably introduced in Formosa. This highly developed form of raft with its drop keel, rudder and sail was one of the most sophisticated in the world; it was built of bamboo poles lashed together illustrating in rudimentary form several characteristics of some Chinese boats and big plank-built Chinese vessels.

1.2.3 Skin Boats/Basket Boats

Skin or basket boats involve the concept of tying a skin or woven mat around a frame. In the skin boat, an animal skin forms a watertight cover. The construction is usually 'skeleton built' (based on the framing) and derives its shape from the frame around which it is built. On a basket boat, a woven bamboo mat is covered with resin to produce a watertight shell and is set inside a bamboo framing.

The Eskimo culture, being largely dependent on what could be won from the sea, perfected the skin boat to perhaps its finest form in modern times. As a maritime hunting people that existed in a very hostile environment, lacking in timber, but rich in skins (with driftwood and whalebone also available), they developed one of the most specialized boat types; the kayak. Skin boats are also found in Bronze Age Europe, such as coracles in Wales, or curraghs or curach in Ireland. In India, coracles were described by Herodote (480-420 AD) and the shells of the Irakian kuffahs are also made of woven reed.

Basket boats in Viet Nam are not thought to have developed from the skin boat or the woven reed kuffah. Vietnamese basket boats are from a very specific tradition of their own and are nowadays found all along the coast, from north to south. There are many different kinds of basket boats that differ from one another in terms of size, shape and use. They can be seagoing, riverine, found in the rice fields, used as small floating shops or even as a dinghy to a larger boat.

From the small round thuyên thúng chài to the longer boat-shaped thuyên nan, bamboo boats are favoured for being cost effective, utilizing available materials, relatively quick to construct, easily adapted to fit family businesses and needs, and importantly, can be easily manoeuvred. All types can be fitted with a mast and a helm. In central Viet Nam, this type of craft evolved into larger seagoing fishing vessels (over 10 metres long), the hull being extended by planks and known as a 'mixed hull'.

The great advantage of using bamboo is that it is resilient to wood-boring organisms. The material contains a high level of silica, not favoured by Xylophagidae and Teredinadae (such as the shipworm *Teredo navalis* and *Bankia sp.*), as the bamboo laths are usually too thin to host them (Aubaile-Sallenave, 1987, pp. 81).

A small round basket boat known locally as a Ghe Thung Chai. © Colin Palmer

1.2.4 Log Boats, Dugouts and Monoxylons

Log boats, dugouts, dugout canoes (but be aware, the word canoe implies a way of moving forward with a paddle), or monoxylons (from the Greek word *mono,* meaning single and *xylon,* meaning tree) are essentially formed from a hollowed out tree trunk. The trunk is worked by hand tools, before being opened up and made larger by burning the interior of the trunk.

Several trunks can be assembled together, to form boats similar to those used for racing in Cambodia. The inside of these hollowed trunks can be fitted with floor timbers or benches to reinforce the structure. A well made log boat from a small log can be efficient, light and seaworthy. In the larger versions, because of the dimension of the tree from which it is made, the dugout is long and narrow. These boats derive their stability from their length and are suited for use on rivers and lakes. The efficiency of larger log boats was greatly improved by softening the sides with fire and water and then forcing them apart with wooden struts (Greenhill, 1995, pp. 102).

Log boat or vallam from Kerala. These are now very rare and no one knows why they have carved frames. © Colin Palmer

According to Greenhill (1995, pp. 104),

> *the undertaking of making a log boat is a considerable one. Suitable trees must be available near to the water, and the community concerned must have a great deal of time available for this kind of specialized work, for making a log boat, frequently takes more time than building houses or cattle pens or fencing fields. It is a kind of large scale capital investment requiring a sufficient surplus of food production to enable the log boat makers to give the considerable amount of time demanded by the work. They must have reasonably efficient tools. It follows that, to make such a big investment, the community must be a prosperous one in a certain stage of technical development*

The dugout construction technique is universal and examples can be found throughout the world since the early times. In Egypt, images on temple walls depict how to make planked boats on a possible dugout base (Hornell, 1946, pp. 48). In terms of material evidence, the earliest dugout dates to 8000 cal. BP and was found in South-East China, in the region of Kuahuqiao. The site of the dugout also contained three paddles, pieces of bamboo or cane matting attached to a wooden frame and working tools, which suggests that the site was once associated with a workshop for making or repairing canoes (Leiping and Li, 2005).

The lines of the descendants of dugouts are very complex and the evolution towards plank-boats cannot be addressed in depth here, but put simply, by adding planks to the edges of the canoe it is most likely that the dugouts later evolved into a basic planked boat. First, the planks would have been sewn or lashed together and then fixed with tenon and mortises, then fully dowelled to form a watercraft. From this form of watercraft, many different types of boats later emerged.

Clear evidence of a probable origin of an expanded and extended log boat is provided when a boat type features solid or block ends to a planked hull, in the place of a stem and sternpost or transoms. These block ends represent the solid ends of almost all log boat structures.

The development from this rudimentary design to a craft of higher quality moved along two lines:

- *By way of the extension of expanded log boats, which eventually became no more than bottom shells.*
- *By way of three part or five part bottom plank boats, which were shaped to closely resemble the form of the log boat. To solve the problem of the plank ends, hollowed out massive baulks of timber were used.*

Dugouts can still seen today along the Mekong River or on Inle Lake in Myanmar. Simple dugouts can be fitted with ribs, expanded with planks or elongated to form long canoes. In Cambodia, dugouts can reach as long as 30 metres (Walker-Vadillo 2010, pers. comm.).

1.2.5 Sewn Planks

In the times before the ready availability of iron fastening material, wooden plank boats have been fastened by wooden pegs or dowels. This method of fastening was also used in combination with binding and lashing, using locally available materials and techniques developed through experience. This practice is seen across the globe and has been followed from prehistory to classical times and through to the present day (Greenhill, 1995).

There are various techniques for fastening the planks together. Essentially, it is possible to either sew them in a continuous way, similar to the basic Indian Ocean tradition or else stitch them together in a discontinuous way, usually only visible from the inside, which represents the general South-East Asian tradition (Manguin, 1993, pp. 260). These differing techniques suggest they are independent, rather than culturally linked traditions.

The stitched tradition seems be widespread throughout South-East Asia and homogenous across the whole Austronesian range. The hulls were built by raising planks on each side of a keel piece, which indicates having evolved from a dugout base (Manguin, 1993, pp. 258). The fastening technique is referred to as lash-lug, with lashing and protruding cleats (Horridge, 1982).

The earliest material evidence that exists for this type of sewn technology is the ship that dated back to 2500 BC and was found in a chamber in the pyramid of Cheops. First, the strakes (planking) were joined together by pegs and then lashed together forming the hull. Once complete, the internal strengthening structures were added.

In South-East Asia, there is material evidence from the third to fourteenth century, but it is thought that this tradition existed during at least the whole of the first millennium, producing ocean going vessels which were large enough to carry large cargos. The evolved lash-lug technology (Horridge, 1982) is considered one of the strongest common South-East Asian traditions.

The series of the Butuan ships found in the Philippines also indicated an evolution in the technique, with boat remains dating from 320 until 1250 AD and moving from a lash-lug tradition to a fully dowelled fastening system (Green et al., 1995).

Boats with planking fastened by bamboo fibre cords were recorded from the seventeenth to the twentieth century in Malaysia, Borneo, Sarawak, Moluccas and the Philippines. This traditional technique can still be seen today in the form of small river crafts used in the region surrounding the ancient capital city of Hue in Central Viet Nam.

Indian Ocean tradition: a sewn boat of India, Orissa. © Colin Palmer

1.2.6 Planked Boats

Planked boats are essentially all types of craft (including sewn boats) that are not rafts, dugouts or skin/ basket boats. Although the principles remain the same, changes in design, shapes, sizes and specific features will vary tremendously from regions and time periods.

Evolution can be quite slow and most of the time it is not well documented, due to a substantial lack of material evidence. However, some general traditions for South-East Asia have been identified and are discussed in this section.

Planked boat: a golekan also known as the 'Madura trader' originate from Madura. Distinctly different from boats in Java, the golekan have a shallow form and small capacity, but are striking crafts, with an intricately decorated stem and stern. © Kurt Stenross

A large janggolan with the sailing rig removed, laid up for the monsoon. In Madura, janggolans are dedicated to freight work, usually carrying a salt cargo. © Kurt Stenross

This lete-lete under construction in Gayam, Sapudi is a good example of a perahus. This contemporary design has been influenced by Dutch boat building in the Madura region. © Kurt Stenross

1.3 Specific Purposes and Categories

Any wooden ship or boat can be classified into one of four categories: transport, naval, fishing or utility. Each of these categories places specific demands on hull design (Steffy, 1994, pp. 10), for example, construction of transporters or carriers focuses on the hold and on the storage spaces, whereas war ship designs are conceptualized to accommodate new forms of aggression and defence; to support archers, catapults, guns or to contain the numerous rowers to propel the ship.

To more accurately describe ships and boats from South-East Asia, additional sub-categories can be added: troop transporters, merchant ships, coasters, fishing vessels, floating houses or floating markets, racing canoes, ceremonial and festival boats, and royal barges. They can also be distinguished according to their environment: coastal, inland (lakes) or riverine and high seas.

However, boats and ships can also be described according to their propulsion systems, to their sizes or purpose, for example:

- *Whalers are relatively narrow vessels that are pointed at both bow and stern. Their design enables them to move either forward or backwards easily. Originally developed for whaling, these vessels became popular for work along beaches since they manoeuvre easily and do not need to be turned around for beaching or refloating.*
- *Caravels are highly manoeuvrable sailing ship developed in the fifteenth century by the Portuguese to explore the West African coast and the Atlantic Ocean.*
- *Schooners are sailing ships characterized by the use of fore-and-aft sails on two or more masts, with the forward mast being no taller than the rear masts. Schooners were first used by the Dutch in the sixteenth or seventeenth century and further developed in North America from the early eighteenth century.*

In South-East Asia specific terminology is seldom used in this way. Terms, such as sampan, junk, praus/perahu are used often, but with little care for precision. As a result, it is even more important that the design and features of a vessel are examined when trying to identify boats or ships in the region.

2 Asian Shipbuilding Technology: Main Traditions

Each period of history produced vessels with distinctive hull designs in specific geographical areas. Some of these designs survived for centuries, even millennia where civilizations were stable. Certain features remained constant or were often adopted in other areas because of their practicality and function. Overall, each seagoing society throughout the world produced distinctive design and construction features that evolved as the society developed.

Greenhill (1995, pp. 20-21) states,

> *Boats have developed all over the world in different ways and at different speeds. Their development has been conditioned by the geography of the local waters, climate, purposes for which the boat was needed, availability of materials for their construction, tradition of craftsmanship which grew up among the boat builders and the general state and nature of the culture of the people building them. To appreciate a boat one must be aware of the factors that give rise to her building, the timber available, the general environment, the building traditions of the society which produced her, and above all, the purpose she was built for.*

It is also noteworthy that evolution in ship technology is a relatively slow process. Steffy (1994, pp. 8) explains,

> *Water is not our natural environment; humans are instinctively uncomfortable with it. It is unstable, presenting structural problems. When water is combined with winds and tides, structural problems increase dramatically. Worse yet, when vessels sank in this unfriendly element there was no haven for their occupants; they could not walk away from a disabled ship as they could from a broken wagon, nor could they come back later and retrieve its payload. It is no wonder that shipbuilders were so cautious with new designs and that global travel evolved so slowly.*

Bajau children and their small boats in Tawi-Tawi.' The Tawi-Tawi Bajau have a great variety of boats. Islands, sometimes even villages, tend to be associated with certain boat types. Thus, a survey of the boats throughout the archipelago might reveal patterns of movement and diffusion. Such a survey is urgently needed since the widespread use of inboard and outboard motors in recent years is drastically altering traditional boat-building' (Nimmo, 1990). © Jo-Marie Acebes

2.1 A Continuitya

There is no direct evidence for water transport until the Mesolithic period and it is not until the Bronze Age (c. 2000 BC) that vessels, other than log boats, appear. Nevertheless, there is sound evidence for their use in lakes and rivers and for overseas voyages from earlier times.

South-East Asia was the scene for one of the most crucial steps in human evolution, namely the completion of the first sea crossings. Mainland South-East Asia is considered as a stepping stone for early colonisations of South-East Asian islands that later extended to more remote destinations as far afield as Australia and Oceania.

Although archaeological evidence from Australia suggests that the world's earliest sea crossings occurred by *Homo sapiens* ca. 50-40,000 BP, little is known about their seafaring capacities or about the types of watercraft that existed. The sea level fluctuations during the Pleistocene are a radical taphonomic factor, which as a result, have eliminated most coastal archaeological evidence from that early period.

Ethnographical data of the area, as well as archaeological record from the mainland has, however, provided knowledge about the prehistoric shipbuilding traditions. In Sundaland (the continental shelf zone, that includes present day Malaya, Sumatra, Java, Borneo and Palawan), the earliest boats that have so far been discovered date back to the second century (McGrail, 2001, pp. 283).

As archaeological remains are scarce, it is the accounts from European travellers (sixteenth to seventeenth centuries onwards) and contemporary ethnographic studies that provide the most important sources of data. Evidence illustrates an increasing technological complexity, yet, also shows that many of the fundamental features of early boat types were never superseded and were still used in the region during recent times (McGrail, 2001, pp. 304).

2.2 Early Sea Crossings and the Austronesian Outrigger Boats

Very little is known about early seafaring, although taking the fluctuations of sea level into account, it is possible to estimate the distances which *Homo sapiens* would have had to have crossed. The lowering of sea level (ca. 60-53,000 BP) opened up routes and pathways (Borneo, Sumatra, Java or Palawan were undoubtedly settled through land bridges) and reduced distances between the Wallacean islands.

Later, rising sea levels (ca. 53-45,000) diminished Sundaland by a third and increased the isolation of some islands along the Wallacea line. During periods of lower sea level, it appears that a minimum of 90 km of sea travel had to be achieved, a distance which required travelling out of sight of land, keeping a heading at night, particular navigational skills, as well as seaworthy watercraft.

Moving forward in time (from ca. 4,500 BC), the dispersal of the Austronesian speaking groups and the introduction of their domesticated agricultural system in newly colonized islands indicates the existence of well-established and continuous maritime activity. There is also evidence to suggest that present day native populations of South-East Asia share ancestries with the ethno-linguistic group of the Austronesians in terms of culture, language and genotype.

There are different theories regarding how this Austronesian speaking group may have spread, with additional insight being provided by advances in linguistics and DNA analysis. Following Bellwood (1997), the most accounted theory is the suggestion that they originated from Fujian, China, then moved to Taiwan and then on to the Philippines. By doing so, they achieved the most widespread dispersal of their time; over 4,000 years, they spread over 7,000 km, reaching as far as Polynesia and Easter Island to the east and Madagascar to the west.

These journeys would have primarily been conducted over small distances, but on a great scale. To achieve this, the group would have had to have utilized seaworthy crafts, capable of carrying cargo, viable units of males and females and possibly domesticated animals and crops.

During the early Austronesian period it is suggested that the vessels would have comprised of seagoing rafts or sewn-planked crafts while later, outrigger canoes were adopted as their emblematic vessel. Ethnographical observations of this period confirm their wide range distribution use and support, as well the common tradition of lash-lug planked boats (Finney, 1996; Horridge, 2006).

The early period occurred ca. 4500-3000 BC, when their diffusion expanded from China to Taiwan (160 km), then to the Philippines (480 km) and eventually west, towards the Malay Peninsula. The very early Austronesian tool kit included ground stone adzes, stone mortars and pestles, stone pads, slate spear points, slate-reaping knives and baked spindle whorls (Bellwood et al., 2006, pp. 107) made out of basalt or clamshell, with drills fashioned from shark's teeth or shell.

Bamboo rafts are the most likely option, as bamboo is found in abundance over South-East Asia and can be easily cut with stone tools (Birdsell, 1977; Horridge, 2006). Lightweight and strong enough to support multiple people, bamboo also does not become waterlogged due to its high silica content. By observing the simple tools used by *Homo sapiens*, bamboo could have easily been prepared and lashed together with vegetable fibres. Ethnographical data also reveals that bamboo rafts are still traditional in Indonesia, Philippines, Melanesia and in the area of Sam Son in Viet Nam (McGrail, 2001; Horridge, 2006).

The later period occurred from approximately 1500 BC onwards, when Austronesian speaking peoples crossed very important stretches of water; from the Bismarck Islands to Melanesia, Polynesia and finally Oceania. To try to identify the type of watercraft used during this expansion, linguistic study offers some clues (Blust, 1995; Pawley and Ross, 2006). Amongst the words that have been reconstructed are those for sail, mast, outrigger and outrigger boom. Linguistics specialists claim that these words and the artefacts they describe could be 5,000 years old (McGrail, 2001, pp. 317).

Before reaching eastern Melanesia, this migrant group must have known that there were further islands beyond the horizon. Given this, watercraft technology would have to have been advanced enough to build boats which were not only capable of longer voyages, but were also able to carry plants and animals (Irwin 1990, 1992; Finney, 1988)

The band of islands stretching from mainland South-East Asia to the Solomon Islands was in a relatively sheltered equatorial position between cyclonic areas, with predictable seasonal reversals of winds and currents. This formed a 'voyaging corridor' (Irwin, 1992, pp. 4), from where most of the islands remained in sight of land. This vast archipelago was thus well placed to become a springboard for exploratory journeys to the north and the east, with the island network from Western Melanesia to the Solomons acting as a safety net on return (McGrail, 2001, pp. 314).

Although the evidence for watercraft from c. 1500 BC to 1300 AD is negligible (McGrail, 2001, pp. 338), linguistics suggests that Proto-Polynesians began their oceanic voyaging abroad outrigger boats with sails. Otherwise, it is on European accounts, starting with the travel logs of Magellan and Del Cano's circumnavigation voyage of 1520 that an image can be formed, completed with ethnographic data relative to much later periods. The late eighteenth century and the nineteenth century are golden ages for pre-ethnographic studies done by captains, seamen and intellectuals who accurately recorded the boats they encountered on their travels. The work of Admiral Pâris (1843), the father of nautical ethnography, is an excellent example of the interesting descriptions compiled on traditional crafts of the region.

Modern example of an outrigger boat, known as a banca in the Philippines. Batangas Bay, Saint Bernardino Strait. © Robert Whitehurst

Suggestions on early watercraft and on the boats potentially used by Austronesian speaking groups are, therefore, essentially based on contemporary data. Contemporary records show the use in the wide regions of Oceania of floats, bundle boats or rafts, as well as log boats around the islands which had suitable trees for boat building or driftwood logs.

Early oceanic voyaging boats could also have been log based boats, extended by sewn planks with treenails (McGrail, 2001, pp. 339). This Neolithic boatbuilding tradition was based upon lashings, protruding pierced lugs and a hollowed base for the hull with added planks, sewn to the sides (Horridge, 2006, pp. 144). Ethnographically, the distribution of sewn plank boats over Europe, Asia and Oceania indicates that this type of boat may have persisted since the Austronesian speaking peoples (Manguin, 1984; Horridge, 2006).

In summary, the Europeans identified four essential types of seafaring vessels:

- *Oceangoing rafts*
- *The single hull planked boat*
- *The planked boat with outrigger*
- *The double hulled or paired plank boat*

These boats share some construction characteristics as they are all shell first, with planks sewn together and framing lashed to the planking (lash-lug tradition). Under the waterline, the hulls are usually double-ended, while above the waterline they are unequal-ended. All are probably log boat based, although the sizes and shapes of planks would have depended on the availability of timber.

Boats with two outriggers have been used in western Melanesia and in Indonesia from at least the eighth to the ninth century, as witnessed on the Borobudur relief in Java (Manguin, 1980; Jahan, 2006). Yet, from eastern Melanesia eastwards, there is no evidence for such crafts. Instead, in all European accounts for the region, boats with only one outrigger are recorded.

A double outrigger banca on the beach. Batangas Bay. © Robert Whitehurst

Their hulls are usually slender, sometimes double-ended (either end being usable as the bow) or sometimes showing a clear distinction between both ends and with the outrigger on port side. The dissimilar ended, have their mast stepped towards the bow and the position of the mast determines how the boat is handled when changing direction relative to the wind.

Some boats with dissimilar ends sometimes have balance boards, which jut out from the boat on the side opposite the outrigger. When the float is to leeward, the boat can be brought more upright by stationing crew on the balance board. Ethnographically, the distribution of outrigger canoes corresponds to the distribution of Austronesian people and they are still used in present day Polynesia, which is located at the tips of the eastern migration.

Outrigger boats and paired boats are the most advanced crafts, clearly capable of ocean voyages when Europeans encountered them. Both types may have been used for ocean voyages during the settlement of Oceania, however, for reasons of speed, manoeuvrability and capacity, it may have been that outrigger boats were preferred for exploratory voyages and paired boats for colonization.

A modern outrigger boat in Mindanao, Sarangani Bay, Philippines.
© Jo-Marie Acebes

2.3 Stitched Boats: the Early South-East Asian Tradition

The technique of sewing planks together to make a watercraft is considered as the earliest common South-East Asian tradition. There is also ethnographical evidence to show the pattern of distribution of the stitched boats and to support their common traits across the region. Associated with most of these vessels is also the complimentary lashed-lug technique that features protruding cleats or lugs carved out on the inner side of the planks, with hollowed out holes in them.

Both traditions have survived under a variety of forms and were found in all areas from Hainan and Viet Nam to the Philippines and Eastern Indonesia, well into the 20th century. (Horridge, 1982; Manguin, 1985; McCarthy, 2005).

The first evidence of this technique came in the form of the Pontian boat which was found in Malaysia in 1926. The boat was dated to 260-430 AD (Evans, 1927; Gibson-Hill, 1952) and featured flush-laid planking sewn together and fastened with occasional dowels, as well as carved out lugs to which framing timbers were lashed. The ties pass through paired L-shaped holes (Manguin 1985*b*, pp. 333), the treenails protrude from the edges of the planking and the stitching is discontinuous. In this design the treenails are clearly auxiliary and supporting the lashings of the sewn boat. It is the earliest example of fastening technology recorded for South-East Asia.

The planks of the Khuan Luk Pat boat of Kolam Pinsi were found in Palembang and dated to the fifth to seventh century. The planks clearly appeared to have belonged to a sturdy hull that had been stitched together and fastened to the frames by way of lashed-lugs (Manguin, 1993, pp. 261).

Lash-lug boats displayed at the Bujang Valley Archaeological Museum. © Noel Tan

One of the Butuan boats, Philippines National Museum. © Noel Tan

The Jewel of Muscat, *a stitched boat replica based on the Beli-tung shipwreck. © Noel Tan*

Little remains of the hull of the early tenth century Intan shipwreck, that was found in the Java Sea, but structural details indicate that the ship was a lashed-lug craft. It is thought that the ship was probably bound to Central or Eastern Java from Palembang. Her cargo 'provides a unique insight into the nature of cosmopolitan trade in the tenth century Western Indonesian, at the height of the Srivijayan power, and enhances our understanding of the ceramic models circulating in South-East Asia, including Cambodia' (Flecker, 2001*a*; Guy, 2007).

The Cirebon shipwreck, found in the Java Sea and dated to the late tenth century, also belongs to the lashed-lug tradition. Investigated in 2004, the ship's cargo was found to consist of 75 per cent Chinese ceramics and an array of valuable trade goods from Indonesia, Thailand, Viet Nam and Persia. Artefacts included pearls, rubies, sapphires, garnets, gold jewellery, lapis lazuli, Fatimid rock crystal, Iranian glassware, Chinese bronze mirrors and Indonesian bronze statues. See: cirebon.mariemont.museum/home-6.htm?lng=en (Accessed March 2012).

In the Philippines, the Butuan boat remains, which range from the third to the thirteenth century, illustrate an evolution in technology. Recovered artefacts show a clear transition from lashed-lugs boats to a fully dowelled fastening system (Green et al., 1995).

From the eighth century onwards, shipbuilding technology evolved towards treenails as a primary fastening technique. This is best demonstrated by the remains of three boats found in Sambijero, Indonesia (one of which dated to 610-775 AD) which features not only lashings between the planks, but also treenails as the essential fastening method (McGrail, 2001 pp. 298).

Boat remains found in Paya Pasir, Butuan (dated from the twelfth to thirteenth century) demonstrate this technique, while the technique was also still described in the sixteenth and seventeenth century by European authors (Horridge, 1982) and can still be seen present day in Bali and Madura.

2.4 Kunlun Ships

Even if during the first millennium China was already highly involved in maritime trade, the principal long distance carriers belonged to the 'South Sea people' (also known as Kunlun), or the Malay people. The term Kunlan was 'probably originally used for the maritime peoples of Indochina and later extended to the Indonesian population' (Nguyên Thê Anh, 1996, pp. 108) or to the Malay people.

There is evidence to show that during this time the main shippers were essentially from Srivijaya and that between the eighth and twelfth centuries, it was these foreign shippers that transported most of the Chinese cargos (Flecker, 2007, pp. 83). In Chinese sources, there are descriptions dating to the third and eighth century of large Kunlun oceangoing vessels called Bo (Needham, 1971, pp. 459). These are understood to be very large ships (measuring up to 50 metres in length) with a capacity of between 500 to 1,000 tons, holding about 1,000 passengers.

These ships were said to be lashed together, featuring multiple masts and a deep V-shaped multi-sheathed hull with a keel that made them sturdy in the open sea (Manguin, 1993, pp. 262). The fact that these vessels were made without the use of a single piece of iron and that their rudders were lateral rather than axial, make them easily differentiable from the Chinese tradition.

Unfortunately, there is no material evidence for these ships. However, their existence suggests a long technological evolution that resulted in the Chinese developing a seagoing fleet during the Song Dynasty, which retained some of these distinctive features.

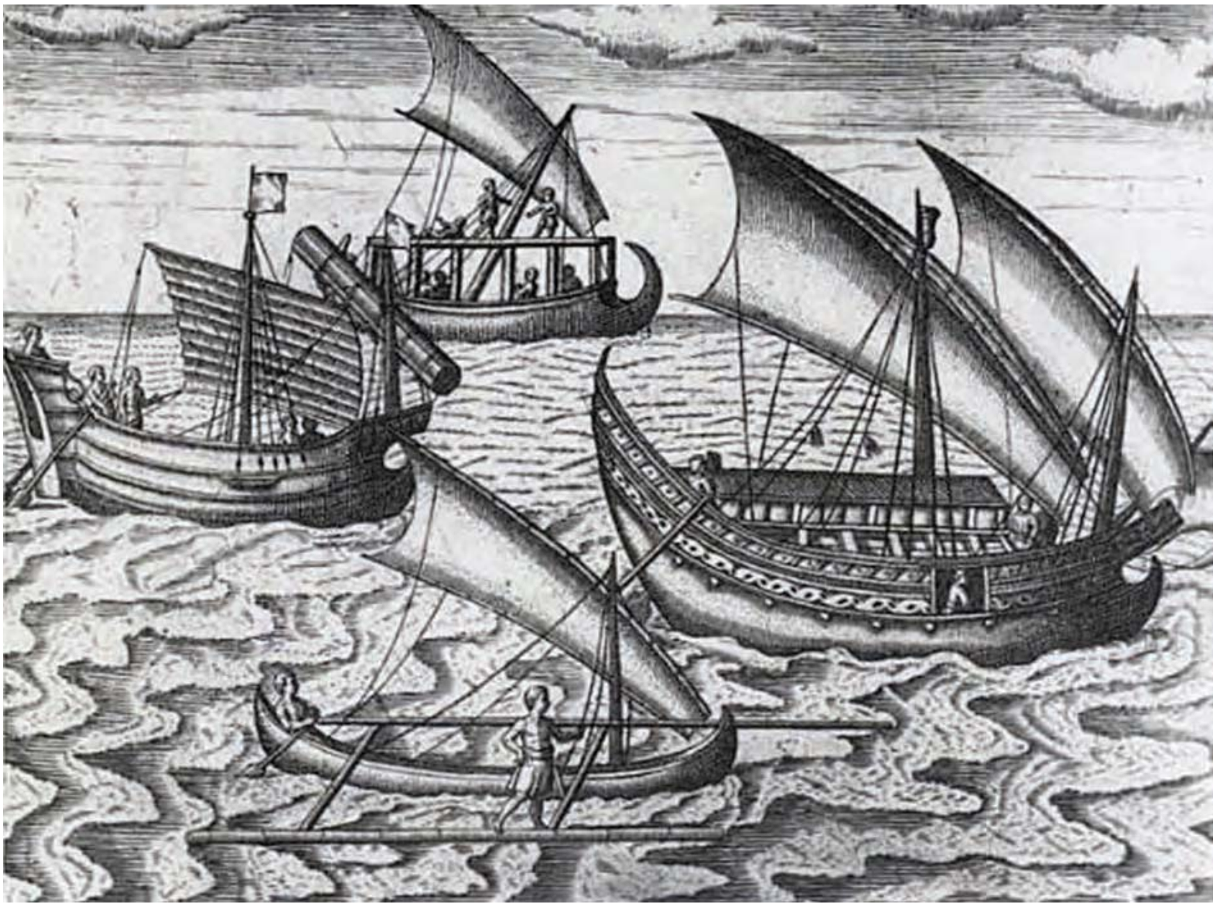
2.5 From Srivijaya to Majapahit, Javanese Jong: the South-East Asia Tradition

After the evidence which attests to the South-East Asian stitched tradition, the textual and archaeological data related to vessels from the thirteenth and fourteenth centuries indicates a radical shift to fully dowelled ships. There is little data to document this progressive evolution (Manguin, 1993, pp. 265), but data relative to South-East Asian ships from the sixteenth century onwards, is relatively complete and allows us to form a firm image of the technology used at that time.

From the fifteenth century onwards, European textual evidence provides descriptions of large seagoing ships called 'jong' in Malay (or Javanese) or 'junco' in Portuguese and makes it possible to understand the design of the trading shippers of the region.

Following the earlier stitched plank tradition, jongs were assembled only using wooden dowels and without iron. Related to their Kunlun ancestor's bo, the jongs were very large vessels, capable of carrying up to 500 tons with a large capacity for passengers. Their V-shaped hull was formed on a keel piece and consisted of a multiple sheathing of hard wood, probably constructed near the teak forests of North Java and South Borneo (Manguin, 1980). Jongs were fitted with multiple masts (and a bowsprit), rigged with canted or lug sails and steered with two lateral rudders.

As these boats are classic examples of South-East Asian tradition, from the sixteenth century the words junco, jonque and junk are terms commonly used to describe all kinds of large ships encountered in the region (McGrail, 2001, pp. 308), as well as Chinese ships.



A late sixteenth century drawing of double outriggers and a Javanese jong in the Banda Sea. © De Bry 1629, plate 28

2.6 The Chinese Junks

Prior to the Song Dynasty, the Chinese vessels were essentially fluvial (Manguin, 1980, pp. 276) and it is only since then that the Middle Kingdom started to build powerful oceangoing fleets. By the thirteenth century, the Yuan Dynasty took control of the seas (and later shipbuilding technology) and seafaring culminated during the Ming Dynasty with the voyages of the General Zeng He.

The earliest material evidence of Chinese river boats that date back earlier than the tenth century, consists of three planked river boats (Peng, 1988, pp. 32) and of the remains of the Tang Dynasty Rugao river boat (Green, 1986). Additional information provided by the Qing Ming scroll (1085-1145 AD) gives a more accurate idea of what the fluvial junks looked like. From here, it is possible to identify the basic characteristics of the Chinese fluvial junks that were retained until later periods.

A nanjing or sand ship has a flat bottom that allows it to theoretically be beached or to travel in river channels. On this Chinese merchant ship depicted on the eighteenth century picture scroll 'Tosen no Zu' (Matsura Historical Museum), it is possible to clearly see the flat transom and the leeboards. This type of ship belongs to a Northern type of Chinese boat building tradition. © Matsura Historical Museum/Jun Kimura

A fuzhou ship is typically a Southern Chinese ship-building tradition. It is possible to recognize the bamboo battened sails, a clear hanging axial rudder and a keel. This ship also figures on the eighteenth century picture scroll 'Tosen no Zu' (Matsura Historical Museum). © Matsura Historical Museum/Jun Kimura

The Chinese junks were constructed shell first with a single layer of carvel planking and fastened with iron nails and clamps. They have a flat bottom design to suit their riverine environment, an overhanging flat transom and the stern is typically the largest part of the vessel.

Another important construction feature of the boats in China is the conception of bulkheads or wooden partitions that provide the transversal strength (instead of frames) and creates watertight compartments within the ship. There is evidence of bulkheads since before the Tang Dynasty, as illustrated by the Rugao boat.

In terms of propulsion and steering systems, there is little information available to identify the poles or steering oars that could have been used, yet, it is possible that the yuloh (a sculling oar over the stern) appeared during the Han Dynasty (McGrail, 2001, pp. 356). It is also quite plausible that in early times, the boats were towed from the river banks. From at least the second century onwards, the axial suspended rudder was commonly used (Manguin, 2010, pp. 336). The Chinese use of sails (most likely the square sail) appears to have begun in the Han Dynasty, followed by the introduction of lug sails somewhere around the time of the twelfth century.

As a result of cross-cultural influences and the presence of foreign ships in Chinese harbours, by the late tenth century the Chinese started developing what became a great oceangoing navy. By the thirteenth century, the Yuan Dynasty (the Mongols) under Kublai Khan followed in their ancestor's footsteps and set about expanding their territory.

In 1274 and 1281 AD, enormous fleets were sent to invade Japan, but both times a 'divine wind' called Kamikaze destroyed the fleets. The Yuan also had views on northern Viet Nam, but there, the fleet was destroyed at the famous naval battle site of Bach Dang, where the Vietnamese planted wooden stakes in the river, so that when the river ebbed, the fleet was impaled in a forest of stakes and finally annihilated.

Later, in 1293 AD, a large invasion fleet was sent to Java to punish King Kertanegara for having refused to pay tribute. So it is possible that at this time, the South-East Asian shipbuilders adopted the Chinese feature of transverse bulkheads. The defeats of Kublai Khan's navy in Japan, Viet Nam and Java paved the way for the downfall of the Yuan Dynasty (Delgado, 2009, pp. 168). Unfortunately in terms of material evidence, there is little remaining about the boats that existed during that time period (Kimura 2006; Sasaki, 2006).

Boat building in Northern Viet Nam, demonstrating the Chinese tradition of using iron nails. © Colin Palmer

The Yuan Dynasty (1279-1368) was followed by the Ming Dynasty. It is during this period that the famous treasure fleet of General Zeng He was constructed in Nanjing for world exploration. It is said that these ships could reach 120 metres long, had nine masts, a beam of 50 metres (more or less the size of a football field) and a capacity of 1,500 tons. Between 1405 and 1433 AD, the General made thirteen voyages. However, the fleet was destroyed along with all the documents related to these voyages in 1465 AD, when the successors of Emperor Yonle shifted China's foreign policy inwards. The Haijin laws, which enacted a strict ban on private maritime activity until they were abolished in 1567 AD, included restrictions on ships sizes in shipbuilding, banned overseas trade (apart official tribute missions), shut coastal facilities and overall, limited foreign contact.

These events consequently had a great influence on the rest of the trade and shipbuilding in the region and potentially lead to the conception of the 'hybrid' tradition of the South China Sea.

2.7 The South China Sea 'Hybrid' Tradition

From the fifteenth century onwards, both Chinese and South-East Asian vessels sailed the seas, the respective features of each, appearing on ships around the region. These features can be clearly identified on multiple shipwrecks dating from the late fourteenth to the late sixteenth century, and suggests a hybrid tradition that Manguin proposed to term 'South China Sea tradition' (1984: 199). This term is used to define this group, which still allows individual traits and distinctive characteristics, but demonstrates a common international trend in shipbuilding.

This tradition is closely linked to the context of economic changes along the South China Sea and is the result of maritime trade and cultural, political and commercial interactions of the time. For example, when the Ming issued their edict on the ban of private overseas trade it triggered the rise of new production centres, such as the ceramics from Thailand and Dai Viet's kilns. The predominance of shipwrecked hybrid ships in the Gulf of Thailand and along the Malaysian coast reflects this surge in Thai production (Flecker, 2007, pp. 81). Certainly, by restricting the commercial activities, shipbuilding declined and this had a specific impact on boat designs in the region.

By this point in history, a new maritime power had risen in Java, the Majapahit. They sailed jongs and increased the presence of South-East Asian ships on the seas. South-East Asian shipyards also provided ships to the Chinese diaspora when they settled in local harbours and commercial centres (Manguin, 1993, pp. 274). Manguin (2010, pp. 348) wrote,

> *as a consequence, the hybrid Sino/South-East Asian shipbuilding tradition, that had came into being in earlier times, appears to have expanded under the Ming, and to have grown into a regular configuration for ships regularly plying South China Sea waters. It coexisted with the still lively indigenous traditions of both China and Insular South-East Asia, as a legitimate offspring of various degrees of interaction between sea-oriented ethnic groups living on the shores of the Asian 'Mediterranean'.*

Shipwreck remains show vessels from this period are a blend of designs; the V-shaped hull, the keel and a thin pointed bow of the South-East Asian tradition, with the partitioning of the hull in compartments following the Chinese tradition. Yet, these 'bulkheads' are not watertight and frames share the structural strength. Additionally, shipwreck remains show the use of iron nails similar to those used by the Chinese, alongside wooden dowels. In some instances, the ships included either Chinese steering systems with an axial rudder or South-East Asian with a lateral rudder (MgGrail, 2001, pp. 299-301, Flecker, 2007).

Boat building in Southern Viet Nam, demonstrating the South-East Asian tradition of using wooden pegs. © Colin Palmer

There are still so many maritime traditions that have yet to be documented, such as the fascinating single leg rowers of Inle Lake, Myanmar. © Charlotte Minh-Hà Pham

3 Various Shipbuilding Traditions in the Region

3.1 The Malay Archipelago

The Malay Archipelago encompasses the Philippines, Singapore, Brunei Darussalam, East Malaysia, Timor-Leste and the islands of Indonesia. It is a region rich with maritime tradition and considered the cradle of great ancient seafaring nations, such as Srivijaya, the Majapahit or the secular Bajau. In this region, maritime trade and boat construction are usually connected to particular groups of people, including the Bugis, the Madurese, the 'Sea Gypsies' Bajau, the Mandar or the Butungese. As each of the independent cultural traditions of these groups are difficult to isolate, it is important to gain knowledge of the islands, their interactions and cross-cultural contexts to better understand boat building and boat use in the region.

Outrigger boats and perahu are commonly considered the most representative types of boat of the archipelago, but the boat traditions in the region are much more diverse. Prau or perahu is actually a generic term that varies in time and according to geographic location. There are multiple ways to spell the word, including praw, prauwe, proa, perahu, or prau. According to Hawkins (1982, pp. 7) the spelling 'prau' is the most accurate to those who built and sailed such vessels. However, that name is narrow in scope as Indonesian linguistic groups have specific names for various watercrafts, which can range in size from canoes to multi-masted sailing traders (May et al., 2009, pp. 3). Liebner, Burningham and Stenross, who are specialists in boat traditions in Indonesia, tend to use the word 'perahu', to describe wooden vessels that are particularly used for transportation work. As Stenross (2007, pp. 2) explains,

> *it can refer to any sort of small vessel. However, in maritime transport circles it refers to substantial wooden craft of traditional or semi-traditional style, intended for cargo work. In Madura, small open vessels of up to 10m in length which may be used for either fishing or short haul transport are referred to as 'sampan' a word borrowed from Chinese, although the boats bear no resemblance to the various small Chinese vessels known by this name – while the term perahu (in Madurese, parao) is reserved for larger vessels, usually decked over. A ship is referred to as kapal. Some large perahu are effectively small ships and indeed nowadays designated so for official purposed but they are nevertheless referred to in common parlance among those who used them as 'perahu'.*

It is impossible to address here in depth the myriad of boat traditions of the region or even to name them all. Therefore, for each country, only some main references (in English language) are listed, with a brief summary on boat types and/or the archaeological evidence or relevant excavation, investigation or project.

3.2 Malaysia

3.2.1 Boats Types

The sailboats of Malaysia (or perahu besar) come in two types, the bedar and the pinas. Similar to broad South-East Asian traditions, boats in Malaysia are built without a plan, constructing the hull first and fitting the frames later. The planks are fire bent and joined edge on edge using ironwood dowels. Before the new plank is hammered on, a strip of the bark of a tree is placed over the dowels. The planks are usually separated by a 1 to 2 mm layer of a natural material which contains sealing properties. This is an ancient and unique building technique, the origin of which might date back to the Proto-Malay migrations that colonized the archipelago thousands of years ago.

There are several types of fishing boats around the Malay Peninsula, such as kolek, payang, bedar and sekoci, alongside four types of perahu besar, such as the dogol, pinis dogol, pinis gobel and anak bedar. The perahu besar vessels plied the trade routes around what is modern day Viet Nam and Indonesia.

3.2.2 Archaeological Evidence: Log Boats

In Sarawak, graves dated to the mid-second millennium BCE to the mid-first millennium BCE include log coffins with plank lids, or coffins made of stitched bamboo strips. Such burial coffins are also found elsewhere in Malaya and Viet Nam (Dong Son log boat coffins).

Three log boats used for burial purposes were found in a site in Malaya (Kuala Selinsing), yet only one was excavated and was dated to the second to third century. The excavated log boat provided the earliest evidence for the feature which has become a diagnostic characteristic of the South-East Asian tradition of plank boats; series of integral pierced rectangular cleats with spacing between series, which suggests that one or more strakes had been added to give a greater freeboard. In more recent plank boats traditions, flexible ribs were lashed to such cleats (McGrail, 2001, pp. 294).

There is also evidence of a treenailed boat, on a fragment of planking found south of Kuala Lumpur and dated to 465-655 AD (Manguin, 1996), and the previously mentioned Pontian boat remains, dated to 260-430 AD and belonging to the lash-lug tradition.

3.2.3 Naga Pelangi Projects

Christoph Swoboda, reconstructed a 14 metre perahu bedar, named the *Naga Pelangi*. Once complete, this traditionally rigged vessel was sailed around the world and became the first contemporary indigenous Malay sailing boat to finish a circumnavigation, thus proving the seaworthiness of this type of craft. In 2003, Christoph started the construction of a second boat, this time of a pinas type with a length of over 20 metres, named the *Naga Pelangi II*.

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3.3 Indonesia

3.3.1 Boat Types

There are several types of boats found in Indonesia, including:

- *Padewakang of South Sulawesi (Liebner, 2004)*
- *Pinisiq (variously spelled pinissi, pinisi, or phinisi)/lamba/palari (Liebner, 2004)*
- *Perahu jukung, the traditional Balinese boat (Spoehr, 1980; Herron, 1993, 1994)*
- *Tena of Lembata, used for traditional whale fishing (Barnes 1985, 1996; Butcher, 2004)*
- *The kora kora of the Moluccas (Hornell, 1946; Horridge, 1979a, 1982).*
- *Perahu mayang of Java (Stenross, 2007)*
- *Madurese boats: golekan, janggolan and lete-lete (Stenross, 2007)*

3.3.2. Iconographical Evidence: the Borobudur Ships (Java)

The carvings on a relief at Borobudur are the earliest depictions of South-East Asian vessels, with or without outriggers, yet their true origin is still debated as they are not considered as being typically Javanese sailing crafts (Manguin, 1980; Burningham, 2004; Jahan, 2006).

3.3.3 Archaeological Evidence

In the region of Palembang (South Sumatra), the ancient capital of Srivjiaya, twenty-four discovered planks seem to be related to the stitched tradition. The planks have stitched fastenings and cleats to which ribs were lashed and appear to belong to a large and sturdy hull. The calibrated date of the wood sample gives 434-631 AD (Manguin, 1993, pp. 257).

Other remains of a boat found near Sambirejo elucidate the evolution of the lash-lug to the treenailed tradition. Dated to the 610-775 AD, the remains show stitches that supplement the unlocked treenails, ensuring that the planking was held fast. It may be classified as a treenail fastened boat (McGrail, 2001, pp. 198); the framing timbers are lashed to cleats integral with the planking.

Remains of large sewn-plank ships at Paya Pasir (North Sumatra) found with Chinese ceramics and hence dated to the twelfth to fourteenth century, show treenails, cleats and a lashing system. This was not a flexible framing, but a reinforcing framing for a relatively large vessel, possibly up to 30 metres in length (Manguin 1996).

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3.4 Brunei Darussalam

3.4.1 Boat Types

Brunei Darussalam was also an essential fraction of the Malay Peninsula, a maritime empire who, during the sixteenth century, controlled the entire island of Borneo, as well as parts of the Southern Philippines and Northern Java and traded with all the countries in the region.

During an exhibition in 2006 and as part of the collection of the Malay Technology Museum in Kota Batu, several boat types were described including the tongkang, pengabat, pelauk, bagong, pedayong, kumpit and bidar temuai.

3.4.2 Archaeological Evidence

In this region there are two primary sites of interest, the Limau Manis River archaeological site and the Kota Batu site. Investigations at Kota Batu revealed that boat building industries have existed in Brunei Darussalam for a long time, as ceramics found in the area dated back to the fourteenth to seventeenth centuries and were mainly from the Ming Dynasty. The site of Kampung Limau Manis is older. More than tens of thousands of ceramic shards ranging from the Song to the Yuan Dynasties (tenth to fourteenth centuries) were found on the site, alongside the remains of small boats, believed to be have been built during the same era (Rozan, 2010).

3.4.3 The Brunei Shipwreck

Lost during the reign of the Sultan Bolkiah (1485-1524), the commonly called 'Brunei shipwreck' was transporting Chinese and Thai products when it sank 40 km off the coast of Brunei Darussalam. In 1998, French maritime archaeologists (Association for the Development of Maritime Archaeological Research) conducted an excavation and a survey.

Identified as belonging to the Chinese tradition, some 13,000 artefacts recovered originated from Thailand, Viet Nam and China illustrate the flourishing trade belonging to Brunei Darussalam some 500 years ago.

The ships from Brunei Darussalam were exporting local products to the Philippines, Siam or the Moluccas, yet little is known of their return journeys, so this shipwreck provides a unique insight into Brunei Darussalam's consumption of foreign goods and the ship's voyage back home. China at that time was isolating itself and had banned all forms of seafaring trade, so most foreign merchants who wanted to deal directly with China came bearing tributes to the Chinese Emperor. Local traders were forced to smuggle exported goods if they wanted to take part in international trade, which in turn lead them to contribute to the hybridisation of naval technology (L'Hour, 2001; Pirazzoli-t'Serstevens, 2011).

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3.5 Philippines

3.5.1 Boat Types

Banca or bangka: is the most commonly used term to refer to boats in the Philippines, such as non-houseboats, with or without outriggers. The Bajau do not have a general term comparable to the English word 'boat' that applies to all watercraft, but rather have a term for each boat type. These terms are often used casually, for example, two Bajau may use different names for the same boat, and similarly the names used for the parts of the boats may vary from person to person (Nimmo, 1990, pp. 60).

The balangay: (balangai) or Butuan boat is considered as the oldest means of transportation by which the Filipinos or people of Samar migrated to the country. The earliest boat finds (the Butuan boats) were all balangays; a name that originates from the Austronesian word for 'sailboat'.

The birau: is similar to a boggo. The only difference is that the Birau is designed so that the bow and stern both slope inward, whereas those of the boggo drop perpendicularly or outward.

The bitok: features a wider beam and a shallower hull than that of either the boggo or birau. It also rarely has outriggers or added planks.

The junkun: typically consists of a simple dugout hull, although a plank is frequently added to either side. It occasionally features outriggers. Typically 2.5 to 8 metres in length, this type of boat is used for fishing or short distance travel.

The tonda'an: is a fishing boat which is essentially a smaller version of the pilang, shorter, with fewer planks and usually lacking elaborate carving. The outrigger attachment is also typically much simpler.

Other notable boat types include:

- *Vinta of Mindanao (Doran, 1973; Doran, 1981)*
- *Pilang/Lipa (double outrigger)*
- *Lipa and pidlas of Tawi Tawi (Nimmo, 1990, pp. 61)*
- *Tawi-Tawi bajau boats*
- *Bettu (lightwood rivercraft)*
- *Pedda (flat hardwood dug-out)*
- *Birok (rough-hewn dugout for fishing)*
- *Bog-goh (sailboat for transport)*
- *Boggo (a simple dugout, 1.5 to 4.5 metres in length)*

3.5.2 Archaeological Evidence

Only three of the nine 'Butuan boats' were excavated, out of which one is dated to 320 AD, one to 1250 AD, while one is still undergoing preservation treatment (the remainder are preserved *in situ*). The planking of the Butuan finds is edge-joined with treenails, and cleat blocks (lugs) integral to the framing had pairs of holes through which the framing was lashed to the planking (Clark et al., 1993; Green et al., 1995). The planks, which were made from a type of hardwood called doongon in the Philippines (*Heritiera littoralis*), were fastened together every 12 centimetres, where holes were driven on the edge of each plank. On the inner side of the boat the planks were provided, at regular intervals, with raised rectangular lugs, carved from the same plank, through which holes were bored diagonally from the sides to the surface (Casal et al., 2003). The National Museum of the Philippines is expected to conduct further research on the remaining Butuan boats in 2012.

3.5.3 The Balangay Replica

In the summer of 2009, the National Museum in cooperation with Bajaus carpenters from Sibutu and Sitangkai carpenters from Tawi-Tawi, built under the driving force of Art Valdez, a replica of a balangay, called *Ngandahig*. The result was not an exact copy of the ancient boat, but one that incorporated the design and construction methods of the Samar people. The main aim of the project is to sail on the routes used by the Filipino Ancestors during the waves of Austronesian settlement that spread throughout the Malay region and the Pacific. In 2009, the project covered seven legs around the Philippines, covering 2,108 nautical miles before culminating at the tip of Sulu. In 2010, South-East Asian waters were sailed, while in 2011, the Balangay retraced the voyages to Micronesia and Madagascar. In 2012, the balangay will sail across the Pacific onward to the Atlantic, all the way around the world, before heading back home to the Philippines in 2013.

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3.6 Viet Nam

Located at a crossroads along the trade routes of South-East Asia, the long coast of Viet Nam enjoys incredible boat diversity. There are two main trends in boatbuilding are clearly related to the two main groups who controlled the region; the Dai Viet and the Champa. Each trend reflects their own cultural, political and economical ties and connections; the Dai Viet linked to its Chinese heritage and influence and the Champa sharing common traits with South-East Asian traditions. A blend of these two main influences can be seen in the features of the planked boats of Viet Nam, but other types of crafts are also still seen along the beaches and lagunas that demonstrate how 'primitive' traditions may have evolved. The great diversity of boats in Viet Nam can be categorized in six groups if looking only at the hull construction: bamboo rafts, basket boats, mixed hulls (basket and planking), stitched boats, planked boats, and log boats (Pham et al., 2010).

3.6.1 Shipwrecks Found in Vietnamese Waters

Several underwater investigations occurred between 1992 and 2002, before a law that prevents illegal treasure hunting and underwater investigations was issued in July 2005 (The Decree No. 86/2005/ND-CP on Management and Protection of Underwater Cultural Heritage).

These explorations produced significant information, maybe not for the archaeological understanding of the shipwrecks themselves, but for the improved knowledge of the different regional trade patterns through the recovered ceramic cargoes. Five wrecks were officially excavated in Vietnamese waters (Nguyen Dinh Chien and Pham Quoc Quan, 2008). None originate from Viet Nam or belong to a Vietnamese tradition, yet, they still add knowledge of the main boat building traditions in South-East Asia and their cargo happened to be very significant in terms of art history (Guy, 2001; Flecker, 2002; Guy, 2005, 2007). The excavations were officially conducted by Vietnamese experts, but were initiated by foreigners and supported by international investments.

1. Hon Cau wreck (1620), also called the 'Vung Tau' wreck, was investigated in 1990 to 1991. The work was conducted by Viet Nam National Salvage Agency (VISAL), Hallstrom Holdings Oceanic and Michael Flecker (Flecker, 1992; Jörg and Flecker, 2001).

2. The Phu Quoc wreck, also called the 'Hon Dam wreck' was dated to the fifteenth century. The ship remains yielded about 16,000 artefacts comprising of celadon and brown porcelain from Sawankhalok's kiln in Thailand (Flecker, 1994; Brown, 1997). The wreck lay at a depth of 40 metres and the investigation was mainly conducted by VISAL, Michael Flecker and Warren Blake.

3. The Cu Lao Cham wreck was investigated in 1997 and considered to be the biggest and most costly salvage conducted in Viet Nam. The wreck lay at a depth of 72 metres, so required an array of advanced technology to recover some 200,000 ceramic artefacts. Various bodies were involved in the investigation and recovery, including VISAL, Mensun Bound, Saga Horizon (Malaysia) and the National Museum of Vietnamese History of Hanoi.

4. The Ca Mau wreck (1723-1735) was discovered 36 metres beneath the surface and was investigated between 1998 and 1999. The project recovered a large cargo of about 60,000 blue and white porcelains from China. The work was conducted by VISAL, the National Museum of Vietnamese History and the Museum of Cau Mau.

5. The Binh Thuan wreck (1573-1620) was investigated between 2001 and 2002 by Michael Flecker with the collaboration of VISAL and the Museum of Vietnamese History (Nguyen Dinh Chien and Flecker, 2003; Flecker, 2004).

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3.7 Cambodia

Boat traditions in Cambodia have not been extensively studied, although there is an interesting diversity in the three main bodies of water that belong to Cambodia, namely the coast of the Gulf of Thailand, the Mekong River and the great Ton Le Sap Lake.

3.7.1 Boat Types

Dugouts: various kinds of dugouts can still be found, such as palm boats which are found in flood plains, or the long racing boats that are constructed to compete in dragon boat races during the annual Khmer water festival (Groslier, 1921; Walker-Vadillo, 2010, pers. comm.).

Plank boats: there are also different types of plank boats. For example, on the Mekong near Stung Treng, there is a narrow-shaped flush-laid plank boat that features a raised, pointed bow, thus exhibiting a strong Laotian influence (Nugent, 2009). Most of the river boats are narrow and long, essentially evolving from a dugout base with added planking. These long canoes are present all along the river from south to north of Cambodia. Some long boats are so elongated that they are referred to as 'needle boats' (Ken Preston, 2010, pers. comm.). In addition, there is the typical Khmer 'pirogue' which is found throughout the country and has a very distinctive hull shape, being sat very low to the water. There are a few variations regionally to propulsion and steering.

Additional boat types include the tuk chaleum (from the Mekong delta), the tuk prabel and tuk chap ky.

3.7.2 Iconographical Evidence

The twelfth century bas reliefs from the Bayon and Banteay Chmar temples feature incredibly detailed depictions of the boats used in times of leisure or war. An interpretation of their nautical features can be found as part of research conducted by Walker-Vadillo in 2008.

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3.8. Laos

There is very little English language knowledge of boat traditions in Laos. At this stage it is only possible to note that the transition between the upper and lower Mekong, which is located at the border between Laos and Cambodia, implies changes in boat traditions. The boats on the Mekong in Laos are long, narrow, flat bottomed and made with just a few thin planks, in comparison to the heavier Cambodian hulls (Ken Preston, 2010, pers. comm.)

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3.9 Thailand

3.9.1. Boat Types

'The boats of the Siamese are innumerable. They are of many sizes and styles, but always beautifully, if simply, constructed from teak. No people in the world, indeed, have such variety of craft, or craft with lines so invariably graceful' (Whitney, 1900, pp. 628-630).

- *The majority of boat types are based on the rudimentary lines of the Rua Chang*
- *Dugouts used on the canals*
- *Royal racing canoes*
- *Royal barges*

3.9.2 Archaeological Evidence

In terms of archaeological remains, various shipwrecks belonging to the South-East Asian tradition or to the South China Sea tradition (with treenailed planking) have been found in the Gulf of Thailand.

The Pattaya was found off the east coast of Thailand and dated to fourteenth or fifteenth century. This boat features a keel, a round hull and Chinese bulkheads, but is also constructed according to the South-East Asian tradition of treenailed planking (three layers).

The Ko Si Chang 3 was a trading vessel of over 20 metres in length and dated to the fifteenth or sixteenth century. The elements excavated included a keel, six strakes of inner planking, some outer planking and possible sheathing, nine bulkheads, frames and a mast step timber (McGrail, 2001, pp. 301). The inner planking is fastened edge to edge with treenails.

The Ko Kradat shipwreck also featured edge to edge planking, fastened with treenails. The pottery artefacts recovered from the site dated to the sixteenth century.

The Ko Si Chang I also has bulkheads, planking fastened edge-to edge, a keel and may have been measured approximately25 metres in length.

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3.10 Myanmar

3.10.1 The One Legged Rowers of Inle Lake

Most transportation on Inle Lake is traditionally conducted by either small boats or by somewhat larger very long and shallow draft boats, fitted with outboard motors. One of the most distinctive sights on the Inle Lake, however, is the local fishermen and their unique rowing style which involves standing at the stern on one leg and wrapping the other leg around the oar to manoeuvre.

This rowing style probably evolved because of the natural conditions on the lake as it is quite shallow and covered with reeds and floating plants, which make it difficult to see beyond while sitting. Standing provides the rower with a clearer view and easier steering. To fish, the local fishermen push conical traps down vertically with one hand, while their other hand and leg manoeuvre the boat.

3.10.2 The Kabang of the Moken Sea-Gypsies of the Andaman Sea

The Moken or Sea Gypsies spend almost half of their life in a kabang, travelling in fleets of ten to forty boats. In the Moken culture, people and boat are almost inseparable and to understand their boat technology, one needs to understand their cultural and symbolic context (Ivanoff et al. 1997, 1999). The kabang are used for cooking, sleeping and as a work space throughout most of the year. When the monsoon rains started to fall, the Moken would go ashore and build shelters on small islands to wait out the rainy season.

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3.11 Bay of Bengal

3.11.1 Eastern Coast of India: the Andhra Pradesh Coast

In India, the diversity of boats is as overwhelming as the diversity of its population and history. Each region and location has its own distinctive traditional boats and boat building technology. For example, the Andhra Pradesh coast is known for four types of traditional boats constructed for cargo transport, fishing and ferrying purposes: catamarans (teppa), dugout canoes, stitched-planks built boats and nailed-planks built boats. Teppas are simple floating devices, but are the predominant traditional sea craft along the Andhra Pradesh. Some keeled planked boats that are locally called padavas are also common vessels along the Andhra coastline (Thivakaran and Rajamanickam, 1993; Tripati, 2006).

Orissa is famed for its maritime trade and vast network of maritime contacts that were established during the Early Historic period. Notable shipbuilding traditions include the Boitas (or Voitas) that were built in during the heyday of the Kalinga Empire, and the Patia. The Patia demonstrates a specific boat tradition, as it is constructed with the reverse clinker technique (in the planking, the lower strakes lap each other in the opposite manner to that used in the Northern European tradition of clinker planking). Visually stunning with its sweeping strakes, the patia is one of the most complex traditional boat constructions in the world.

Frame-first vessels of Tamil Nadu include the vattai and the vallam. These boats are interesting because they are built frame-first (unlike all other traditional plank boats observed on the east coast of India) and they are generally similar in structure and form. Furthermore, they are designed using variants of a standard technique which was probably brought to India by Europeans, possibly by the Portuguese in the sixteenth century. Vallam are either extended log boats with a rounded bottom and flared or narrow 'carvel-built' plank boats. The Vattai, in comparison, is an open fishing boat that features three, sometimes two masts, balance boards and leeboards (Blue et al. 1998; Kentley et al., 2000)

3.11.2 Boat Types of Bangladesh

Basil Greenhill (1957, 1966 and 1971) provided one of the earliest analysis and system of classification of the boats from Bangladesh.

As a result of the inconsistencies in boat names, Greenhill classifies them based on their features, as follows:

- *Round hulled, smooth skinned (binekata in Bangla)*
- *Round hulled clinker (digekata)*
- *Clinker boats of the Upper Ganges*
- *Chine built, smooth skinned of Dhaka region*
- *Flat bottomed boats (koshas)*
- *Dugouts (log boats)*

3.11.3 The Oru of Sri Lanka

The oru, an outrigger boat with a dugout hull from the south and west coasts of Sri Lanka, is probably the most representative type of boat for the region. Thirty-five types of this vessel were extensively documented by Kapitan (2009) in his beautiful collection of scale drawings and photographs.

Based on types of fishing and environment, Kapitan identified five different kinds of watercraft in Sri Lanka; the raft, vallam, oru, angula and ma-del-paru.

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3.12. West Indian Coast and Goa

3.12.1. Boat Types of Goa

Goa is a former Portuguese colony on the west coast of India. Here, the fishing boats are named after saints, and the owners and crew of the vessels make offerings to the relevant saint on his or her feast day.

Different kinds of boats can still be seen along the Goan coast, including dugouts, plank boats of different sizes and shapes (with or without outrigger), sewn-planked boats and motorized fishing boats.

3.12.2. Some Boat Types of the West Indian Coast

On the Kerala coast, there are different kinds of rafts, dugouts and plank built boats (stitched and nailed). The smallest craft of the Karnataka region is a canoe, known as a hudi, which is scooped out of a single tree trunk. Here, mid-sized crafts are known as doni (boat) while the largest crafts are known as machchwa (ship). (Gaur, 1993; Sundaresh, 1993).

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3.13 The Arabian Sea/Oman/Pakistan

Arabia and Persia were two distinct and independent trading nations, but from historical evidence alone it is impossible to distinguish clearly between Arabian and Persian ships, as the interaction and inter-influence across the Arabian Sea was so great (Flecker, 2001*b*).

Stitched hull construction was the only technique used by both Indians and Arabs, until iron nails were introduced by the Portuguese (Hourani, 1995, pp. 93). Evidence on this early tradition is presented in the chapters of the *Periplus of the Erythraean Sea* (first century) and continues to be mentioned in descriptions of this region from the sixth century to the present (Hornell, 1942; McGrail, 1996).

3.13.1 The Dhow

A dhow is a traditional Arab sailing vessel, easily recognisable with its triangular lateen sails, pointed overhanging bow, sheer rising to a high poop and a racked transom. It is primarily used to carry heavy items, such as fruit, along the coasts of the Arabian Peninsula, Pakistan, India and East Africa to China, through the Straits of Malacca. Larger dhows have crews of approximately thirty people, while smaller dhows typically have crews of around twelve. Dhows are much larger than feluccas, another type of Arab boat usually used in fresh water in Egypt, Sudan and Iraq (Hawkins, 1977).

3.13.2 Boat types of Oman

Some of the traditional boat of Oman recorded by Vosmer and his team (1992; 1997; 2000) are as follows:

Badan: there are two basic types of badan, the fishing badan and the larger cargo badan, both known locally as a uwaissiyyah.

Baggarah: a long, narrow vessel with long raking stem and radically upswept stem sections.

Baghlah: large cargo vessel distinguished by its elaborately decorated high poop and quarter galleries.

Battil: a type of double-ended vessel with club shaped stem head and stem profile, in the shape of a stylized dog's head. The end of the stems of these vessels are usually covered in goat skin.

Boom: a double ended vessel which features a sharply raking stem and less sharply raked stempost. The stem is normally painted with a black and white motif and bears one or two masts.

Ghanjan: very similar to the baghlah, but less elaborately decorated. Its stemhead features a distinctive decoration of concentric circles surmounted by a trefoil crest.

Houri: dugout canoe or extended dugout.

Jalibut: a transom-sterned vessel with vertical stem.

Karib: large fibreglass dinghy that is powered by an outboard motor and used for fishing.

Shashah: a small one or two person vessel made from the spines of date palm fronds.

Shu'l: a transom-sterned vessel with straight stem that ends in an ogee curve. Commonly used for fishing.

3.13.3 The Belitung Wreck

Located near the island of Belitung (Indonesia), the Belitung wreck (also known as the Tang wreck) is an Arabian or Indian ship dated to the ninth century whose cargo includes ceramics from the Tang Dynasty (618-906 AD). The wreck provided the first evidence that clearly demonstrated direct trade between the Indian Ocean and China during the latter part of the first millennium.

The analysis of its construction method, hull form and timber species shows similarities with both traditions. Wood analysis could have helped determine the origin of the ship, but the analysis was inconclusive due to the poor state of the wooden samples (Flecker, 2001*b*, pp. 347).

3.13.4 Jewel of Muscat

The *Jewel of Muscat* is a replica of a ninth century sailing ship whose reconstruction was based on a range of historical sources, including the findings of the Belitung wreck. The 18 metre ship was built without nails and the planks were sewn together with coconut fibre. Her voyage started in February 2010, in Oman, with stops in India, Sri Lanka and Malaysia, before ending in Singapore four months later. The journey retraced part of the historic maritime trade route between Arabia and the Far East.

The project was funded and supported by the governments of Oman and Singapore. Every stage of the *Jewel of Muscat*'s construction and voyage was documented and can be seen at: www.jewelofmuscat.tv (Accessed March 2012).

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Unit Summary

This unit explores the terminology, building techniques and boat types of Asia and even further a field. Having been introduced to different construction methods, students have the basic interpretation tools required to identify future underwater finds.

By exploring the traditions of the region, we can clearly illustrate how each feature of each type of boat is designed for a different purpose that do not just relate to functional or environmental factors. The design of a ship, its concept, overall purpose and construction sequence are dictated by the people who construct and use them, by the materials that are available and also the political, social and economical context of the period. Boats reflect a region's history and help archaeologists and historians to place local traditions in a wider maritime historical landscape.

It is important to remember, however, that although this unit introduces numerous boat types and building traditions, knowledge is still lacking in countries, such as Myanmar and Cambodia. Even in areas where we appear to have a great understanding, documentation and data is often hard to access (particularly in the English language) and much of the information presented has not been collected during archaeological excavations.

Unfortunately, through events such as the Tsunami in 2004, these traditions are disappearing much faster than is anticipated and further research is required to preserve maritime cultural heritage and craft traditions. It is hoped that in the next few years new archaeological excavations, that incorporate a holistic approach, will increase the knowledge of past Asian shipbuilding technology.

Small traditional boats are still used, but are fast disappearing along with traditional crafts and ways of life.
Inle Lake, Myanmar. © Charlotte Minh-Hà Pham

Suggested Timetable

15 mins	Introduction to Asian Shipbuilding Technology
	Break
60 mins	General Boat Technology - *The Basics of Boats, Ships, Vessels and Watercraft* - *Basic Boat Types* - *Specific Purposes and Categories*
	Break
120 mins	Practical Session: Boat Terminology
	Break
60 mins	Asian Shipbuilding Technology: Main Traditions
	Break
60 mins	Practical Session: on Each Country: Part I
	Break
60 mins	Practical Session on Each Country: Part II
	Break
60 mins	Present 5 Minute Description of One Specific Boat Type per Country - *Complete reference list on boat traditions* - *Exchange documents*
10 mins	Concluding Remarks and Closure

Teaching Suggestions

Trainers should present the various aspects of Asian shipbuilding technology through a series of lectures and practical exercises. The practical sessions will help students put the appropriate terminology to use and help them become more familiar with boat diversity in the region.

The lecture can be split into three parts: a short lecture on general boat technology, one that covers boat terminology (combined with a practical exercise) and finally a lecture and long practical exercise on Asian and South-East Asian shipbuilding traditions.

Practical Session: Terminology

The aim of the first practical session is to help students familiarize themselves with boat terminology. To begin the practical session it is recommended that trainers introduce students to the different names for each component of a boat. Students should be encouraged to take notes and request translations and further explanation where needed.

The practical session gives students a chance to test their knowledge and reflect on each of the terms. Trainers should prepare and provide each student with a folder that contains pictures of different types of boats from around the region. The pictures can either be discussed as part of the lecture to illustrate the theoretical material and/or used as part of a group exercise.

In small groups, students should be asked to think about how each of the boats can be categorized e.g. boat types, rudder types, construction types, etc. This not only allows students to practice identifying specific characteristics, but also highlights the great technological diversity to be found in the region.

Alternatively (or in addition), if the training centre is in the proximity of a small harbour, trainers could take the students and discuss the types of boats encountered.

The lecture introducing the main traditions of Asian shipbuilding technology provides students with a basic list of boat types found in the region. This is meant to form a foundation, from which to develop further knowledge. The aim is to then encourage students to share the knowledge they have on their countries respective boat types, by selecting one representative boat for each country and presenting the main features and characteristics of that boat to their fellow students.

It is important that the list of boat types in each country evolves and that additional references and boat types are added to create more comprehensive and up-to-date information. As it is not possible to browse through all the regions and boat types collectively in one lecture, it is recommended that a practical session be conducted. Students should be divided into small groups, e.g. by region or by sea or river network. In their groups, students should begin by assessing the existing reference list and adding more references or boat types as appropriate. The students also need to assess how much knowledge is available and what more research needs to be undertaken.

Next, each group needs to select one representative boat that they want to share with the rest of the classroom. Students need to accurately identify the different features, characteristics and most essential terminology belonging to that boat. It is useful if students can also include anecdotal, historical, or environmental information that will help other students remember the craft. Students must select a picture and prepare a short presentation (maximum of 5 minutes) for the rest of the class.

All of the documents, articles and essays related to the groups selected boat should be saved in a central database (CD or USB) and circulated to the other students. The aim is for each student to create a reference folder of information (including pictures and reference documents and articles) with which to build on after the Foundation Course is complete.

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The Protection of the
Underwater Cultural Heritage

UNIT 15

Author Andrew J. Viduka

Material Culture Analysis

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Cover photo: By studying the wooden elements of shipwrecks in detail, the characteristics of the original ship and the shipbuilding traditions used to construct it can be identified. © Martijn R. Manders

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UNIT 15

Contents

UNIT 15

Author Andrew J. Viduka

Material Culture Analysis

Core Knowledge of the Unit

This unit aims to introduce students to the theories, methods and issues related to material culture analysis.

- *On completion of the Material Culture Analysis unit students will:*
- *Be introduced to the topic of material culture analysis*
- *Gain knowledge of design and culture analysis theories, concepts, methods and issues*
- *Gain insight into how theories, concepts, methods and issues relate to materiality, education and learning*
- *Gain insight into how a material culture analysis can be used*

Introduction to the Unit

Archaeology is about the systematic study of materials left behind by people in the past. Material culture analysis is, therefore, an important part of an archaeologist's everyday work. This types of analysis can and will be influenced by the theoretical models of archaeological interpretation, such as antiquarianism, processual and post-processual archaeology. The systematic study of artefacts, features, ecofacts and manuports can tell us much about past life. Further insight can also be gained by taking into consideration the context these objects are in. This unit will examine how theory and context not only influences the way we look at objects, but also how we interpret them.

1 Definitions

Archaeology can be considered as the study of the physical remains and traces of human activity, ranging from pottery and bottle fragments, to plough traces and cargo. It can be found on land and underwater, in structures (including, monuments, buildings and wrecks) or in the open field; they can be isolated finds, but also related to a context. To reconstruct past human life and culture a proper methodology must be used, so that as much information as possible can be retrieved from the source. To undertake analysis, excavated material culture has to be identified, interpreted. The data and information obtained has to then be 'translated' into something others can also comprehend.

Material culture encompasses the study of the creation, uses, meanings and interpretations of the tangible products of human endeavour. As any object can have many different values to a wide range of people, the study of material culture needs to be interdisciplinary in nature to take into account historical, iconographical, aesthetic, cultural, scientific and behavioural perspectives (See Unit 5: *Desk-based Assessment* and Unit 6: *Significance Assessment*).

The translation (archaeological theory analysis) of the material culture of a past people is done through subjective and/or objective interpretation, largely dependant upon the theoretical approach of the individual interpreting the material.

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2 Archaeological Theories

2.1 Antiquarianism

Possibly the most well-known archaeological theory is antiquarianism, which was the dominant paradigm for the 'interpretation' of material right up until the end of the nineteenth century. Antiquarianism is characterized by the detailed recording and description of a collection of artefacts, buildings or sites. This is strongly linked with the early periods of classical archaeology and museology (see Unit 16: *Museology*).

Antiquarianism is associated with the cabinets of curiosities that were so popular in the sixteenth and seventeenth centuries, and which subsequently formed the basis for several major institutions. The British Museum, for example, was founded in 1753 using Sir Hans Sloane's extensive collection of curios that ranged from manuscripts and drawings, to natural history specimens and antiquities from around the world.

Today, Antiquarianism is viewed as limited in its attempts at interpretation of the past societies which manufactured these materials.

2.2 Cultural-historical Archaeology

Cultural-historical archaeology developed in the mid to late nineteenth century (post-Darwin and the Industrial Revolution). The theory is based on the idea of different, yet distinct cultural groups which can be identified through their material culture.

Changes in the culture of a historical society were ascribed to the diffusion of ideas or migration and mixing of peoples. Elizabeth Wayland Barber (1994) in her book *Women's Work the First 20,000 years* utilized aspects of this theory. In her study of women's work in textiles, Barber explored the existence of the cultural characteristics of weaving and how they could be used to illustrate the spread of people and ideas.

Changes in a society's material culture can be viewed as being the result of either diffusion or migration. A diffusion of ideas could be assisted by trade, inter-marriage and other small scale movements of people. Migration can be categorized as large scale movements of people which could be also stimulated by war or through the act of war.

The concept of the independent development of ideas by other cultures was not integrated into this model. This became an issue of contention with evolutionary archaeologists who considered that the same idea could be independently concluded in different locations. John Giacobbe supplies a concise but detailed analysis of the current role of evolutionary theory in archaeological thought. See: www.nakedscience.org/evol1.htm (Accessed March 2012).

2.3 Processual Archaeology

Processual archaeology was a rebellion against cultural-historical archaeology paradigms and its 'limited' interpretation of artefacts. The aim of processual archaeology was to move away from the simple description of material culture (to catalogue, describe and create timelines based on the artefacts), towards interpreting the material with the aid of quantitative methods of analysis.

Processual archaeology focused on more scientific and anthropological approaches to answer questions about past humans and their societies. This archaeological theory originated in America and England in the 1960s with Lewis Binford and David Clarke both publishing aspects of the theoretical approach. This alignment of anthropological ideas with archaeology is characterized by the oft quoted 'archaeology is anthropology or it is nothing' (Willey and Phillips, 1958, pp. 2).

Processual archaeological drew on the biology systems theory, which argued that knowledge about one portion of a system, enables knowledge of other components of a system to be inferred. The method enables study within a system and looks at a system's relationship and interactions with other systems, and the environment that these interactions are occurring in. See: http://www.statpac.org/walonick/systems-theory.htm (Accessed February 2012).

Proponents of processual archaeology claimed that with the rigorous use of the scientific method it was possible to get past the limits of the archaeological record and learn something about how the people who used the artefacts lived. Thus the archaeological record evolved from data to interpreted information about the past.

2.4 Post-processual Archaeology

Post-processual archaeology originated in England in the 1970's with work by Ian Hodder (Trigger, 2007, pp. 450). Through his spatial analysis research of Iron Age and Roman Britain archaeological sites, Hodder concluded that even when using the processual approach, very different conclusions could be put forward from the analysis of the same data. In his view, this countered the assertion from processual archaeology theory, that only by using scientific method could objective fact be derived from the archaeological record (Johnson, 1999, pp. 98-99).

Post-processual archaeology took an opposing view to processual archaeology, in that it viewed data as not being objectively derived through the scientific method, but alternatively suggested that archaeological interpretation was inherently subjective and a product of the archaeologist's viewpoint.

Matthew Johnson stated that, 'post-processualists suggest that we can never confront theory and data; instead, we see data through a cloud of theory' (Johnson, 1999, pp. 102).

Essentially, post-processualism assumes that material culture will always be influenced by subjective views and as a result, conflicts with those that believe conclusions should be based on scientific objectivity.

2.5 Scientific Method

The scientific method refers to the process by which phenomena is investigated, resulting in 'reliable, consistent and non-arbitrary data'. The scientific method attempts to minimize the influence of the scientist's bias on the outcome of an experiment.

The scientific method has four defined steps:

1. *Observation and description of a phenomenon or group of phenomena.*
2. *Formulation of a hypothesis to explain the phenomena.*
3. *Use of the hypothesis to predict the existence of other phenomena, or to predict quantitatively the results of new observations.*
4. *Performance of experimental tests by several independent experimenters*

It is important that each of these steps must be repeatable, in order to dependably predict any future results.

See: http://teacher.pas.rochester.edu/phy_labs/appendixe/appendixe.html (Accessed February 2012).

Within the scientific method there is the principle of full disclosure which aims to fully document and archive data. This data and methodology must then be shared, to enable other researchers and scientists to validate the original findings and check the reliability of statistics.

2.6 Hypotheses, Models, Theories and Laws

In the scientific method, the terms hypotheses, model, theory and laws have explicit meaning:

- *An hypothesis is a limited statement regarding cause and effect in specific situations*
- *The term model is reserved for situations when it is known that the hypothesis has at least limited validity*
- *A scientific theory or law represents an hypothesis, or a group of related hypotheses, which has been confirmed through repeated experimental tests*

Source: http://teacher.pas.rochester.edu/phy_labs/appendixe/appendixe.html (Accessed February 2012).

Broad theories can often bring a number of independently derived hypotheses together in a coherent framework. This in turn may help form new hypotheses or place groups of hypotheses into context.

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- *International Council of Museums:* ***icom.museum/who-we-are/the-vision/museum-definition.html*** *(Accessed March 2012).*

3 Material Culture

Material culture is the manifestation of culture through material products, e.g. the production of objects, artefacts, relics, etc. It includes buildings, ships, tools and other objects that constitute the material evidence of (usually past) societies. It also considers natural materials that are unmodified (such as stone and ecofacts), human created materials (such as pottery and glass), as well as human remains (skeletal material).

Mot importantly material culture not only exists in a context, but also helps form that context. It is not just a backdrop; it is instead the stage and props for human action (Randall McGuire, 1992, pp. 104)

3.1 What does Cultural or Anthropogenic Material Consist of?

3.1.1 Artefacts

An artefact is any object that was produced by a human. This can include everything from tools and toys, through to artwork, clothing, buildings and altered landscapes. Each artefact, regardless of its form, is inherently an expression of our human culture.

This tangible evidence of human culture is collected by museums (see Unit 16: *Museology*), though the vast majority of material culture exists outside of museums, in people's homes and workplaces and the surrounding landscape.

Stonehenge, one of the world's most famous artefacts. © Andrew J. Viduka

3.1.2 Features

Champion (1980, pp. 48) describes a feature as, 'any constituent of an archaeological site which is not classed as a find or a small find', i.e. any dug or built evidence of human activity.

3.1.3 Ecofacts (Biofacts)

Ecofacts are flora and faunal materials (natural materials) that have been used by humans (Champion, 1980, pp. 40). These materials, when recovered from archaeological sites or other sealed deposits, are relevant to the study of ancient environments and ecology. Examples of ecofacts include animal bones, seeds, shells, waterlogged wood and pollen.

3.1.4 Manuports

Manuports are unmodified natural objects transported and deposited by hominids; a primate from the family Hominidae, which includes modern man (Homo sapiens) and the extinct precursors of man. (Source: Collins English Dictionary.)

The word 'Manuport' is derived from the Latin words manus, meaning 'hand' and portare, meaning 'to carry'. Manuports are distinguishable by being of a material clearly foreign to the sediment deposit they occur in.

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Randall-McGuire 1992. A Marxist Archaeology. Orlando, Academic Press, pp. 104.

Useful Websites

- *Hominid Definition:* ***www.collinsdictionary.com/dictionary/english/hominid*** *(Accessed March 2012).*
- *Objects: Artefacts, Ecofacts and Manuports:* ***escrapbooking.com/escraps/objects/index.htm*** *(Accessed March 2012).*

4 Material Culture Analysis

Material culture has a life history which can provide insight on:

- *Production (creation or making; the capacity of the society that enables this production)*
- *Function and style (continuity and change)*
- *Meaning*
- *Context*
- *Exchange (trade)*
- *Consumption*
- *Transformation (changing use)*

4.1 Production

Production refers to the creation or the making of artefacts. The investigation concerning the production evolves around the method that a certain object was made. In the aspect of material culture analysis, the study focuses upon what this object was made from. The analysis can be deepened by the concept of archaeometry, that is, by adapting techniques and knowledge in chemistry, physics, engineering, physical and biological sciences to find out the materials used to produce the studied objects. The analysis of production tells us about technological capability at the time of the producers; what these people could make and how they made it.

ADDITIONAL INFORMATION

1 *Artifacts. An Introduction to Early Materials and Technology* (1989) is one of the most thorough and comprehensive examinations of production process, classifying the analysis by types of historical materials used to produce artefacts.

Suggested Reading

Hodges, H. 1989. Artifacts. An Introduction to Early Materials and Technology. London, Duckworth.

(See Additional Information 1)

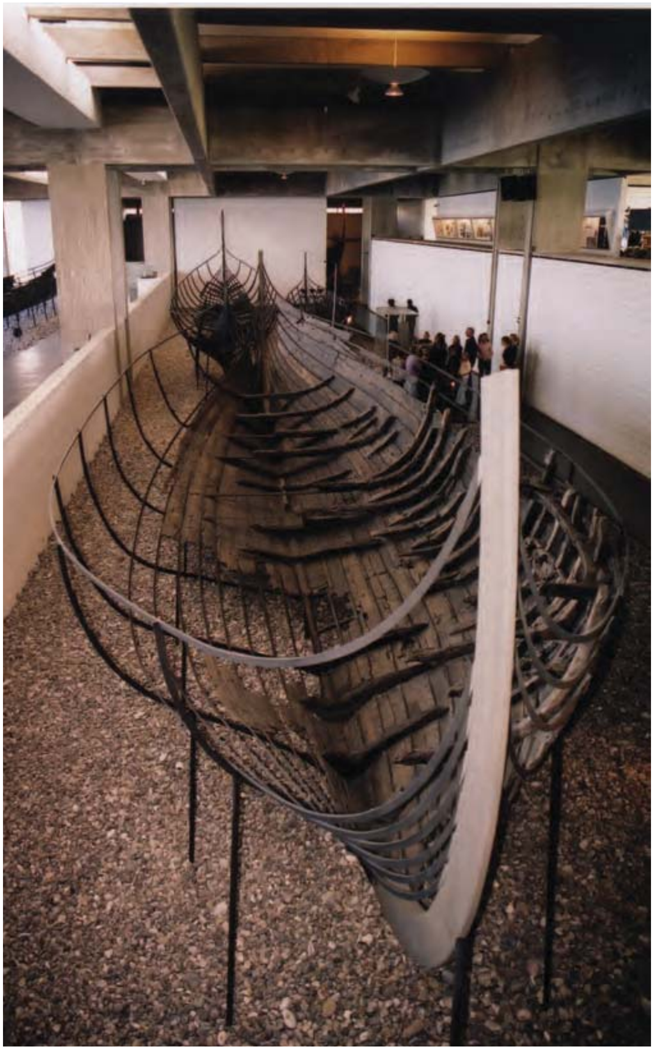
Reconstruction of a Viking ship at the Viking Ship Museum, Roskilde, Denmark. © Andrew J. Viduka

4.2 Function

Function refers to the use or purpose of an artefact, structure or site; what it was for or what it did for user. There are numerous points to consider when studying functions: The interrelationship between shape and function: i.e. shape indicates function and function dictates shape. For instance, a container has to be able to contain.

Assumption-based investigation:
function is not always obvious or straightforward. What has been assumed as the function of a certain object might not be its direct or only function. In fact the analysis of function is based on presentism; that is, we believe that a certain object was used for a certain purpose in the past, considering the present day perspectives of our own culture, rather than considering the socio-cultural context of the society in which the object was created.

Changeability and fluidity of functions:
functions can change over time or can be different in different cultures.



A conserved and assembled Viking Ship, Skuldelev I, *Viking Ship Museum, Roskilde, Denmark.*
© Andrew J. Viduka

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Ethnographical objects collected in the Pacific by the crew of HMS Pandora *1791. © Queensland Museum*

In brief, when a function analysis is performed, it needs to answer the following points:

- *Material (type)*
- *Morphology (shape or form)*
- *Production (or manufacture)*
- *Date (and provenance)*
- *Context (or relationship)*
- *Use life (use wear and residue)*
- *Analogy (or comparison)*
- *Experiment*

The result of the analysis can provide insight on four primary aspects:

Function in everyday life: e.g. eating, drinking, human behaviour.

Function in diet: e.g. edible plants (almonds and carbonised grain), animal bones, items related to food processing and preparation.

Function in warfare: e.g. type(s) of ships and armaments.

Function in technology: e.g. technology utilised by ship itself or its cargo *(See Additional Information 2).*

ADDITIONAL INFORMATION

2 Cooperage is a term that describes the production of barrels or casks. On a sixteenth century Basque vessel wrecked in Red Bay, Canada, there was evidence of whale oil casks made entirely of organic components (Ringer, 2007, pp. 180-196). This particular type of barrel is liquid tight and known as dry cooperage. The recovered casks were made up of three main components: staves, heads and hoops.

Life on board the Warrior. *© Andrew J. Viduka*

Timber barrel from the Rapid *(1811) being assembled post-conservation. © Western Australia Museum*

When analysing the functions of a ship, we need to divide it by its main components based on different functions (Reinders, 1988):

- *The ship itself, e.g. anchors and rigging*
- *Equipments in the ship, e.g. cargo handling gear (davits and winches) and armament (gun and ammunition)*
- *Inventory, e.g. navigational instruments, galley, victuals*
- *Objects associated with the crew and passengers, e.g. personal possessions*
- *Cargo, e.g. trade*

4.3 Style

Style refers to the distinctive pattern or decoration on an artefact, structure or site.

- *Style can change depending on time, culture or specialist*
- *Style plays a significant role as the basis for typology, classification or categorization*
- *Chronology and temporal change*
- *Seriation (change in style over time)*
- *Continuity (tradition and persistent technology)*
- *Change (innovation and variation)*
- *Style as social communication (recognition, making sense of the world)*
- *Common understanding (cultural norms)*
- *Style as construction, i.e. style is constructed by people and can be created via social action, interactions, isolation and exchange*

Leather shoe from the Nydam Mose bog site, Denmark. © Andrew J. Viduka

4.3.1 How Does Style Change?

Style can evolve over time as a result of a diffusion of ideas, innovation, the movement of people (via migration, exogamy or war), the movement of goods (trade or distribution networks) or by changes in the means of production (mass production, industrial technology and globalisation).

It is important to note that a similar style in two geographically separate locations is not necessarily evidence of a link; it may be an example of parallel development.

4.4 Meaning

Function and style contribute to our understandings of meaning. Objects have life histories and meanings that are attached to them. Many aspects of these cultural meanings are attached by different people, at different times and from different places. They can be examined from two anthropological perspectives:

Emic meaning: is a term for an insider perspective, i.e. for people at the time.
Etic meaning: is a term for an outsider perspective, i.e. for observers, such as archaeologists.

4.5 Context

Context is the place where an object is found and the relationship or association of the object to everything around it (usually other artefacts). Its chronological position is inferred by its location within the stratigraphy. The careful documentation of context enables an artefact to be interpreted through various archaeological theories. Without context, an object loses much of its interpretive value and can be considered a loose find. A loose find is any artefact that cannot be accurately placed in context.

This Ovoid earthenware jar was broken and repaired in antiquity. It was later re-used as a burial urn and found containing the bones of a dog. © Andrew J. Viduka

4.5.1 Macro-scale Context

As artefacts exist within multiple frameworks of interpretation at any one time, it is possible to consider them on both micro and macro scales. A shipwreck is, for example, a discrete and contained (closed) deposit. Artefacts recovered from this type of site can be interpreted in such a way that they provide us with a broader understanding of the site and its association with the societies and cultures that the artefacts belonged to.

Studies such as this enable a larger scale analysis that can encompass other sites from other periods. Mike McCarthy's excavation and analysis of the *SS Xantho* (1872) enabled, for example, a detailed study of the Broadhurst family, examining the life and ingenuity of early Western Australian settlers using a detailed study of a trunk engine recovered from the site.

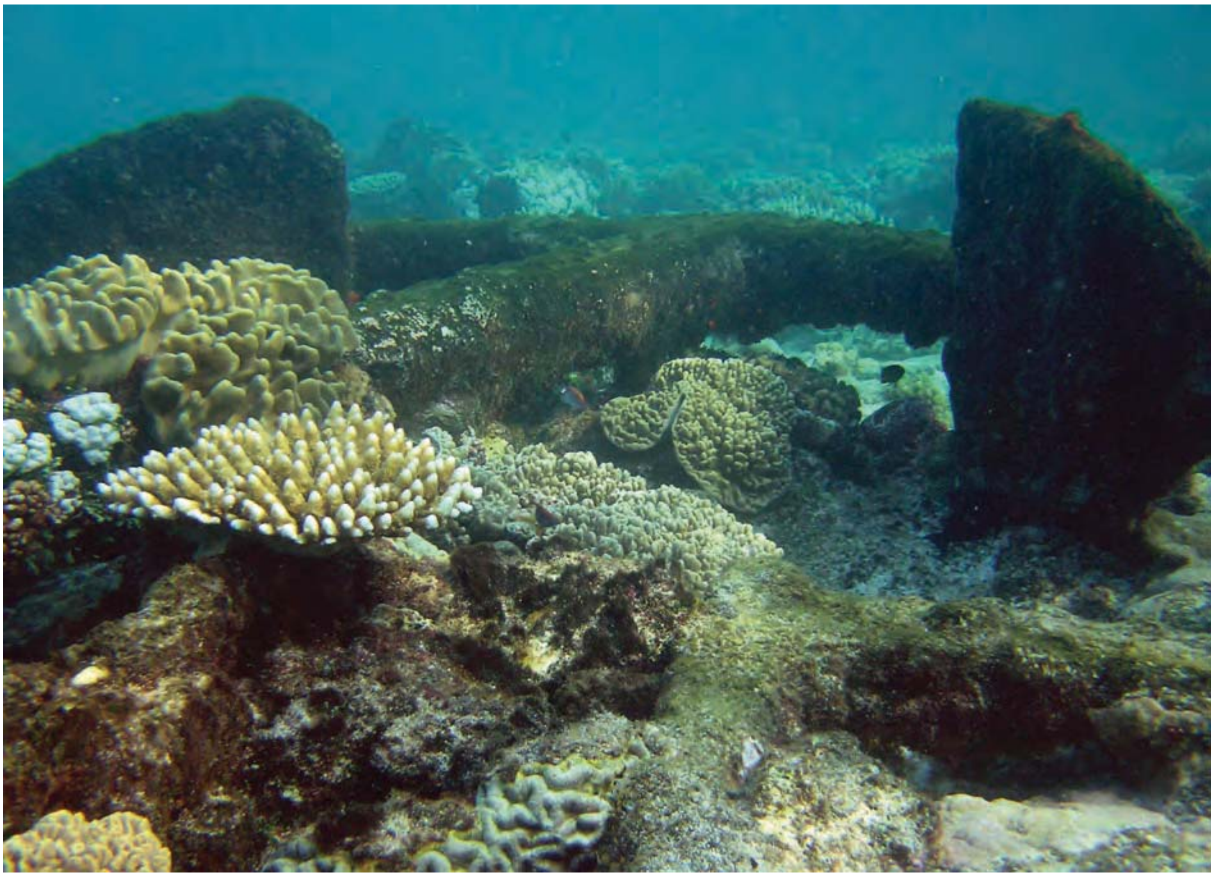
For more information see: http://museum.wa.gov.au/broadhurst/ (Accessed February 2012).

4.5.2 Micro-scale Context

As a shipwreck can been considered a time capsule, it enables micro-scale context analysis. Archaeologists have to consider:

- *What is the artefact's relationship to other objects?*
- *Out of context what does it mean?*
- *A single isolated artefact can lose its associations (context)*
- *What other objects were with this object when it was found?*
- *How was this object packaged for transport? (Souter, 2009 and Staniforth, 1996)*

Anchors are commonly found as isolated objects which cannot be linked to a site. This anchor is a part of the Aerd Van Ness *(1854), situated on the Great Barrier Reef. © Andrew J. Viduka*



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Staniforth, M. 1996. Tracing Artefact Trajectories – Following Chinese Export Porcelain. *Bulletin of the Australian Institute for Maritime Archaeological Institute.* 20.1, pp. 13-18.

Useful Websites

- *Western Australian Museum SS Xantho:* ***museum.wa.gov.au/broadhurst*** *(Accessed March 2012).*
- *Western Australian Museum Archaeology Collection:* ***www.museum.wa.gov.au/research/collections/anthropology-and-archaeology/archaeology-collection*** *(Accessed March 2012).*

UNIT 15

5 Exchange Trade

For centuries, colonization, as well as international and long-distance commerce in goods, was dependent upon a trade network of ships and boats that allowed the flow of goods from the place of production, to the place of consumption.

Trade patterns and the goods that circulated as a result, can provide valuable insights into the cultural attitudes of people by revealing what was considered to be 'suitable' goods, e.g. food, drinks and textiles.

Sometimes only the containers survive, rather than their contents. As a result, we may know more about barrels and amphora, than their liquid contents, such as wine or we may know more about the construction of the ship, than what it was carrying and to where it was carrying it.

Replica of the Dutch East India Company vessel Batavia *(1629) in Lelystad, the Netherlands.*
© Andrew J. Viduka

Dutch East India Company emblem on the wall of Galle Fort, Sri Lanka. © Andrew J. Viduka

Case Study

Amsterdam (1949)

While all shipwrecks can be analysed on both micro and macro-scales, the *Amsterda*m is a particularly good example of a shipwreck that offers a broad context for artefacts (see: http://shipwreck-heritage.org.uk/maritime-shore/amsterdam-wreck/).

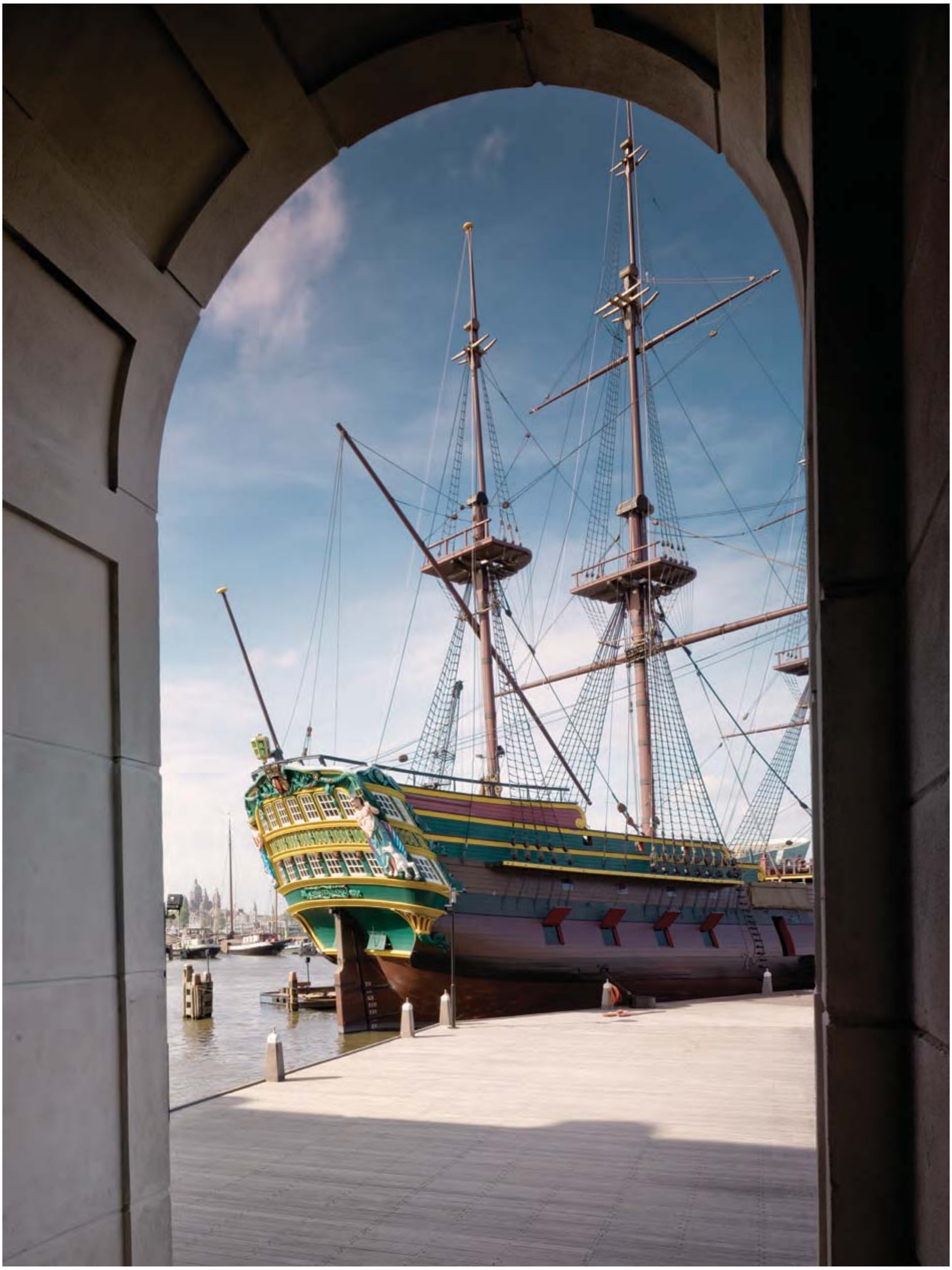
The wreck itself is significant (see Unit 6: *Significance Assessment*) due to the high preservation value of the site, which have resulted in numerous organic and inorganic objects being preserved, as well as a significant portion of the ship's structure. The site can be studied and interpreted as a discrete site, yet its value increases once it is placed in context with the broader historical setting, offering a unique insight into the period and the development of the Dutch East India Company (VOC) (Marsden, 1974).

The VOC was established in 1602 when the Estates-General of the Netherlands granted the company a twenty-one year monopoly to carry out colonial activities in Asia. Issuing stocks, the VOC became the world's first multinational corporation and remained an important trading concern for almost two centuries, until it became bankrupt and was dissolved in 1798.

The Amsterdam was a VOC ship that ran ashore at Bulverhythe, near Hastings in southern England in January 1749. Located in the surf zone, the ship appears to have rapidly sunk approximately 6 to 8 metres into the mud. As a result of this burial, the Amsterdam is the best preserved VOC shipwreck that has been found (to date) anywhere in the world.

The shipwreck is complete up to the upper gun deck on the port side and the lower gun deck on the starboard side. Excavation work was concentrated on a 15 metres long section of the vessel, located at the stern (seaward end) of the site. About 3 metres of largely undisturbed archaeological deposit was excavated which consisted of a dense layer of artefacts and organic materials. These materials included ecological components and ecofacts, such as insects, botanical and faunal remains.

The wreck of the Amsterdam *in Hastings, UK. © English Heritage*



The replica of the VOC ship Amsterdam, *September 2011. © Het Scheepvaartmuseum/Eddo Hartmann*

Suggested Reading

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- Beck, S. 1999. Ceramic Links: An Interim Report of the Archaeological Investigation of the Ceramic Armbands Recovered from the Wreck of the Queensland Labour Trader *Foam. Bulletin of the Australian Institute for Maritime Archaeological Institute.* No. 23, pp. 11-17.
- Buranasiri, B. 1992. Ceramic Wares found in Koh Talu Wreck Site: Their Usage and Life. *Bulletin of the Australian Institute for Maritime Archaeological Institute,* Vol. 16:1, pp. 7-12.
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- Lenihan, D. J. 1983. Rethinking shipwreck Archaeology: A History of Ideas and Considerations for New Directions. *Shipwreck Anthropology.* Gould, R. (ed.). University of New Mexico Press.
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A selection of finds from the 1984-1986 archaeological research from the Amsterdam *(1749).*
© VOC-Ship Amsterdam Foundation, the Netherlands.

Unit Summary

Archaeology is the study of the material culture left behind by people. Ships are time capsules and can often be compared to unique terrestrial heritage sites, such as Pompeii, that contain a rich diversity of objects that can be studied. Shipwrecks can be preserved in remarkably good condition, offering an enormous amount of information about a short period of history, which can be examined in detail. Some of the artefacts contained within shipwrecks, such as such as their cargoes, armament or items related to life on board, can not be found in sites elsewhere.

The material culture recovered from sites can reveal much about the lives, living conditions, behaviour and technology of people who lived in past eras. However, this requires detailed analysis and an interpretation (explanation) of artefacts, which is what, essentially, material culture analysis is.

Material culture analysis encompasses the study of the creation, uses, meanings and interpretations of the tangible products of human endeavour. As the study of material culture is interdisciplinary by nature, artefacts have to be studied from multiple perspectives: historical, iconographical, aesthetic, cultural, scientific and behavioural. Added to this there are also numerous frameworks and theories which individual researchers can utilize to interpret their data.

In this unit, students have been briefly introduced to the theoretical and practical approaches to material culture analysis. To gain a deeper understanding of this topic, it is recommended that students further explore traditional formal analyses of artefacts and recent studies that focus on consumption, perception and social self-definition (see *Suggested Reading*).

Suggested Timetable

15 mins	Introduction
60 mins	Material Culture Analysis - *Archaeological Theory* - *Scientific Method* - *Hypotheses* - *Models* - *Theories and laws* - *Material culture analysis* - *Exchange trade* - *Case study*
	Break
60 mins	Workshop Activity
	Break
45 mins	Group Presentations and Discussion
15 mins	Concluding Remarks and Closure

Teaching Suggestions

It is recommended that trainers introduce material culture analysis to students in the form of a lecture, followed by a group exercise where students can utilize the ideas and concepts presented to them. The objective of the practical session is for students to draw, measure, analyse and discuss an artefact. For further teaching aids and suggestions see *Additional Information 1*.

How to Organise the Practical Session

To facilitate the practical session, trainers should first select a range of objects that are, or could be described as, an artefact, manuport or an ecofact. If the location allows for it, features can also be included in the selection. Trainers should prepare a short biography for each object that provides the students with contextual information that offers insight into the object's significance.

It is recommended that trainers divide students into equal sized groups of no more than four. Each group must select one object to study.

1. Trainers should instruct the students to:
2. Examine their selected object, measure and draw it on the scale paper provided.
3. Identify whether the object is an artefact, feature, ecofact or manuport.

Consider what information can be interpreted from the object, such as:

- *Production (creation or making)*
- *Technology (e.g. shipbuilding)*
- *Function and style (continuity and change)*
- *Meaning*
- *Context*
- *Exchange (trade)*
- *Consumption*
- *Transformation (changing use)*

ADDITIONAL INFORMATION

3 Additional teaching materials that can be used to facilitate a practical session on material culture analysis can be found at: http://www.cyberbee.com/culturalanalysis.pdf (Accessed February 2012). Provided by the library of Congress American Memory Summer Institute, this guide can be easily adapted and modified by trainers to suit requirements.

Trainers should allow students approximately one hour to complete the exercise and should spend time with each group, actively directing their efforts.

After a short break, a representative from each group should present the results of their analysis to the rest of the class. Trainers should encourage questions from the other groups and re-enforce important topics and ideas covered in the unit.

Equipment Required for Each Group of Students

- *Scale paper*
- *Plain paper*
- *Ruler*
- *Drawing Compass*
- *Pencils*
- *Eraser*
- *Magnifying glass*

If available and relevant include: a thread counter, stereo-microscope, Munsell colour charts, small torches or desk lamps. *(See Additional Information 3)*

Suggested Reading: Full List

Barber, W. E. 1995. *Women's Work: The First 20,000 Years: Women, Cloth, and Society in Early Times.* W. W. Norton & Company.

Beck, S. 1999. Ceramic Links: An Interim Report of the Archaeological Investigation of the Ceramic Armbands Recovered from the Wreck of the Queensland Labour Trader *Foam*. *Bulletin of the Australian Institute for Maritime Archaeological Institute,* Vol. 23, pp. 11-17.

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Prown, J. D. 1982. Mind in Matter: An Introduction to Material Culture Theory and Method *Winterthur Portfolio*, Vol. 17, No. 1. The University of Chicago Press, pp. 1-19.

McGuire, R. H. 1992. *A Marxist Archaeology*. Orlando, Academic Press, pp. 104.

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Schnapp, A. 1996. *The Discovery of the Past. The Origins of Archaeology.* London, British Museum Press.

Souter, C. 2009. Archaeology of the Iron Barque: Stowage on the *Sepia*. *Iron, Steel and Steamship Archaeology Proceedings of 2nd Australian Seminar, Held in Fremantle, Melbourne and Sydney, 2006*. McCarthy, M. (ed.). Special Publication Australasian Institute for Maritime Archaeology No.15, pp. 159-164.

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The Protection of the
Underwater Cultural Heritage

UNIT 16

Authors Somlak Charoenpot, Barbera Boelen and Martijn R. Manders

Museology

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UNIT 16

Contents

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Authors Somlak Charoenpot, Barbera Boelen and Martijn R. Manders

Museology

Core Knowledge of the Unit

This unit provides students with an understanding of the role of museums and their importance in the preservation of underwater cultural heritage.

Upon completion of the Museology unit, students will:

- *Have a basic knowledge of museology*
- *Understand that museology can be useful for integrating the knowledge of many fields related to underwater cultural heritage*
- *Understand the relationship between the archaeologist and the museum*
- *Have knowledge of the ethical issues surrounding museum collections*
- *Have knowledge of how to prepare an exhibition and create storyboards*

Introduction to the Unit

A museum is usually regarded as a public building which showcases objects of artistic, cultural, historical or scientific interest, through permanent or temporary exhibitions. Museums have a story to tell people; the story that is presented may be influenced by archaeologists in order to convey a message that they think is important. By providing a floor to disseminate information, museums play an important role in raising awareness, which in turn assists the preservation of cultural heritage. This unit will explore both the practical and theoretical aspects of museums and how they can be employed for maritime archaeological purposes.

Opened in 1784, the Teylers Museum is the Netherland's first and oldest museum. © RCE

1 What is Museology?

Museology is the theoretical study of museum practices, encompassing the history and development of museums, infrastructural organization and museum management.

There are an enormous variety of subjects that can be taught under Museology. This unit will focus on a selection of topics that are of specific interest for underwater archaeologists: the objects, the museum and its functions, and society. These issues are all important to understand when archaeologists have to work together with museum institutions.

1.1 The Object

In museology, it is not the aesthetic value of an object that matters, but the meaning within the object. In the same way this can be said for archaeologists, for whom an object has value because of the information it contains.

In principle, museology focuses on the responsibility for preserving an object or heritage and making it accessible. This also encapsulates the responsibility for presenting information and taking advantage of intellectual opportunities concerning an object.

Sometimes museums present objects to the public because they are beautiful (aesthetical value) or valuable (economical value). This is often the practice in art museums. For objects in archaeological museums, archaeologists customarily provide detailed context to create valuable meaning for artefacts (see also Unit 6: *Significance Assessment).*

A surgical instrument found on the Dutch East India Company ship the Rooswijk (1737), wrecked at Goodwin Sands, United Kingdom. © Martijn R. Manders

1.1.1 Information

An artefact not only contains information about its physical state, material, form, etc., but also information about its function and meaning. We can determine aspects such as how and why it was used, by whom and by which culture, etc (see Unit 15: *Material Culture Analysis*)

1.1.2 Context

To learn more about the context of an object, information concerning the object has to be collected and studied. As an example, a pen is a familiar object that can be used for writing. It is not a particularly special object in itself, however, an 'everyday' pen may have been used to write an important text, agreement or treaty, which transforms it into an object of high historical or cultural significance.

A good maritime example of this is that a normal ceramic creamware plate costs a few dollars, whereas a creamware plate from the White Star Line costs approximately US$50 to US$100. In comparison, a creamware plate from the White Star Line that was recovered from the Titanic costs approximately US$900 (at auction). This has everything to do with the added value provided by context and provenance.

1.1.3 Value

An object can be of great value because of its high economic value or if it provides a missing link or holds a fascinating story (see Unit 6: *Significance Assessment*).

Hundreds of ceramics plates being stored at the Horniman Museum and Gardens in London, United Kingdom. Only the context of an individual plate would make it stand out against the others. © B. Boelen

A conservator is checking the finds that have been excavated from the Avondster *(1659) wreck site, Sri Lanka. © MAU*

1.2 Functions of the Museum

A museum has three basic functions regarding the artefacts or collections, these are:

1.2.1 Preservation

Preservation is also known as collection management. It involves acquisition, registration, documentation, conservation and restoration.

Museums can obtain artefacts in many ways, from collector's bequests, loans from other museums, trade with private sectors, to acquisition from the field. Fieldwork is an important source from which archaeological museums, in particular, can establish new collections with the direct involvement of archaeologists. Through fieldwork documentation, detailed information concerning the context of an object can be obtained, however, collecting through fieldwork often has ethical and legislative problems.

A collection usually consists of objects from different backgrounds that have been brought together. These objects do not necessarily have to come from the same source, but instead, are often combined to convey a theme or a narrative that the museum wants to present to public. By doing this, a collection creates a vibrant image of the past.

The way the objects are displayed or collected is the choice of the curator. Even within the collection of one shipwreck, choosing what to display takes careful consideration. Should only the precious finds be displayed? Or can other finds, such as the wood from the ship or the cargo of wheat, also help tell a larger story? The story of the daily life of the crew is a very different narrative to the grandeur of a story regarding the 'treasures' that are found on a wreck site.

Wooden anchors from the sixteenth century Bankachai II wreck, await conservation in a fresh water basin. © Martijn R. Manders

BELOW: The Westfries Museum (Hoorn, the Netherlands) created an exhibition tracing the voyage of Schouten and Lemaire. Artefacts recovered from the Hoorn *(1615) wreck site, combined with other objects from different sites and periods, were used to create a unique atmosphere. © Martijn R. Manders*

1.2.2 Communication

Communication with the public in a museum is done through presentation (exhibitions), education and publications. The most effective way that a museum can communicate with the public, is through an exhibition.

This process of communication is analysed in *The Museum Experience* (Falk en Dierking, 1992) and is known to take place in the interaction between three contexts:

The personal context: knowledge, experience and expectations of the individual. This defines the way a visitor looks at and understands the exhibition.

The social context: the social environment, family members and friends. Is the visitor alone or with a small or large group? The accompanying individuals can influence a visitor's museum experience.

The physical context: not only the exhibition itself (the showcases, colors used and the lighting), but also the building or museum complex.

Visitors at the Samed Ngam Community Museum in Thailand. © Martijn R. Manders

Different types of exhibitions can be distinguished. Objects can be arranged in different orders: chronological, by theme, by using a story as a starting point, etc.

1.2.3 Research

Collections are often used for research. Not only are the objects themselves used, but even more importantly, the information about their original context is studied. This contextual information is usually entered into a database system as soon as the objects are collected and arrive at the museum. This information is crucial for researchers who were not present when the archaeological objects were originally found or excavated.

One example of such a database is *Adlib*: www.adlibsoft.com (Accessed February 2012).

1.3 The Museum

According to the International Council of Museums (ICOM), the definition of a museum evolves over time, in line with developments in society. Since its creation in 1946, ICOM has updated their definition in accordance with the realities of the global museum community. The most recent definition was adopted in 2007 during the 21st General Conference in Vienna, Austria, and states,

> *A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment.*

Source: http://icom.museum/who-we-are/the-vision/museum-definition.html (Accessed February 2012).

This definition can be used as a reference for the international community. According to it, a museum is involved with all kinds of heritage concerning mankind and its environment. There are many categories of museums, including zoological (collecting animals) and botanical gardens (collecting plants), archives, libraries and institutions for nature and monument preservation. Each will have its own specific interest of collection. This collection needs to be well preserved, conserved and researched, in order to disseminate the insight provided through exhibitions to society.

Brochures belonging to maritime museums from all over the world. © Martijn R. Manders

In the last few years museums have been established in the field; the archaeological site itself has become the museum. There are underwater museums, for example, shipwrecks open to the public that have been established all over the world. This is not in conflict with the ICOM definition, but for many people it is still difficult to accept this concept as a museum.

One example of a museum which is very much worth emphasizing here is that of the ecomuseum. The term 'ecomuseum' describes ecological activities which aim to make a region a living museum. There are three elements:

- *The preservation of different kinds of heritage in a region, including natural, cultural and industrial.*
- *The management and entrepreneurship of this heritage, which allows participation of the locals for the sake of their future*
- *The function of preservation is similar to that of a museum*

One such example in Thailand is the Samed Ngam wreck site that consists of a 200 year old dockyard and a shipwreck (Asian junk). The first investigations in 1982 explored the ship's interior, followed by further external investigations during the SPAFA training in 1989 (see *Additional Information 1*).

Today the site consists of a small part of the remaining dockyard and within that dockyard, the wreck is preserved *in situ* just below the water level. The site is also now part of a community museum that includes an exhibition centre that examines the site and the archaeological work that has been executed on it.

ADDITIONAL INFORMATION

1 SEAMEO-SPAFA, the Regional Centre for Archaeology and Fine Arts. The Centre is under the aegis of the Southeast Asian Ministers of Education Organization (SEAMEO) and is hosted by the Government of Thailand. For more information see: http://www.seameo-spafa.org (Accessed January 2012).

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The structure above the Samed Ngam archaeological shipwreck. © Martijn R. Manders

The Samed Ngam shipwreck. © Martijn R. Manders

The museum adjacent to the archaeological site. © Martijn R. Manders

1.4 Society

According to the ICOM definition, museums are in the service of society. Here, we need to consider what society is and the role it plays in determining displays in museums.

The Universal Declaration of the Human Rights (Paris 1948) stipulates that everybody should have the right to participate in the cultural life of a community, to enjoy it and to share in scientific advancement and its benefits. Derived from this point of view, the Council of Europe developed the Framework Convention on the Value of Cultural Heritage for Society, (Faro 2005), which emphasizes the rights of the public to give meaning to heritage and aid its preservation. In this way, the public has been given its own voice and to allow them to participate, cultural heritage management and museums will have to adopt a bottom up approach. Is this in service of society or is it even more; is it determined by society? (See Unit 17: P*ublic Archaeology and Raising Awareness*).

Suggested Reading

HREA. 2003. Right to Culture. http://www.hrea.org/index.php?doc_id=423 (Accessed February 2012).

United Nations. 1948. *The Universal Declaration of the Human Rights*. Paris. http://www.un.org/en/documents/udhr/index.shtml#a1.Article 27 (Accessed February 2012).

2 Museums at Work

Although museums have often been established out of interest from a collector, they have become a learning institution for society. People can gain knowledge from visiting museums and studying the collections.

Visitors being educated at the Teylers Museum in Haarlem, the Netherlands. © G.J. Luijendijk

As a consequence, it is necessary that the museum has in-house trained professionals in museum management (i.e. curator, conservator, exhibition designer and educator) in order to be well equipped for raising awareness with the general public, supporting the scientists and managing both the collection and museum in general. These different duties may be done by one single person or by several people in larger museums.

Once a collection enters into the museum, it must be registered and recorded. The information recorded will include a variety of detailed data about an object, such as its provenance. The object will then be preserved and either displayed or safely stored.

Artefacts recovered from the Hoorn (1615) wreck site in Argentina, are being cleaned and registered. © J. Wijnands

The curator, who is responsible for the overall collection or a specific part of the collection, is also responsible for the research that gives each object a place in the collection. The curator has to then deliver the content of an exhibition, permanent or temporary. This function may be executed by or with the help of archaeologists. When an exhibition is created about a specific shipwreck, an archaeologist who has excavated the site may be invited to take up the position as a (guest) curator.

For an exhibition, a curator will have to work together with many professionals from different disciplines, including other specialists in the field of a collection, conservators, designers, technicians, educators and archaeologists.

Ideally, public relation officers and educators should be involved in the early stages of the creation of an exhibition, so that they can begin to prepare for the learning process and marketing of the exhibition. These individuals have an excellent understanding of the target audience and how they should be addressed in order to best convey a story.

3 Museum Ethics

In order for archaeologists and museums to work well together, it is important to acknowledge the ethics of both groups. There has to be a common ground or at least an understanding of ethical guidelines in order to work together effectively (see Unit 3: *Management of Underwater Cultural Heritage*).

Some issues that can come up when collecting or making an exhibition include:

- *Displaying human remains that could be part of the finds of a shipwreck*
- *Illicit trade on finds. See the UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (Paris 1970) and the Intergovernmental Committee's Return Policy of Cultural Property (Paris 1978)*
- *How to handle 'difficult' heritage, e.g. finds regarding slavery on board, or illegal trading*

These days national heritage is a complex topic and includes repatriation and legal issues regarding the acquisition of museum collections and archaeological finds. Museum staff, those who are responsible for working with the collection, must learn about international laws and act on the code of ethics of each profession very carefully, in order to avoid becoming involved in an illegal procedure or a legal, but ethically controversial issue.

Suggested Reading

ICOM. 1986. Museum Code of Ethics. http://icom.museum/what-we-do/professional-standards/code-of-ethics/preamble/L/0.html (Accessed February 2012).

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4 Museums and Underwater Archaeology

For many decades, museums exhibited finds that were salvaged from the seabed and the relationship between museums and underwater archaeology only extended as far as the acquisition process. This was to be expected; back then, the underwater world was inaccessible and everything that came to the surface was mysterious and often without context. The only context that could be given was a historical one, derived from written sources. Often, underwater archaeological objects were simply an illustration of something that was already known.

This relationship has however changed over time. Today the seabed has become more accessible through new technology that have been recognized by the museum world. Large exhibitions and even specialized museums have been created that focus solely on underwater cultural heritage. Sometimes, they are dedicated to a specific ship find, such as the *Mary Rose* in Portsmouth, United Kingdom (UK), Strandingsmuseum *St. George* in Thorsminde (Denmark), the Vikingship Museum in Roskilde (Denmark) and the *Vasa* in Stockholm (Sweden).

An information plate provides information about the SS Copenhagen, *Pompano Beach, Florida. Heritage trails, including those underwater, have become a component of tourist infrastructure in many countries. The* SS Copenhagen *Underwater Archaeological Preserve became a State Preserve and Florida Heritage Site in 1994. © Florida Bureau of Archaeological Research*

Other museums are devoted to regional underwater cultural heritage, such as the maritime museum in Texel (the Netherlands), Hastings Shipwreck Heritage Centre (UK) and many other local maritime museums. National maritime museums today often emphasize research techniques specifically used for underwater archaeology. Centralne Museum Morski in Gdansk (Poland), Musée de la Marine in Paris (France) and National Maritime Museum in Chanthaburi (Thailand), for instance, study not merely the historical and iconographical information, but also the material culture.

This evolution has continued, taking the museum out the building and into heritage trails and publicly accessible underwater sites. Museums even exist on the Internet, for example The Museum of Underwater Archaeology (MUA). See: www.uri.edu/mua (Accessed March 2012).

The Viking Ship Museum in Roskilde (Denmark) is dedicated to maritime archaeology. The museum's main exhibits are the Viking ships found at Skuldelev. © Martijn R. Manders

These new forms of museums have been created by professionals and avocationals, governments and the wider public, using both a top down and bottom up approach. Creating impressive visitor experiences has become ever more important, either by artificially creating the underwater world in a building or getting the public themselves under water (see Unit 17: *Public Archaeology and Raising Awareness*).

BELOW: Using digital techniques, information about underwater sites can be brought into a museum. At the Westfries Museum (Hoorn, the Netherlands) visitors can go on an interactive journey, following the expedition of Schouten and Lemaire. © Martijn R. Manders

4.1 Underwater Museums and Heritage Trails

Below are examples of well-established underwater museums around the world (see also *Additional Information 2*).

Maritime Historical Underwater Park, Finland
Opened in 2000, the Maritime Historical Underwater Park is situated near the wreck of the Kronprins Gustav Adolf (Helsinki). Divers can access the wreck by following a line around the site. While exploring the site, visitors can read a series of twelve signs that contain information about the wreck.

For more information see:
www.nba.fi/en/mmf_park (Accessed February 2012).

Underwater Museum Project, Egypt
The Underwater Museum Project exhibits sculptures and objects found in the harbour of Alexandria. During a UNESCO meeting it was decided that the museum should include not only an above water exhibition room for the interpretation of the archaeological finds, but also an accessible underwater area, such as an aquarium with tunnels. By creating this unique structure, visitors have the opportunity to see in situ protected objects and underwater archaeologists at work.

ADDITIONAL INFORMATION

2 For additional information on underwater museums and dive trails, see: www.unesco.org/culture/underwater/underwater_museums_en (Accessed February 2012).

For more information see:
www.unesco.org/new/en/culture/themes/underwater-cultural-heritage/about-the-heritage/underwater-museums (Accessed July 2012).

The Sunken Harbour of Ceasarea, Israel
Opened in 2006, this museum claims to be the first underwater museum in the world. Following a network of underwater trails, divers and snorkellers can explore a Roman wreck, a ruin of a lighthouse and other structures.

For more information see:
www.sacred-destinations.com/israel/caesarea-underwater-museum.htm (Accessed February 2012).

Baiheliang Underwater Museum in Chongqing, China
Opened in 2009, the Baiheliang, (which translates to the White Crane Ridge) is an archaeological site in China, now submerged under the waters of the newly built Three Gorges Dam. The museum displays some of the world's oldest hydrological inscriptions, recording 1,200 years of changes in the water level of the Yangtze River, north of the Fuling District of the Chongqing Municipality.

For more information see: www.whatsonchengdu.com/travel-msg-32.html (Accessed July 2012).

Unit Summary

Museology is the study of museum theory that encompasses not only the object itself, but also the functions concerning the object, the museum and society. It is not the aesthetic value of an object that matters, but the meaning of the object. Museology focuses on the preservation of an object or heritage and the responsibility for disseminating information concerning it, in an educational form.

There are many types of museums, each with their own specific interest of collection. Every collection needs to be well preserved, conserved and researched, in order to disseminate what can be learnt from it through forms of presentation; most prominently, exhibitions.

Once a collection enters into a museum, it must be registered and recorded. The information recorded will include a variety of detailed data about an object, such as its provenance, possible dating, etc. The object will then be conserved and either displayed or safely stored away.

When working with other individuals or organizing an exhibition, ethical choices have to be made. Contentious issues can include illicit trading, displaying human remains or dealing with taboo. The laws regarding these issues have to be understood and the ethical consequences examined carefully.

For decades, the relationship between museums and underwater archaeology did not extended further than exhibiting finds salvaged from the seabed. This is rapidly changing and nowadays, larger, more informative exhibitions, heritage trails and underwater museums have been developed around the world.

It is, therefore, necessary that contemporary underwater archaeologists, whose responsibilities are now so closely linked with museum sectors, understand the museological aspects of their work. They will need to understand the museum's perspective and work together closely with them in the way that benefits their investigation and interpretation of the excavated finds. This collaboration can result in better awareness raising for underwater archaeology and greater public engagement in the protection of the heritage.

Suggested Timetable

30 mins	Introduction
90 mins	What is a Museum and What is Museology? Part I
	Break
60 mins	What is a Museum and What is Museology? Part II
	Break
60 mins	Museums at Work
30 mins	Museum Ethics
	Break
30 mins	Museums and Underwater Archaeology
60 mins	Storyboards
30 mins	Concluding Remarks and Closure

Teaching Suggestions

This unit provides students with an understanding of the role of a museums and their importance in the preservation of cultural heritage. Some teaching suggestions, designed to enhance the student's knowledge of some of the topics in the unit, are listed below.

Introduction

Discussion can often be an ideal way to engage students with a new topic.

Trainers may want to introduce this unit by asking the students the following questions:

- *Do you regularly visit a museum?*
- *Do you go to museums primarily for work or leisure?*
- *Have you ever worked with museum staff?*
- *Have you ever worked on museum exhibitions?*
- *Do you think museology is important for foundation knowledge of underwater archaeology?*

1.1 The Object

Trainers should select an object and ask the students what kind of information they can obtain, just by looking at it. It may be useful to ask students if they can think of other examples from their own countries, as often things are more valuable when placed in a specific socio-cultural context.

It can also be interesting to discuss the fact that an archaeologist may be able to provide an object's context, which immediately gives them a higher monetary value. This is one of the reasons why commercial salvage companies often undertake their own archaeological research.

1.2 Functions of the Museum

The function of a museum is an excellent topic for facilitating lively discussion.

It is recommended that trainers ask students the following questions:

- *What choices can a curator make? Should they choose to display only treasures from shipwrecks or alternatively, also exhibit the grain found on a wreck, in order to tell a broad narrative about trading?*
- *Should a museum tell only the positive stories or also the negative stories ('wrong heritage')? How is this dealt with in the student's countries?*

It may also be worth initiating a discussion on the following topics:

- *Contexts have a significant influence on a visit to an exhibition. Can students give examples from their own experience?*
- *Exhibitions with familiar subjects. Are they different from exhibitions you know nothing about prior to the visit?*
- *How does visiting a museum alone differ from a group visit?*
- *To what extent does an exhibition which incorporates lots of colour and design have a different impact from one with white walls and minimal design? Is one better than the other?*
- *Students will very probably use a narrative order for the storyboard. It is however interesting to discuss with them how the exhibition would look if it was one of the other exhibition types.*

1.3 The Museum

The definition of a museum may trigger a few discussions:

- *What is meant by non-profit? Does it mean that a museum should not make any money?*
- *Or does non-profit mean that financial gain should not be the main goal of a museum? How would it affect the public if this was the main goal?*
- *What about the 'permanent institution'? What types of institutions are excluded by this definition? Do you feel an institution with no permanent collection can be called a museum?*

It may also be interesting to discuss what constitutes a museum with students.

- *Is an underwater archaeological site a museum? By placing information boards at a site, does it then become a museum?*
- *What examples can students think of from their own countries?*

2 Museums at Work

Trainers should discuss with students how archaeological artefacts are depositioned in a museum. Again, it is interesting to examine the similarities and differences between countries.

Ask students:

- *Do artefacts have to be handed over in a conserved status?*
- *Do all the artefacts have to be brought in at the same time? Including all the archaeological reports? Or do the artefacts have to brought to a depot and the museums can obtain (borrow) the objects from there?*
- *Who pays for the conservation? Who pays for the excavation?*

It is important to also examine the differences between conservation and restoration. Conservation is the treatment of objects to ensure their condition is stable, while restoration is the preparation of objects for exhibition.

For example, a small shipwreck:
Conserving the wreck: is looking after the wood in order to keep the condition of the wreck in such a state that it can be kept for a long time.

Restoring the wreck: is putting it back together to make it look like a ship again. This may include reconstructing parts of the ship in order to complete the structure.

3 Museum Ethics

Trainers can engage students in a discussion on the *UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property (Paris 1970)* and the Intergovernmental Committee's Return Policy of Cultural Property (Paris 1978). Trainers can begin the discussion by posing the question: have the students encountered similar issues in their own country?

Trainers can then further discuss the tensions between what is considered academically correct and what is attractive, for example:

- *Do students limit themselves to pictures only from the excavation that they are studying or working on, for use in their exhibitions or publications? Or do they borrow illustrations from other excavations to make the sequence of their narratives complete? Can this be a problem?*
- *Can an exhibition on a shipwreck focus solely on the ceramics that have been found? Or should there be also an emphasis on the stories about how the ship was constructed and the lives of the crew on board?*
- *Can students identify any other potential tensions?*

4 Museums and Underwater Archaeology

It may be useful for trainers to illustrate this section by also referring to UNESCO's exhibition on underwater cultural heritage in Thailand. For more information see: www.unescobkk.org/culture/uch/exhibition (Accessed February 2012).

Practical Session

The Storyboards

One objective of the Foundation Course is to create storyboards that can be used for display and raising awareness. By creating storyboards, students use the archaeological data gathered during the training and 'translate' it in such a way that the story of the site is brought to life for the wider public. In the process of doing so, students will learn how an exhibition is constructed.

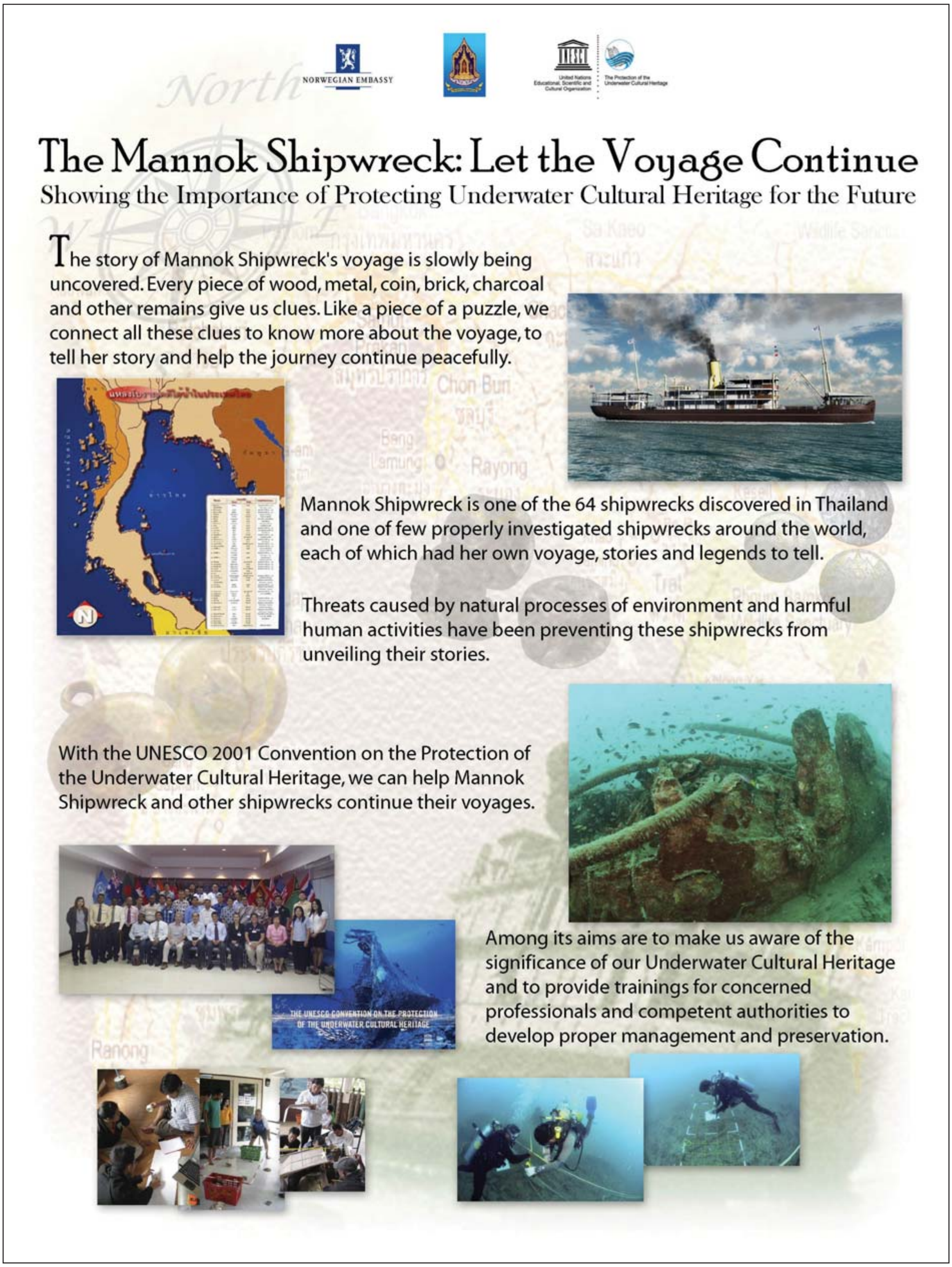
The subject of the storyboard is the Mannok Island shipwreck. The shipwreck is an early twentieth century steel boat, with possible Asian features and contains material from the French Colonial period, as well as typical Asian artefacts.

The students have to develop the story they want to tell and the message that they want to transmit to the wider public. In this case, the audience will be visitors to the Maritime Museum in Chanthaburi, Thailand. During both fieldwork and the post-fieldwork processing, students have to keep in mind what kind of information they need to collect in order to be able to tell the story in an engaging manner.

The students should be provided with a maximum of six A0 posters that they can use to tell the story. The students need to consider all the possible options and come to a collective agreement on what story they want to show and tell.

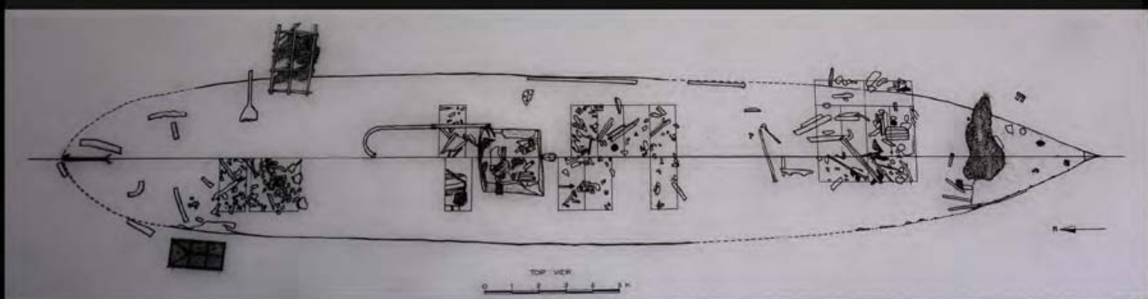
After deciding the theme of their exhibition, students (usually in their fieldwork groups), have to divide the story into three segments and assign each one to a fieldwork group. Each group must then consider what data and pictures they have and draft the contents into a series of storyboards. Once complete, each group should present their storyboard and merge all of the boards from the different groups, to form one complete six-panel exhibition set.

A series of storyboards created by students during the Third UNESCO Foundation Course. © UNESCO

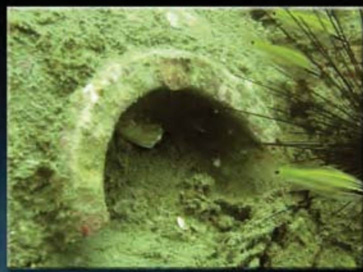


The voyage of the Mannok ship did not end when she touched the seabed under 20 meters of water in the Gulf of Thailand about 100 years ago. We may never know the fate of her passengers and crew on that fateful day. No one knows what caused the tragic event. She remained under tranquil waters, slowly giving in to the forces of nature and man, until a fisherman found what was left of her former glory.

She was a metal ship about 42 meters long and 6.50 meters wide, powered by a steam engine. She might have ferried passengers from Chanthaburi to Bangkok and vice versa before she succumbed to the depths. She is now lying in a north-south orientation with her bow pointing south. Her sheer weight must have caused her to sink into the silty-sandy bottom seabed over the years.







Underwater archaeological survey provided some clues of her heydays. Just before she sank, she must be already in her prime. Her rusting iron hull was reinforced with concrete. Her decks may have been of wood. Her cargo included ceramics, bottles, and coins, aside from loads of charcoal fuel to run her steam engine. She had at least one life boat hanging on the upper deck from two inverted "J"- shaped metal pipes. The lifeboat may have been lowered down to sea and take in surviving passengers or crew before she went down.

Presently, she hosts a variety of marine lives making her an attraction to fishermen and diving enthusiasts alike. We believe that she should be assisted to revert back to her tranquil state and continue her voyage.



THREATS TO MANNOK SITE

1. FISHING
Shipwrecks make conducive breeding sites for fish which attract fishermen. Traveling for fish destroys fragile underwater shipwreck sites and removes artefacts that may be lost forever. Fishing nets also hamper site exploration.

2. LACK OF A MANAGEMENT PLAN
The main threat to Mannok shipwreck is the lack of a management plan. Management plans outline all issues relating to site management: planning, conservation and maintenance, administration, policies among others. Lack of this important tool leads to poor or lack of management of the resource.

3. ENVIRONMENTAL IMPACTS
Submerged artefacts are not only threatened by human impacts but also threats attributed by environment such as sedimentation, corrosion of metal ship parts and decay of organic artifacts.

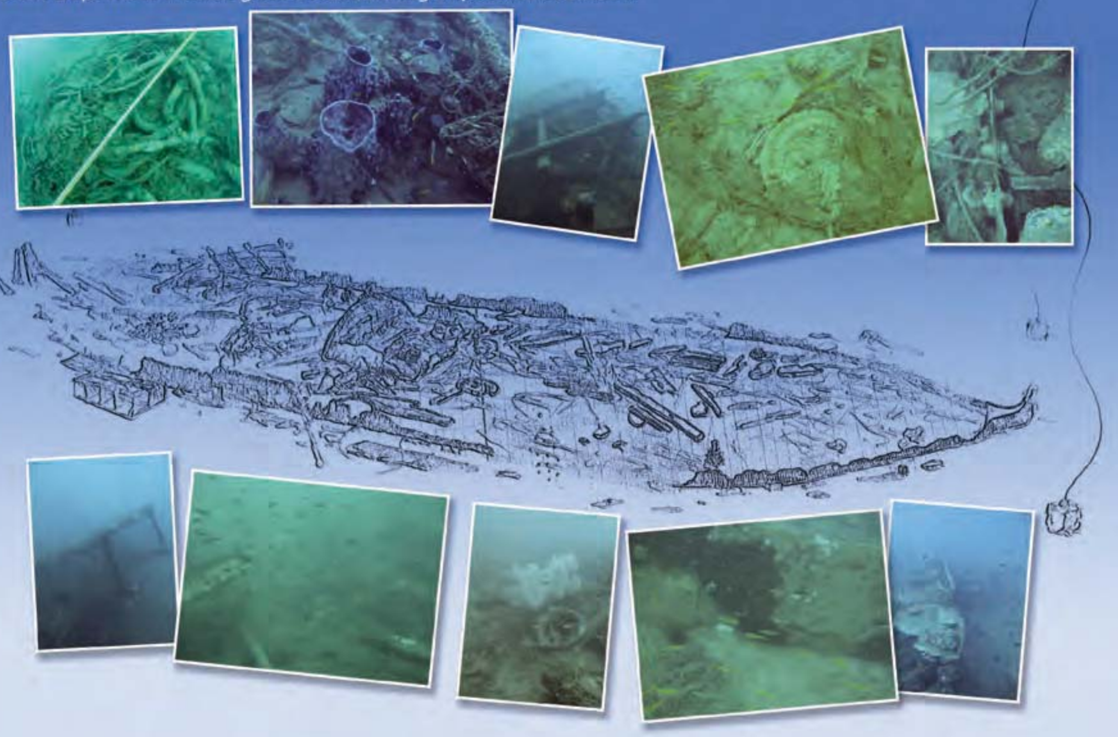
MITIGATION

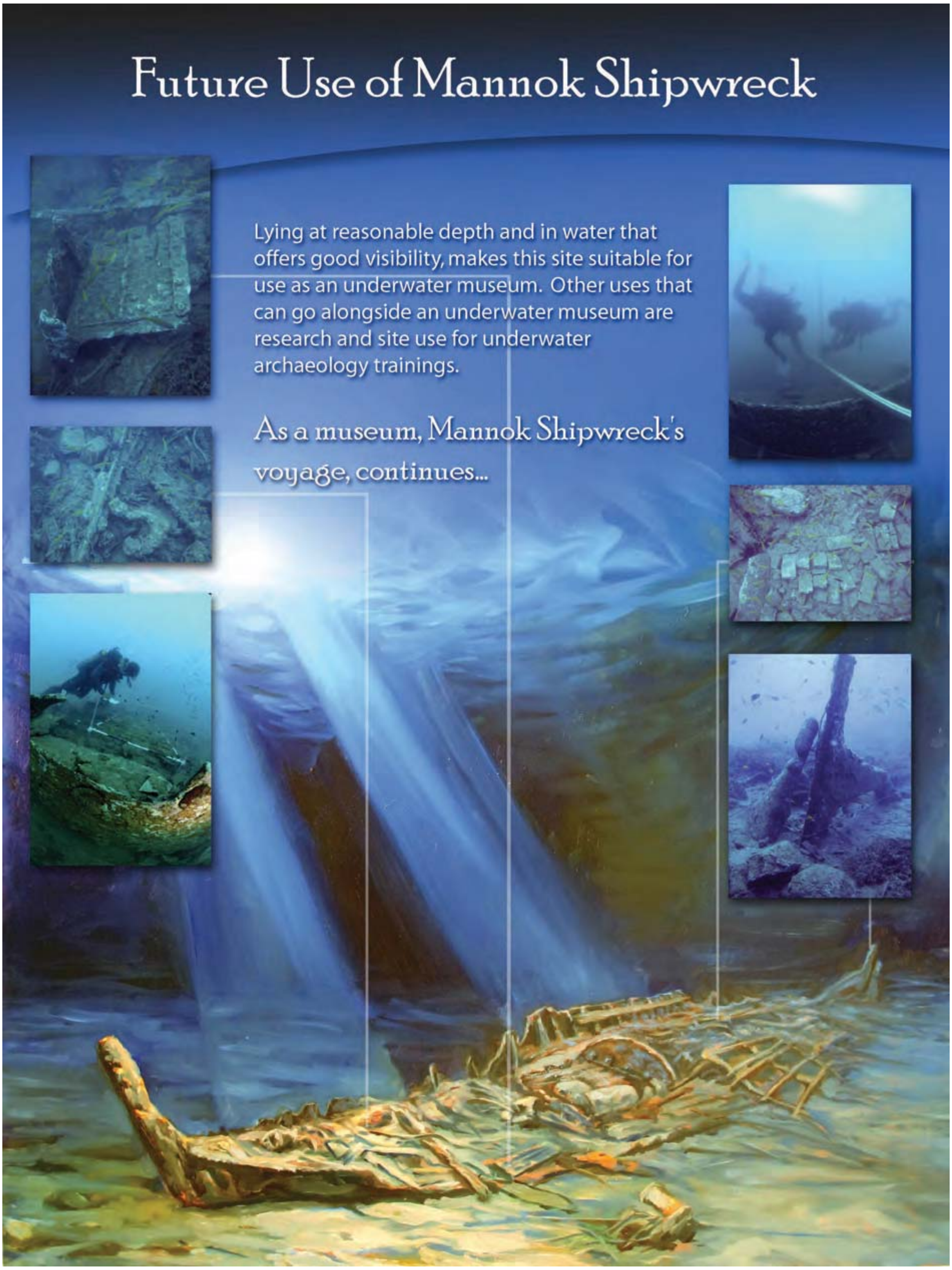
1.PUBLIC AWARENESS / SENSITIZATION
It is important that the public, specifically the local people are sensitized on the importance of protecting heritage as part of their history. They form a key partner in the preservation of the site. This can be achieved through billboards, radio, television, schools.

2. STAKEHOLDER INVOLVEMENT IN MANAGEMENT OF THE SITE
These include tour operators, divers, tour guides, fishermen, media, security, navy, local administration. These are to be actively involved in collaboration with Underwater Archaeology Division of Thailand.

3. BOUYS AT THE SITE TO WARN / CAUTION
A bouy may be placed at the site to inform or warn or caution fishermen and tourists. This can be done in collaboration with local administration and the Navy.

4. REMOVAL OF FOREIGN MATERIALS FROM THE SITE
To appreciate the shipwreck as a museum there is a need to rid the site of materials that do not belong to the ship. These include glass bottles, fishing traps and net sinkers.




Future Use of Mannok Shipwreck
Lying at reasonable depth and in water that offers good visibility, makes this site suitable for use as an underwater museum. Other uses that can go alongside an underwater museum are research and site use for underwater archaeology trainings.
As a museum, Mannok Shipwreck's voyage, continues...

Suggested Reading: Full List

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United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

UNIT 17

Authors Martijn R. Manders, Christopher J. Underwood
and Erpbrem Vatcharangkul

Public Archaeology

Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeolog

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UNIT 17

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Public Archaeology

Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology

Core Knowledge of the Unit

Many archaeologists and heritage managers consider raising public awareness as one of the most effective ways to protect underwater cultural heritage. To be able to encourage the participation of stakeholders in the protection and management of underwater cultural heritage, one should be able to identify the different stakeholder or interest groups and know how to influence each group. Only then can their mind sets be changed to be supportive of the protection and appropriate management of underwater cultural heritage.

This unit consists of two parts:

Part I: *provides a general introduction to community or public archaeology.*

Part II: *explores a number of projects aimed at raising awareness and helping the public to appreciate the importance of underwater cultural heritage. These projects have been specifically formulated to include the public and to minimize the impact of recreational diving on underwater archaeological sites, while maintaining professional archaeological standards.*

Part I: Raising Public Awareness

Core Knowledge of Part I

On completion of Part I of the Public Archaeology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology unit, students will:

- *Understand the concepts of public or community archaeology, raising public awareness*
- *Be able to apply the concepts in the field of underwater archaeology*
- *Recognize that the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) has provisions relating to the public*
- *Recognize that public archaeology is a key component of a heritage management framework*
- *Understand that raising public interest can influence appropriate policies relating to underwater archaeology*

Introduction to Part I

Public archaeology is used to describe archaeology's relationship with the public. It is essentially 'archaeology by the people for the people'.

According to Uzi Baram (New College of Florida), public archaeology:

- *Stimulates public interest in the study of archaeology through the demonstration of archaeological techniques and analyses, workshops, training in excavation and recovery of artefacts and features, site tours, displays and exhibits, or the development of educational programs and materials*
- *Promotes awareness of cultural resources and heritage preservation*
- *Fosters individual or collective efforts to advance the ethical practice of archaeology*

The scope of public archaeology comprises of many facets. The design, goals, communities and methods used in projects can vary greatly, but there are two general aspects that are common to all.

First, public archaeology involves communities having an input into the decision making process, particularly in cases where construction, infrastructure or research projects have a direct link to those communities. Secondly, public archaeologists generally believe they are making an altruistic difference by providing advantages to the communities.

There are also a number of common goals in public archaeology. Similarities can even be found in different countries and regions, due to commonalities in archaeological communities, laws, institutions and types of societies.

Common goals of public archaeology include:

- *Encouraging historic preservation, conservation and public education*
- *The exploration of public memory, localized heritage and commemorations of the past*
- *Facilitating an active engagement with local and descendant communities regarding their history and cultural landscape*
- *Sustaining historic places as localities for civic engagement and civil discussions about the past*
- *Attempting to make archaeology more inclusive and multivocal*

Source: Uzi Baram: http://faculty.ncf.edu/baram/public_archaeology.htm (Accessed March 2012).

Suggested Reading

Grenier, R. Nutley, D. and Cochran, I. (eds.). 2006. *Heritage at Risk Special Edition.* ICOMOS.

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1 Raising Awareness

Raising awareness is often regarded as the best possible way to preserve our cultural heritage. Essentially, it is any activity that promotes an understanding and acceptance for the meaning and value of heritage, with the aim to conserve it for future generations. Only when we understand and accept not only the richness, beauty and historical significance of our heritage, but also how it is threatened, can we make judgements on how to treat it.

According to the classical trinity of heritage management, the future perspective of a tangible past is determined by political commitment, public awareness and economic feasibility. Without public awareness, political commitment will lose its legitimacy and economic feasibility will lose its sustainability. For that reason the support of public awareness is of primary importance.

To do this we must consider who the public is and how to effectively address them. Should this be a one way dialogue? Do cultural heritage professionals have the sole task in creating this awareness or is it the responsibility of everyone?

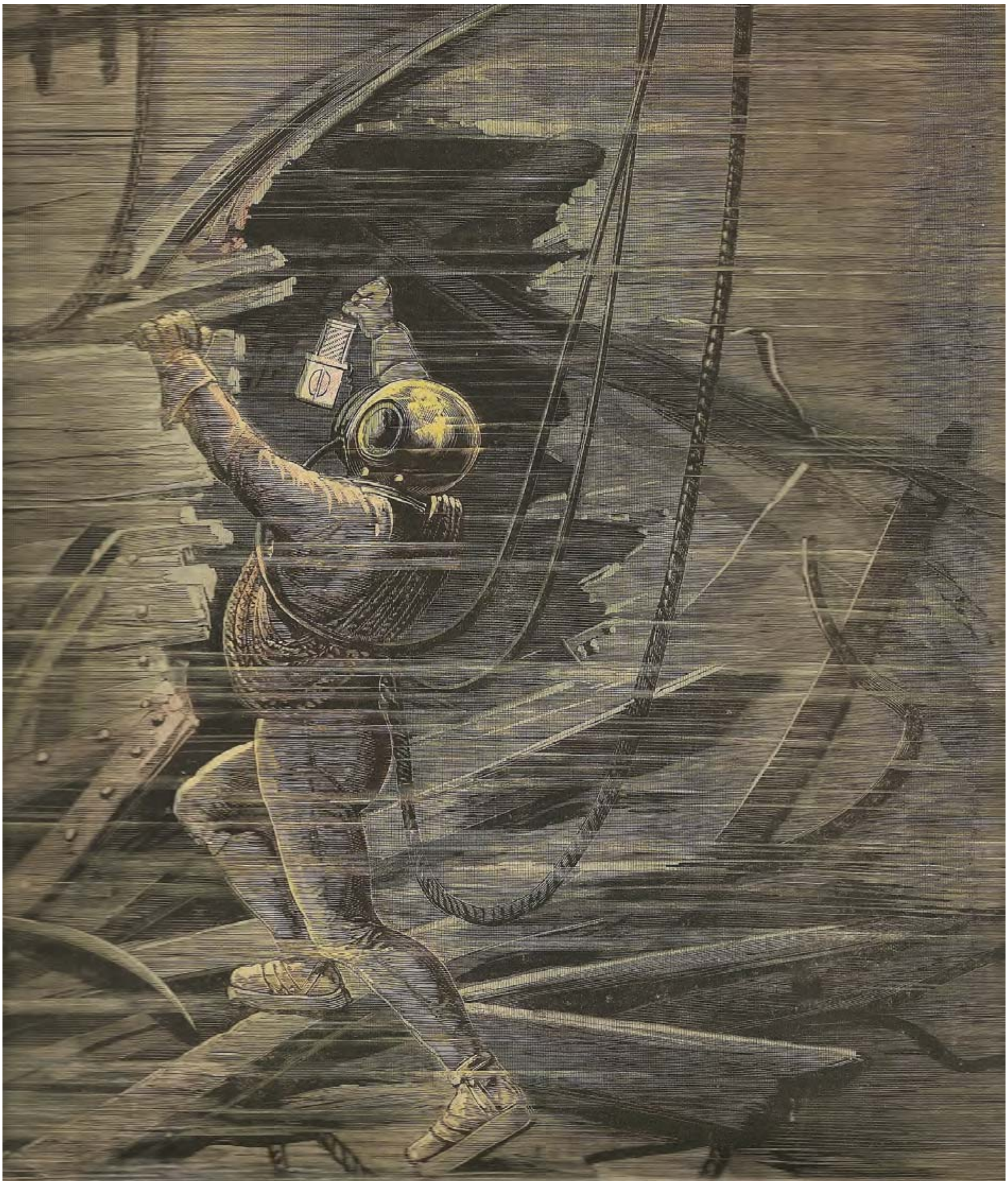
1.1 Raising Awareness of Cultural Heritage

The management of cultural heritage can only be effective when the main stakeholders are aware and actively participate in the management process. Stakeholder groups may differ; they can be school children, local communities, cultural experts or government units at the local, regional and national levels. Each of these different groups has to be approached in a specific manner, e.g. through school education, public archaeology projects, practices of communities, etc.

One effective way to raise awareness is to organize public participation projects that help non-professional stakeholders understand the value of research, protection and appreciation of cultural heritage.

1.2 A Focus on Underwater Cultural Heritage

Public participation plays a fundamental role in the management and protection of underwater cultural heritage. This has been recognized in the 2001 UNESCO Convention, as well as other international conventions and national policy documents. The 'public' is normally defined as stakeholders that are not professionally involved in heritage; this can either refer to the people as a whole or segmented into smaller, defined target groups.



For many, underwater archaeology has an adventurous appeal. Archaeologists are imagined wearing heavy helmets, entering mysterious shipwrecks that lie intact on the seabed. This attraction may lead to negative actions, such as looting or petty theft on shipwrecks, but can also have more positive effects, such as people wanting to become part of the community to protect underwater cultural heritage. Scaphandriers à la recherche d'épaves au Havre' in Le Petit Journal, 13 February 1892, pp.56. Courtesy Martijn R. Manders' collection

Fishermen, recreational divers or the navy often discover shipwrecks. As a result, these groups have become the eyes and ears for underwater archaeologists. Despite being recognized as discoverers of underwater archaeological sites, these stakeholders have not always played an active role in the overall management of sites. However, there is a now a growing effort to recognize and include them in the process.

Protection of underwater cultural heritage can often be most effective on a local level, facilitated by communities that have an understanding of their shared heritage and history. In this case, archaeologists and other heritage professionals can facilitate as guides and advisors, and in the process help raise awareness. Examples of cooperation between underwater cultural heritage professionals and other stakeholders can be found in many countries, such as in Thailand, Sri Lanka, Indonesia, Australia, United States, Canada, United Kingdom and the Netherlands.

The UNESCO Convention (Paris 2001) has brought focus on underwater cultural heritage in many countries. Although only forty countries have ratified the Convention so far, many more are taking the management of underwater cultural heritage seriously. Many of them have adopted the code of good practice in accordance with the rules of the Annex of the UNESCO Convention and in compliance with national legislation that is already in place.

As underwater cultural heritage has a unique international character, the need for cooperation between governments (e.g. neighbouring countries or countries with a shared past) and other stakeholders, has become increasingly important. Most countries are connected by culture, religion and trade. The connection between countries may have been beneficial to both countries or may have been advantageous to only one. Whatever the nature of their past connection was, the concerned countries and their nationals must be informed about their shared or common heritage.

Underwater, we can find relics of these past connections between countries, often in an excellent state of preservation and providing us with 'time capsules' of the past. Unfortunately, most of these important sites are inaccessible at the present time or are under severe threat by natural or human interference. See *Additional Information 1*.

Our shared or common heritage sites found underwater need to be preserved in an appropriate manner. In some cases, they may be equally important or significant for more than one country (see Unit 6: *Significance Assessment*). Given this, information about the sites should be shared. Article 19 of the 2001 UNESCO Convention specifically mentions the sharing of information among interested States.

ADDITIONAL INFORMATION

1 Every shipwreck tells us something about the period of time when they sunk. Therefore, they can be considered as time capsules. Shipwrecks that yielded so much information about the past include the well-known *Vasa* in Sweden, the *Mary Rose* in the UK, the 17th century Dutch flute *Ghostwreck* and the *Vrouw Maria*, an 18th century Dutch *snow* found in the Baltic Sea. The *Hamilton* and the *Scourge* (1812) found on the floor of the Great Lakes in the USA are also very well preserved.

1.3 Inductive and Deductive Approaches

Article 20 of the 2001 UNESCO Convention directly relates to public awareness, stipulating that 'Each State Party shall take all practicable measures to raise public awareness regarding the value and significance of underwater cultural heritage and the importance of protecting it under the convention'. This insinuates a top down approach, from the government to the citizens, which may or may not be the most effective way to move forward.

Awareness of cultural heritage can be created by collecting and sharing information, either in an inductive or deductive manner. An inductive approach builds upon experiences from the past and is illustrated by cooperation between the discoverers of wrecks and the diving amateur archaeologists (see Part II of this unit). Increasingly, some groups are entrusted with more responsibility and freedom to decide what to do with the sites they have discovered.

Amateur archaeologists in discussion with a provincial archaeologist. Avocational divers have played a large part in researching the Roman site of Nehalennia in the province of Zeeland, the Netherlands.
© Martijn R. Manders

A deductive approach creates heritage awareness by working from a theoretical base on how to do so. In the last decade, quite a few of these theoretical approaches have come into force, such as the Malta Convention, Faro Convention or even the Dutch Belvedere programme, all of which have a political backing. Although developed within a scientific framework, the thoughts have been taken over at a political level and put into force often within legal or policy frameworks. Essentially, a deductive approach is an effective, vigorous and professional approach that is similar to what is promoted by the 2001 UNESCO Convention.

In recent years the deductive approach has become more popular in Europe. By definition, a deductive approach is more methodical than an inductive approach. However, using a deductive approach may alienate some stakeholder groups, as it is predominantly based on academic setting. Furthermore, with little concern to stakeholder groups outside the professional cultural groups, heritage can easily be too dependent on external or government financing.

The inductive approach, which is often applied in Asia, typically works on a bottom-up approach. It depends primarily on the enthusiasm and commitment of the public. In this case, heritage is accepted as a functional part of the society and, therefore, maintains its relevance and importance in contemporary life. After all, shared cultural heritage is in the public domain; without public support heritage may disappear. The weakness of this approach may lie in the fact that it relies so much on the efforts of non-professionals, thus this approach can often become less effective and less vigorous. The inductive approach also runs the risk of using ethical standards that may differ from the professionally established norms. This may lead to serious conflicts regarding the interpretation of the significance of sites and ethical ways to deal with underwater cultural heritage (see Unit 6: *Significance Assessment*).

The inductive cooperation among other stakeholders can be beneficial if the professionals deal with the public at an equal level. The challenge lies in how to encourage cooperation and create awareness with mutual respect for all stakeholders. Is it possible for different interest groups to cooperate at the same level? How can an ethical basis for heritage protection be discussed and decided upon by all concerned groups?

Suggested Reading

- Bowens, A. (ed.). 2009. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Nautical Archaeology Society. Blackwell. pp. 11-14.
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- Underwood. C. 2009. Public Archaeology. *Proceedings of the Shared Heritage Seminar, School of Legal Studies,* University of Wolverhampton 2008. English Heritage.

2 *In Situ* Preservation: A Blessing or a Curse for Raising Awareness of Heritage?

In situ preservation has been the preferred option for archaeological heritage management for the last 15 to 20 years (See Unit 9: *In Situ Preservation*). Legal and policy frameworks, such as the Council of Europe's Treaty of Valletta (1992), ICOMOS Charter on the Protection and Management of Underwater Cultural Heritage (Sofia 1996) and UNESCO's Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) support this. However, this strict approach has led to negative reactions claiming that politicians and cultural heritage managers are not giving some sites the attention they deserve. They argue that sites are left on the seabed and sometimes even covered with a protective layer, so that not even the recreational divers can enjoy them. There could be some truth in these claims, as it has become increasingly difficult to investigate the past through the material source in an intrusive manner.

Even more problematic is the fact that sites are often left *in situ* without proper regard for its sustained protection in the future. Divers and fishermen are the first to complain, for they feel that access to these sites and the opportunity to enjoy the sites, which form a part of their environment, are already restricted. At present, heritage professionals are now becoming aware of the benefits of having other stakeholders involved in the management process. They now realize that local communities have a major stake about the heritage in their environment. Keeping the sites *in situ* strengthens their relationship with the environment and, therefore, strengthens the communities around it. It is important the wishes of all concerned stakeholders, including the source communities (which originally owned the site) should be respected.

Creating awareness and instilling shared responsibility offer greater opportunity for the successful protection and management of a site. The process of attributing significance to these sites should no longer considered the exclusive domain of the heritage professionals; instead, source communities and other stakeholders should also be invited to assist in determining site significance.

To successfully implement the *in situ* policy while involving other stakeholders in the process, strict rules must be made flexible. If history has to be learnt and shared to enrich our lives, then research may have to be done in both non-intrusive and intrusive manner. It is important to select wisely for the right reasons, with the right stakeholders and within the appropriate timeframe. This entails a delicate balance between research that may use some intrusive processes and *in situ* preservation for future enjoyment and investigation.

Heritage awareness is also about sharing responsibility. However, the specific roles of the professionals and other stakeholder groups need to be carefully determined and agreed upon.

2.1 Data, Information and Access to Sites

To effectively raise awareness of underwater cultural heritage, data and information regarding the sites have to be made available. The kind of information depends very much on the target group. Stakeholders can range from school children, local community members, the general public, the government or the archaeological community.

The government would need to know about the importance and significance of underwater archaeological site, and its positive effect on national identity. It may also need to know about the threats that the underwater cultural heritage is facing. To provide this kind of detailed information and analysis, some expertise is required, which is one reason why the heritage site managers need to participate in the UNESCO Foundation Course.

With assistance from Asian and European governments, underwater archaeologists and cultural heritage managers from the Asia-Pacific region have been trained. Through capacity-building programmes such as this, national governments are now more aware of the need to protect their underwater cultural heritage. In the process, national governments are now more knowledgeable and better equipped to raise public awareness through inductive and deductive approaches.

Other stakeholder groups have to be approached in different ways. As many as 500,000 recreational divers visit Thailand each year to dive. Even the dark and cold waters of the Netherlands are dived by more than 60,000 recreational divers each year. This significant global diving community wants to enjoy the natural environment with underwater archaeological sites. The opportunity to learn from the past undoubtedly increases the attractiveness of diving enthusiasts.

In many coastal communities, a strong sense of cultural awareness has been developed. Due to their shared heritage, cooperation exists among the community members, the diving community, the service providers to divers and local authorities, as a result of the socio-cultural and economic benefits that responsible diving around underwater cultural heritage sites can provide. The diving communities are establishing their own shipwreck databases and are actively involved in discussion forums regarding their environment.

Here, the role for government agencies (often the competent authorities for underwater cultural heritage management) should be to facilitate and influence the discussions regarding research, protection and the accessibility of sites. To achieve this, authorities should have the right information and willing to share appropriate information with other stakeholders, including those from outside their country.

An example of this initiative is the development of MACHU, a Geographical Information System that can be used in the management of underwater cultural heritage. Funded by the European Union, this system contains data about underwater archaeological sites that can be shared through the Internet. At present, ideas are being explored to develop a similar kind of system in Asia (See Unit 8: *Geographical Information Systems*).

Although it is imperative that information about sites is shared, many databases are only available to heritage professionals, due to the sensitivity of the information contained therein. The exact locations of archaeological sites are considered restricted information, not readily disclosed to non-professionals, despite the fact that some locations may have originally been reported by these groups. This attitude, however, creates an atmosphere of distrust, which may result in a decrease of sites being reported. Partly to overcome this problem, a content management system has been developed by the same creators of the MACHU project. Accessible online, the system allows everyone to share their stories about underwater cultural heritage sites.

Stakeholder groups may have their own opinions regarding underwater cultural heritage that differ from those of the heritage professionals. Professionals have to think carefully about how these stakeholder groups should be approached and appropriately dealt with, so that an active dialogue on sharing of responsibilities can be facilitated.

There is, however, a disadvantage of identifying a target group and dealing with it separately. In the process, other groups may feel excluded or alienated. At times, stakeholders who have had a prolonged involvement in the management of a site may feel excluded if focus is suddenly shifted to a group who has not been involved from the very start. This is particularly experienced by professionals who suddenly appear to show their concern for a site.

Part II: Public Participation, the Advantages of Working Together

Core Knowledge of Part II

The aim of Part II of this unit is to explore some initiatives that raise awareness and encourage public participation in the protection and management of underwater cultural heritage sites.

Upon completion of Part II of the Public Archaeology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology unit, students will:

- *Understand that there is a broad range of initiatives aimed at raising public awareness about the importance of underwater cultural heritage and the threats to its preservation*
- *Understand that by providing public access to archaeological sites, there is a potential threat to the preservation and protection of underwater cultural heritage*
- *Recognize that the public can contribute to our knowledge of underwater cultural heritage*
- *Recognize that the public can become effective custodians of underwater cultural heritage*
- *Understand that public inclusion projects should have specific objectives and follow a series of guidelines*

Introduction to Part II

Part I of this unit highlights some of the main issues and challenges regarding the relationship between the professionals and the public. The initiatives presented in Part II of the unit represent a selection of initiatives implemented to raise awareness and involve the public in archaeological projects.

1 Involving the Public

As public interest in cultural heritage is increasing (as recognized in the 2001 UNESCO Convention, see *Additional Information 2*), it is not surprising that public archaeology has become one of the most rapidly developing sectors of archaeology. This rapid development poses a problem, as this sector is absorbing a significant part of management resources which could be used in research, planning and actual management of sites. Unfortunately, the budget for archaeology has not increased to accommodate the rapid expansion of this sector. Therefore, any financial support for this sector needs to have both meaningful and measurable outcomes to justify the investment, such as in the form of a cost-benefit analysis.

ADDITIONAL INFORMATION

2 The introduction to the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) notes the 'growing public interest in and public appreciation of underwater cultural heritage', alongside the 'public's right to enjoy the educational and recreational benefits of responsible non-intrusive access to *in situ* underwater cultural heritage, and of the value of public education to contribute to awareness, appreciation and protection of that heritage'.

Over the recent decades, an increasingly wide range of initiatives have been implemented, designed to raise the public's awareness and provide direct or indirect public access to archaeological projects. Many of these initiatives have been implemented by non-profit, non-governmental organizations (NGOs), whose activities are often funded by grants received from donors that includes cultural agencies. Some of the more common public archaeology initiatives are outlined in the following sections.

1.1 Stickers, Leaflets, Information Booklets and Posters

Stickers and leaflets usually aim to convey simple 'impact messages' to the public. Booklets and posters provide more space, so the message can be expanded to include more detailed information and examples of cultural heritage. If the message is focused on threats to preservation, booklets and posters can provide important information, such as who to contact in the event that a site is discovered, or when damage to a heritage site has been noted.

'Danger in the Sea: Some destroy our history, don't be one of them'. Such simple initiatives usually form part of a wider range of activities. © Fundación Terra Firme/Carlos Del Cairo & Catalina Garcia

These leaflets illustrate how maritime culture has become a tourist attraction across the globe, from Portsmouth in England to Itaparica Island in Brazil and the Island of Wieringen in the Netherlands. © Martijn R. Manders

Leaflets of promoting conferences, programmes and projects focused on underwater archaeology. © Martijn R. Manders

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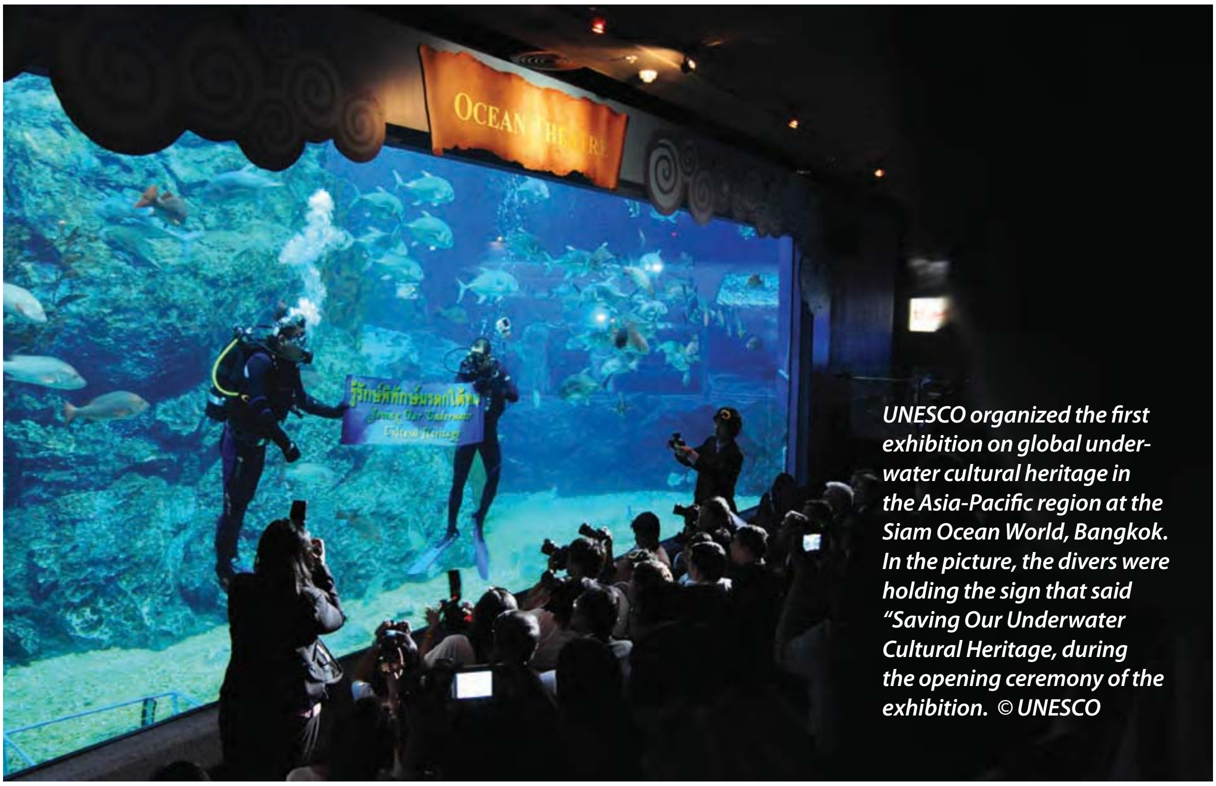
Promotional leaflets on the protection of the underwater cultural heritage. © Martijn R. Manders

1.2 Exhibitions

In 2010, UNESCO Bangkok organized a major exhibition on underwater cultural heritage, particularly from the Asia-Pacific region. Held at the Siam Ocean World in Bangkok, Thailand, the interactive exhibition featured underwater heritage scenes from around the world, a life-sized replica of an actual Thai shipwreck, showcases of artefacts recovered from the seabed, special demonstrations of maritime archaeologists in action and various play zones for children. The exhibition was visited by an estimated 150,000 local and foreign visitors over a three month period. Exhibit items now form part of the permanent collection of the National Maritime Museum in Chanthaburi, Thailand.



UNESCO organized the first exhibition on global underwater cultural heritage in the Asia-Pacific region at the Siam Ocean World, Bangkok. In the picture, the divers were holding the sign that said "Saving Our Underwater Cultural Heritage, during the opening ceremony of the exhibition. © UNESCO

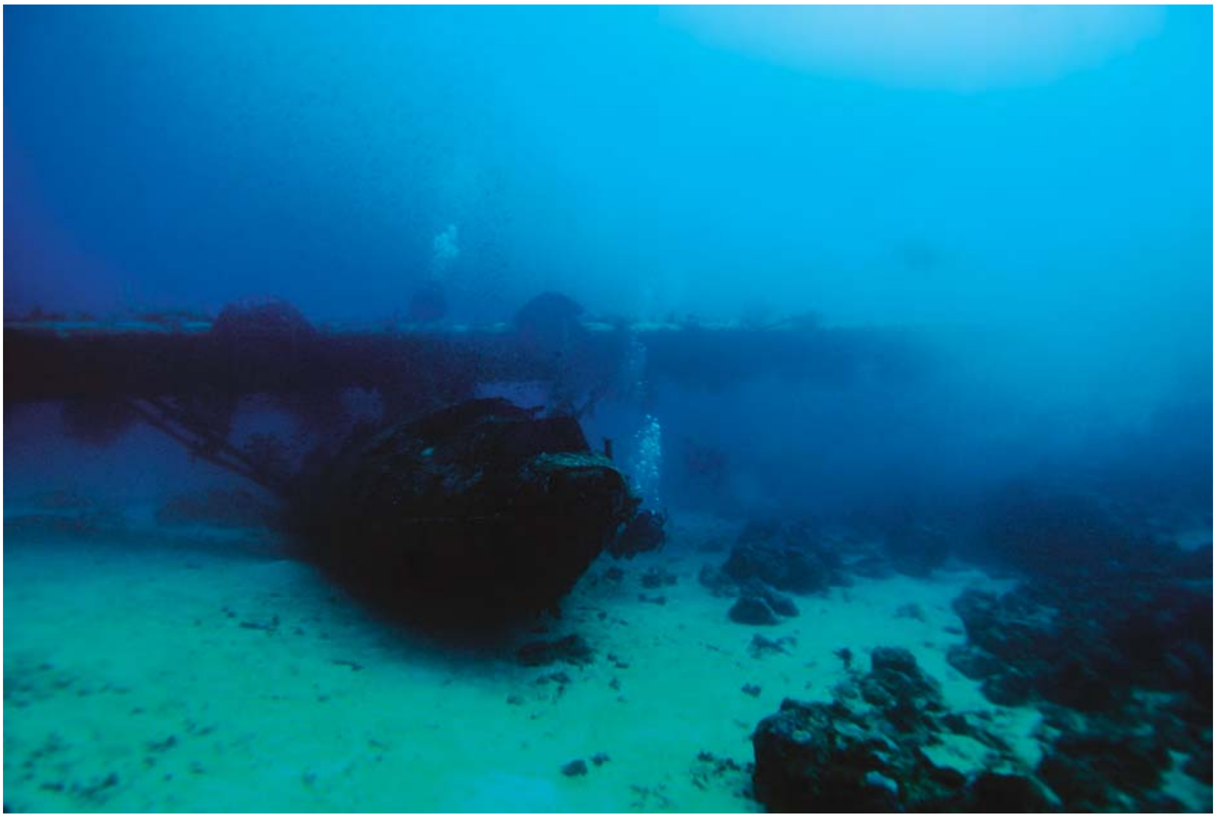
1.3 Conferences and Lectures

Due to its unique nature, underwater archaeology has always been a discipline where the public and the professionals have easily interacted. Archaeologists often attend and present papers at archaeological conferences, such as Europe's International Congress on Underwater Archaeology or the USA's Society of Historical Archaeology annual meeting. These archaeologists are often the ones who discover and investigate new sites, offering professionals an interesting perspective on pertinent issues.

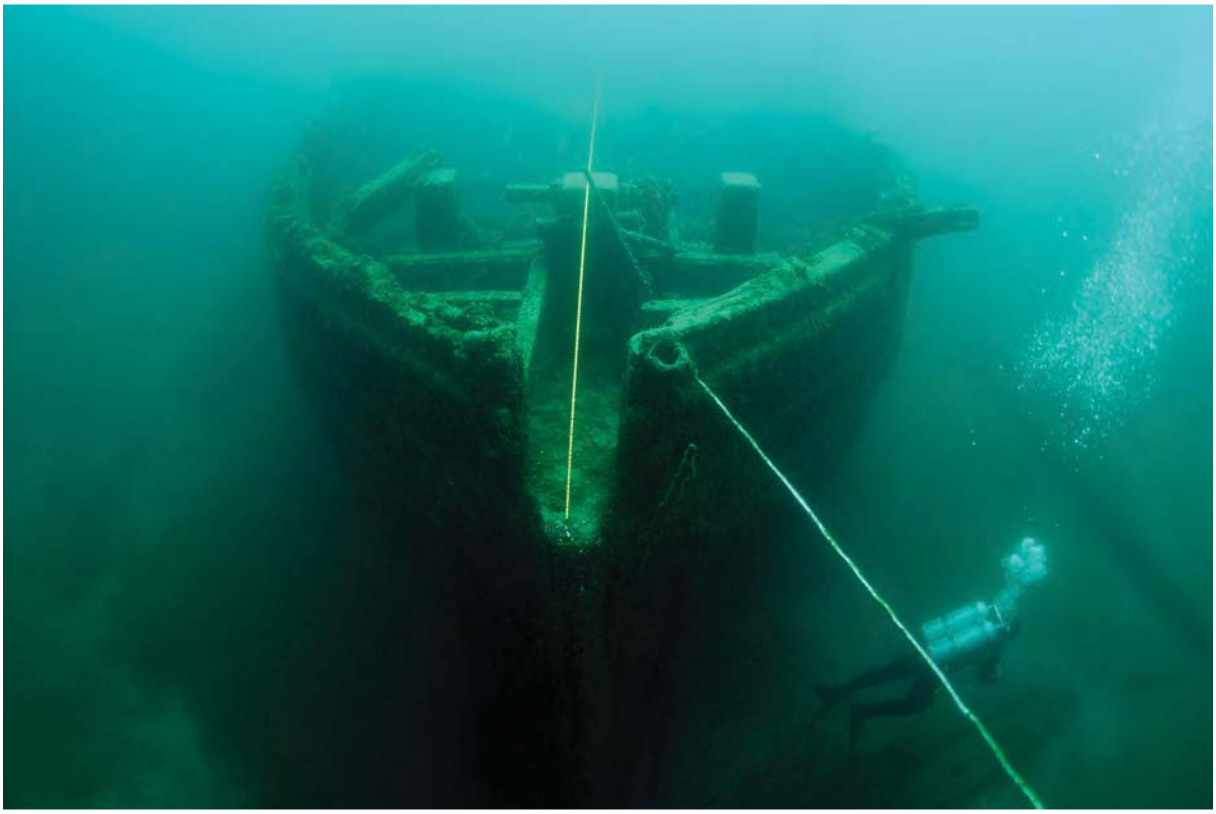
1.4 Marine Sanctuaries, Preserves, Protected Areas and Parks

Across the world, unique underwater heritage trails and site museums have been established, such as the *Kronprinz Gustav Adolf* Underwater Park in Finland, the Oceanário in Portugal and the Baiheliang in China. Others, such as the Biak Underwater Park in Indonesia are currently under development.

In Europe, divers in the Baltic region will soon be able to gain access to the well-preserved wrecks located in the Nordic Blue Parks, while in the Netherlands, a large underwater museum/park is being developed in Lake Oostvoornse.



Catalina Flying Boat which will be part of a proposed maritime conservation area in Biak, West Papua, Indonesia. © Ministry of Marine Affairs and Fisheries, Republic of Indonesia.



The E.B Allen*, one of the more than fifty sites in Thunder Bay National Marine Sanctuary. © NOAA/Tane Casserley*

The Great Lakes Maritime Heritage Centre has constructed a replica of a wooden schooner, designed to simulate a shipwreck. The Centre has also constructed a series of overhead tunnels that allows visitors to view the 'wreck' as if they were divers. © NOAA/Tane Casserley

1.5 Museums, Memorials (National or Community)

These can be traditional 'bricks and mortar' buildings, such as the community museum in Chanthaburi, Thailand (see Unit 16: *Museology*) or virtual concepts, such as that of Florida State Department's Museums in the Sea. Here, visitors can gather information from video guides about Florida's Underwater Preserves and Museum of Underwater Archaeology via their website.

For more information see: www.flheritage.com/archaeology/underwater/seamuseum/index.htm and www.themua.org. (Accessed February 2012).

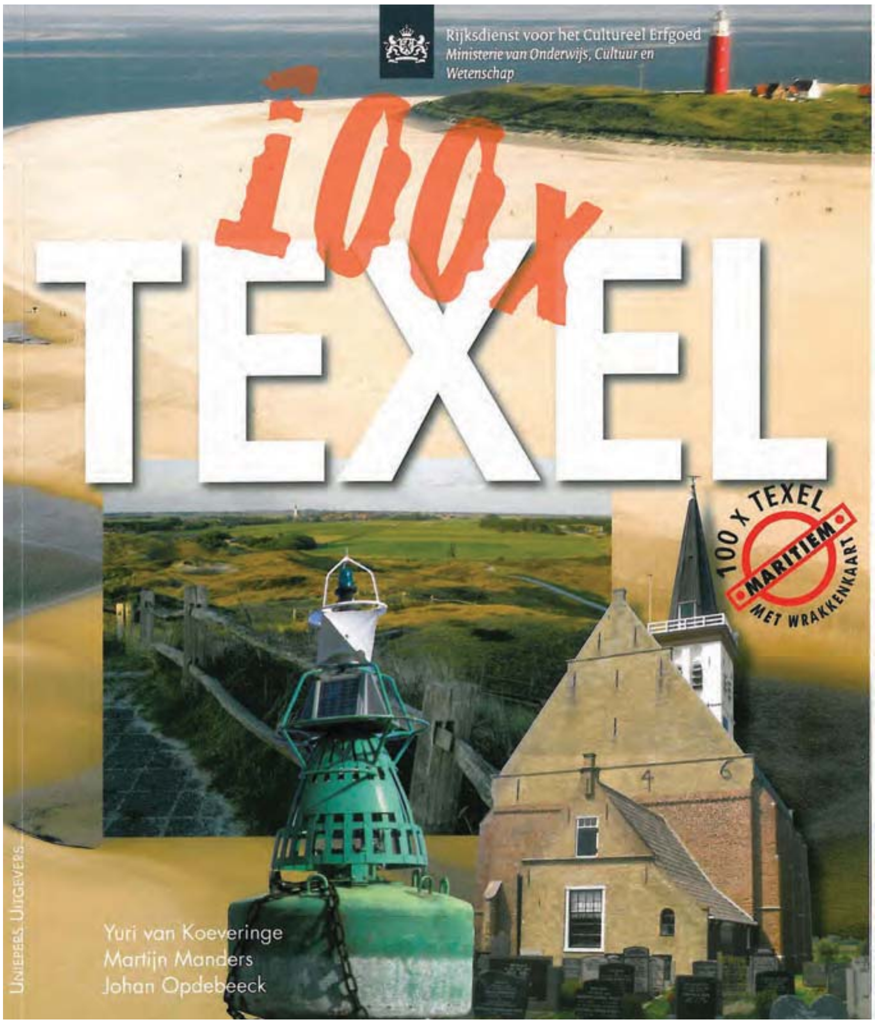
1.6 Publications and Reports

Aside from printed reports, field reports are now increasingly made public from online sources.

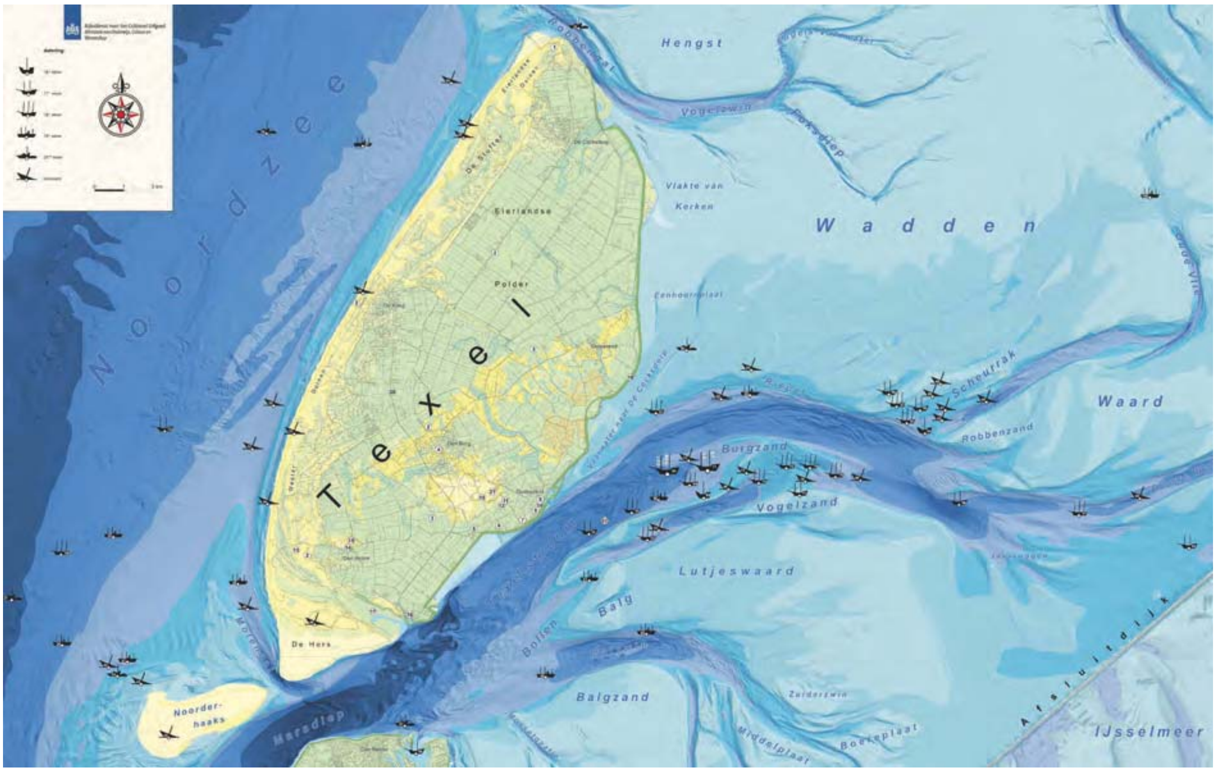
1.7 Terrestrial Maritime Cultural Heritage Trails

Heritage trails can take different forms. Some feature both natural and cultural heritage, while others focus on foreshore and underwater cultural heritage sites, such as the Underwater Shipwreck Discovery Trail in Victoria, Australia, the Cayman Islands Maritime Heritage Trail, and the 100 x Maritiem Texel in the Netherlands.

Viewing points, placed close to where the sites are located, usually have boards or even audiocasts that provide explanatory information. However, visitors may have to use their imagination to fully appreciate underwater sites and as such, site interpretation is a major challenge for site managers. Site managers have to be creative to raise public awareness and appreciation of site significance.



100 x Maritiem Texel explores maritime history on and around the island of Texel in the Netherlands. The book illustrates one hundred sites on land, as well as underwater. © Uniepers Uitgevers



Texel, The Netherlands. This map has been published together with the book 100 x Maritiem Texel © RCE

This heritage trail in the Cayman Islands features thirty-six historical maritime sites, including lighthouses, maritime architecture, shipbuilding and anchorages. © M. Leshikar-Denton

The Sarmiento Argentina *is part of a heritage trail around Puerto Madero, a nineteenth century port in Buenos Aires.*
© Christopher J. Underwood

Information in several languages can be accessed by dialling the number shown on the plaque located adjacent to the ship.
© Christopher J. Underwood

1.8 Maritime Heritage Trails for Watercrafts

Various countries have established marine or even freshwater heritage trails using watercrafts, such as glass bottom boats, kayaks, canoes and even submarines. In the Cayman Islands, tourist submarines offer the non-diving public the opportunity to visit reefs and shipwrecks, while in Scapa Flow, Scotland, visitors can view the wrecks of the German High Seas Fleet, through the eye of a remotely operated vehicle (ROV).

2 Public Archaeology Initiatives Aimed at Recreational Diving

The popularity of recreational diving has grown rapidly over the last 40 years. The increased diving activities pose a major threat to the preservation and protection of underwater cultural heritage. This threat has to be balanced with the possibility that divers can also monitor underwater archaeological sites, acting as the 'eyes and ears' of archaeologists and site managers.

See Unit 3: *Management of the Underwater Cultural Heritage* and *Additional Information 3* and *4*.

Divers are a special stakeholder group. Unlike the general public, divers have access to underwater cultural heritage sites *in situ*, an activity that is often unregulated. While enjoying their sport, divers sometimes discover new sites, some of which are archaeologically or historically important. Therefore, heritage managers and archaeologists should maintain good relationships and regular contact with divers, the dive shops and owners of chartered boats, so that new discoveries are reported and known sites monitored.

Recreational divers preparing to explore wrecks in the Oostvoornsche Meer in the Netherlands. © Martijn R. Manders

Educating divers about the fragility of sites and leaving them undisturbed is very important. In countries where diving is a relatively new sport, there is the opportunity to raise awareness among the diving community before problems develop. This is particularly relevant in South-East Asia, where the recreational diving industry is developing rapidly.

Other initiatives are aimed specifically at divers and snorkellers. Public archaeology programmes, for example, typically focus on educating divers about the threat they pose to the preservation of the heritage. Aside from poor diving techniques that can disturb the site environment, artefacts and parts of shipwrecks are also taken as souvenirs by divers.

Wrecks in shallow water can be seen by snorkellers or even by those in small boats. © NOAA/John Brooks

ADDITIONAL INFORMATION

3 Between 1970 and 2010 the number of PADI Diver training certifications (all level of qualification) awarded annually has risen from 24,000 in 1970 to over 920,000 in 2010. A copy of the PADI statistics report is available at: www.padi.com/scuba/uploadedFiles/2010%20WW%20Statistics.pdf (Accessed February 2012).

4 New technical diving techniques using trimix, semi and closed circuit rebreather systems are enabling divers to access wrecks in deeper waters. Wrecks that were traditionally beyond the reach of the majority of divers have become accessible. Raising awareness and encouraging a 'look and don't touch' policy provides a continuing challenge.

2.1 Underwater Heritage Trails

Public access to underwater archaeological sites poses a number of significant challenges for site managers. Site managers should ensure that access to the sites does not accelerate site deterioration. By the very nature of the sites, monitoring the impact of site visitation on a daily basis is very difficult, if not impossible. if not impossible, particularly as the sport divers are not usually accompanied by archaeologists or guides.

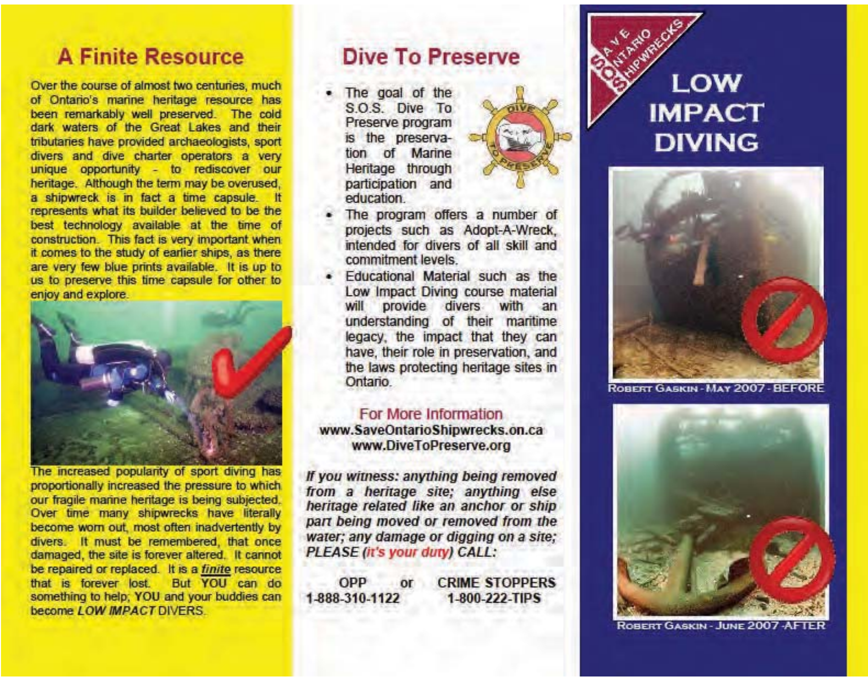
In the United Kingdom, recreational divers can apply for a license to dive in any of the protected sites. Permission to dive in specific sites can be restricted, depending on site fragility and whether the site is currently being researched. This restriction conforms with Rule 7 of the 2001 UNESCO Convention that states, 'Public access to *in situ* underwater cultural heritage shall be promoted, except where such access is incompatible with protection and management'.

A diver about to begin the underwater trail around the site of the* Swan *in the Sound of Mull, Scotland. © Christopher J. Underwood

Though the remains of the German High Seas Fleet in Scapa Flow, Scotland are protected by legislation, a diving license on the site is not required. In this case, divers must be encouraged to adopt a 'look but don't touch' approach. Monitoring of this site is obviously difficult, thus the cooperation of the local diving industry is required to effectively safeguard the site.

2.2 Low Impact Diving

This Canadian initiative encourages divers to treat sites with respect and to adapt a 'look but don't touch' approach. The initiative includes a code of non-intrusive diving that aims to reduce a diver's impact on sites. The code encourages improved diver's buoyancy skills, non-disturbance of artefacts and the protective silts, avoidance of physical contact with parts of the shipwrecks and not to anchor on the sites. An information leaflet about the initiative includes a 'Crime Stoppers' telephone number, so that anchoring at shipwreck sites or the removal of artefacts can be reported.



A leaflet promoting low impact diving. © Save Ontario Shipwrecks/ Vlada Deking

2.3 Respect Our Wrecks Initiative

This initiative, which has similar aims to Low Impact Diving, is specifically designed to curb poor wreck diving practices. Adopted by various international diving organizations, such as the Professional Association of Diving Instructors (PADI), British Sub-Aqua Club (BSAC) and the Confédération Mondiale des Activités Subaquatiques (CMAS), the initiative encourages codes of ethical diving practices, reminds divers about their responsibilities and describes the importance of respecting the integrity of wreck sites.

2.4 Protecting Sites from Anchor Damage

Initiatives, such as Low Impact Diving and Respect our Wrecks, aim specifically at preventing damage from anchoring directly on a site. Anchor damage has a measurable impact on wrecks. Grapple anchors are sometimes used to drag the seabed to find the wreck prior to beginning diving. It has also been quite a common practice to tie a line to a part of a wreck to make diver's access and egress easier. Over time, these parts weaken and are tear away from the wreck. These factors accelerate the 'wrecking process'. Raising awareness of the impact of these processes and by creating fixed anchors close to, but not on the site help to reduce the impact of sport divers to the underwater archaeological sites.

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2.5 Training Courses

A number of heritage and archaeological organizations run training courses for the public, such as the Nautical Archaeology Society, the Florida Public Archaeology Network's (FPAN) and the Maritime Archaeological and Historical Society's (MAHS). Recreational diving organizations, such as PADI also have special courses that focus on archaeology and raising awareness.

3 Inclusion of Recreational Divers in Archaeological Projects

The concept of involving recreational divers in archaeological projects is contentious, with the opinions of heritage professionals divided on whether or not amateurs should be involved. Most, if not all, accept that managed public access to *in situ* cultural heritage sites is acceptable, provided adequate safeguards are put in place to minimize impacts. Access to the most fragile and important sites should remain restricted.

Fewer are convinced that amateurs should have a more direct role, such as working on sites either with or without the supervision or presence of a trained archaeologist. Questions are raised about the value of their contribution, whether the results meet acceptable professional standards or whether amateurs can be trusted (see Case Studies on pp. 29-36).

These issues are not discussed here, as the focus of this unit is to illustrate how public involvement can be successfully managed to provide positive results. It is not suggested that recreational divers should participate in commercial marine infrastructure projects, but it can be valuable to provide them with a defined role that enables them to make a positive contribution. In cases where amateurs are included in archaeological projects, there are a number of recommended principles.

3.1 Principles

- *Archaeological standards must be maintained. Trained archaeologists should provide guidance and support amateurs*
- *Volunteers must receive training and be able to demonstrate skills in the archaeological techniques required for the project*
- *Volunteers must be qualified for the anticipated diving conditions*
- *Volunteers must be fully briefed and provided with all appropriate information about the project*
- *Safe diving practices must be adopted at all times*
- *The results of the project should be disseminated as widely as possible*

3.2 Archaeological Standards

All archaeology projects should meet acceptable archaeological standards, a principle that should not be sacrificed because a project includes volunteers. Rule 10 of the Annex of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Paris 2001) provides a suitable framework for the development of a project plan, which includes the following components:

- *An evaluation of previous or preliminary studies*
- *The project statement and objectives*
- *The methodology to be used and the techniques to be employed*
- *The anticipated funding*
- *An expected timetable for completion of the project*
- *The composition of the team and the qualifications, responsibilities and experience of each team member*
- *Plans for post-fieldwork analysis and other activities*
- *A conservation programme for artefacts and the site, in close cooperation with the competent authorities*
- *A site management and maintenance policy for the duration of the project*
- *A documentation programme*
- *A safety policy*
- *An environmental policy*
- *Arrangements for collaboration with museums and other institutions, in particular, s cientific institutions*
- *Report preparation*
- *Deposition of archives*
- *A programme for publication*
- *Project direction*

To help achieve acceptable archaeological standards, it is strongly recommended that volunteers are supervised by a trained archaeologist. However, the level of supervision will depend to some extent on domestic regulations and the aims of the individual projects.

3.3 Qualifications of Volunteers

Volunteers must be qualified to dive on the site, noting that diving organizations specify parameters, such as the recommended maximum depths. They must be experienced or trained in archaeological techniques, to help ensure that they are competent enough to be able to successfully achieve the archaeological objectives of the project.

3.4 Resources

It is important that archaeological projects are appropriately resourced. For the projects outlined in the case studies at the end of this unit, this has been achieved through successful grant applications that provide funds for archaeological direction, logistical support and for diffusion/publication of the results.

In addition, it is normal practice for volunteers to contribute:

- *To the direct costs of the project*
- *To the costs of training*
- *By providing their own diving equipment*

In some cases, local community support has been provided to cover some of these associated costs mentioned above.

3.5 Safety

The projects must comply with relevant safety legislation, have a competent person responsible for diving safety and have safety protocols appropriate to the prevailing conditions of the site.

3.6 Dissemination

The results of projects involving the public should be treated in exactly the same way as those involving professionals. Results must be published. Depending on resources and the aims of the project, the results of a project may be disseminated through an academic publication, newsletter, public media, websites, posters, leaflets and presentations.

3.7 Conclusion

Before involving the public in projects, the possible consequences of public participation should be carefully considered. Factors such as archaeological standards and outcomes for projects are important and should not be compromised. However, under the right circumstances and with a high level of archaeological direction, the results can be worthwhile.

Suggested Reading

Nautical Archaeology Society. 2009. *Benchmarking Competence Requirements and Training Opportunities related to Maritime Archaeology*. www.nauticalarchaeologysociety.org/research/images_PDFS/benchmarkingcompetency_final_report.pdf (Accessed February 2012).

Underwood, C.J. 2008. The Development of the Nautical Archaeology Society's Training Program and Diving with a Purpose. *Collaboration, Communication & Involvement: Maritime Archaeology & Education in the 21st Century*. Pydyn, A. and Flatman. J. (eds.). Toruń, Nicolaus Copernicus University.

Useful Websites

- *NAS current list of adopted sites:* ***www.nauticalarchaeologysociety.org/projects/wrecks.php*** *(Accessed February 2012).*
- *Remotely Operated Vehicle (ROV) tourist experience:* ***www.orknet.co.uk/rov/rov.html*** *(Accessed February 2012).*
- *Tourist submarines:* ***www.caymanislandssubmarines.com*** *(Accessed February 2012).*
- *Florida Public Archaeology Network:* ***www.flpublicarchaeologynetwork.org*** *(Accessed February 2012).*
- *Save Ontario Shipwrecks:* ***www.saveontarioshipwrecks.on.ca/_Downloads/SOS_LID_brochure.pdf*** *(Accessed February 2012).*
- *British Sub-Aqua Club:* ***www.bsac.com/page.asp?section=1006&sectionTitle=Underwater+Heritage*** *(Accessed February 2012).*
- *Project AWARE:* ***www.youtube.com/watch?v=z02J4P4WWjo*** *(Accessed February 2012).*

Unit Summary

Raising public awareness is recognized as a key factor in the effective management of underwater cultural heritage. Raising awareness is not only about influencing broad public opinion by the cultural heritage managers. It should also target the different stakeholders, such as the governments units at the local, provincial or national levels, local and federal enforcement agencies, coastguards, divers, diving instructors, school children and even cultural heritage managers themselves.

It takes skill to convince different stakeholder groups; they need to be approached at their own level and using the language that they understand. It is important for groups to be involved in data gathering and information sharing. For the effective management of underwater cultural heritage, it is important to provide a platform for an active dialogue among the various stakeholder groups, letting them speak openly and play their roles. Raising awareness of heritage can utilize either a deductive (top-down) or an inductive (bottom-up) approach.

Regardless of the approach to be used, professionals have their own role to play. Underwater cultural heritage managers should provide guidance and be part of an underwater cultural heritage community consisting of different stakeholders sharing the same aim - the research, protection and enjoyment of their shared underwater cultural heritage.

This unit has described a number of initiatives that effectively raised public awareness. A number of organizations, such as Florida's Public Archaeology Network (FPAN), has been established with the engaging sole purpose of the public in the field of underwater archaeology.

Suggested Timetable

30 mins	Introduction: Raising Awareness
40 mins	Examples of the Deductive and Inductive Approaches From the Asian-Pacific Region
	Break
30 mins	*In Situ* Preservation
20 mins	Introduction: Public Participation Projects
30 mins	Discussion: Public Participation, the Effectiveness of Working Together
	Break
40 mins	Lecture: *Introduction to Public Archaeology Initiatives in Foreshore and Underwater Archaeology*
40 mins	Public Participation: Case Studies
20 mins	Concluding Remarks and Closure

Teaching Suggestions

Throughout this unit students are introduced to public archaeology and awareness raising, and are provided with an understanding of how they can be used in the protection of underwater cultural heritage. Discussions can enhance the student's understanding. Although not all relevant aspects can be covered, a few topics that may be most useful to talk about are listed below.

Part I: Raising Awareness

To complement the first series of lectures, it is recommended that trainers discuss:

- *The goals of public archaeology*
- *Examples of deductive and inductive approach in countries in the Asia-Pacific region*
- *The general public's perception of in situ protection*

Part II: Public Participation, the Effectiveness of Working Together

It is recommended that before the lecture begins, trainers encourage students to discuss the benefits, risks and associated ethical issues involved in raising awareness and allowing recreational divers and the public to participate in archaeological projects. A discussion before the lecture has the benefit of enabling the students to express their personal views and experience of public participation, without being influenced by the trainer's own views.

Trainers need to take into account that other countries have different recreational diving traditions. The United Kingdom (UK), for example, has a well established practice that is highly focused on wreck diving. Not all countries share the same tradition. In the UK, diving is relatively unregulated and divers have access to all but a relatively small number of protected sites within defined boundaries, without prior permission.

To conclude, trainers should explore whether the unit lectures have changed the opinions of the students or revealed other issues that were not raised during the opening discussion.

Case Studies: Projects for Amateurs

The projects outlined in the following case studies have similar aims, such as:

- *To encourage the public to participate in the recording and preservation of underwater cultural heritage*
- *To promote local custodianship of sites*
- *To provide opportunities for the public to take part in archaeological projects that contribute information to local and national cultural heritage site archives*
- *To utilize the archaeological skills learned during NAS training courses*
- *To disseminate the results of the fieldwork*

Case Study 1

Sound of Mull Archaeological Project (SOMAP)

The Sound of Mull is a 34 km long stretch of water that separates the Isle of Mull from the Scottish mainland and has provided a relatively sheltered passage for watercraft since prehistoric times.

The area has an important and diverse underwater cultural heritage resource that includes two sites, *Swan* (1653) and *Dartmouth* (1690) which are both designated under the Protection of Wrecks Act (1973). A variety of steamships, sailing vessels and isolated finds can also be found. The Sound of Mull has become a very popular dive location due to the diversity of the wrecks, many of which are in excellent condition with abundant marine life and surrounded by spectacular coastal scenery.

Introduction to the Project

The project was initiated in 1994, utilizing volunteers to resurvey the site of the *Dartmouth* (1690), a protected wreck and the *John Preston*, a nineteenth century schooner and unprotected wreck, from where artefacts are suspected to have been removed.

Archaeologists provided on-site training and supervision, to help maintain archaeological standards throughout the fieldwork.

The resurvey of the *Dartmouth* revealed that two cannons and two anchors were either missing or buried in the sediment (the absence of the cannon and anchors was confirmed in 2003 by the government's archaeological inspection team). A baseline survey of the *John Preston* was also achieved. Subsequent diving seasons were under the supervision of a local archaeologist, with grants from Historic Scotland. Approximately 200 volunteers participated in the project between 1995 and 2005.

Project Objectives

The scope of the Sound of Mull Archaeological Project widened from its original objectives on the two sites to include additional initial assessments of more wreck sites, anchorage sites, structural remains and isolated finds. These assessments were designed to determine the extent, character, condition, date and origin of each of these sites. Outputs from the assessments included baseline maps, accurate locations, seabed bathymetry and recorded evidence of human activity (see *Additional Information 5*).

The project involved desk-based research, diver and geophysical surveys. In total, public and private support enabled four geophysical surveys to be carried out, although these were undertaken separately from the volunteer field activities. Further to this, licensed visitor schemes on the *Swan* (1653) and the *Dartmouth* (1690) were implemented.

ADDITIONAL INFORMATION

5 SOMAP
Geophysical Surveys

1995: Sonar search by the Royal Navy in two sections of the project area

1999: Side scan and proton magnetometer survey by the School of Ocean Sciences, University of Wales

1999: Side scan sonar on two wreck sites in the area

2004: Sound of Mull Mapping Consortium utilizing multibeam sonar.

Interdisciplinary Approach

The project adopted an interdisciplinary approach. Voluntary research was carried out on the character of the burial environments, followed by metallurgical and biological assessments on the *Thesis* and the *Pelican*. The Marine Conservation Society also utilized its own volunteers and undertook qualitative biological mapping of several of the wrecks in the study area.

Archive

On completion of the SOMAP monograph in 2007, the entire site archive was deposited with the Royal Commission on the Archaeological and Historical Monuments of Scotland (RCAHMS), which will curate the archive. The site continues to be managed by Historic Scotland.

Results of the Project

The project produced preliminary surveys of a number of the sites in the project area, with a more detailed recording of the steamship *Thesis*, the schooner *John Preston* and an isolated group of cast iron cannons. The *Thesis* and the *John Preston* have been subsequently adopted under the NAS' Adopt a Wreck programme.

Reports and Publications

The results of the fieldwork (1994 to 2005) and information gathered from project reports were published in a monograph (BAR 453, 2007).

Acknowledgement of the Project's Success

The project's success is recognized in the policy document *Towards a Strategy for Scotland's Marine Historic Environment*. The document stated that, 'projects such as the Sound of Mull Archaeological Project have been successful in developing skills at the community level and in involving the public in the recording and conservation of historic assets around Scotland's coasts' (Historic Scotland, 2005).

Suggested Reading

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- Historic Scotland. 2005. *Towards a Strategy for Scotland's Marine Historic Environment.* Historic Scotland, pp. 29.
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Useful Websites

- *Sound of Mull Archaeological Project:* ***www.nauticalarchaeologysociety.org/projects/somap.php*** *(Accessed March 2012).*

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Case Study 2

Adopt a wreck

Introduction to the Project

The Adopt a Wreck scheme was created after the UK's Wreck Amnesty (2001), during which discussions concluded that divers should be encouraged to take more responsibility for the wreck sites which they dived (see Additional Information 6).

The scheme, with funding from PADI's Project Aware, enabled the development of a project starter pack that promoted the scheme and disseminated results through a series of newsletters.

ADDITIONAL INFORMATION

6 In 2001, the UK Maritime and Coastguard Agency held a three-month amnesty from prosecution for failing to declare artefacts retrieved from wreck sites, a statutory duty defined by the Merchant Shipping Act (1995). Over 30,000 objects were reported, with approximately 900 of them considered historic (over 100 years old).

Aims and Objectives

The aim of the scheme is to encourage volunteer teams to develop a sense of ownership and stewardship for coastal and underwater cultural heritage.

The objectives are to:

- *Add information to the records of archaeological and environmental organizations*
- *Disseminate information about coastal and underwater sites to the public*
- *Enhance and widen the understanding and appreciation of underwater cultural heritage*
- *Understand the impact that factors, such as recreational diving, are having on underwater cultural heritage.*
- *Conduct baseline surveys*
- *Monitor subsequent changes to the adopted site*
- *Conduct wider historical research*
- *Disseminate the research results*

Baseline Surveys

Adopt a Wreck encourages groups to conduct baseline surveys and to monitor changes noted during subsequent visits to sites. Groups can use a variety of techniques, such as video, still photography, sketches and tape measure survey. Although the project initially targeted recreational divers, non-divers are also encouraged to participate.

Project Pack

A 'project pack' CD, supporting the initiave, includes:

- *Case studies from previous winners of the Adopt a Wreck Award*
- *Guidance on working safely*
- *Information on useful equipment*
- *Information on project planning, recording and research*
- *Fourteen different recording forms*
- *Relevant legislation that might affect projects*
- *Guidance on reporting, archiving and funding*
- *Applications for the Adopt a Wreck Award*
- *Information on appropriate training*

Annual Award

As an incentive, an annual award is presented to the 'person or group that has made the most significant contribution to maritime archaeology and research through the adoption process' (NAS, 2011).

The Award criterion includes:

- *Number of people involved*
- *Time spent on site*
- *Type of work undertaken, such as video, photography and sketches*
- *Dissemination of historical research through various media, such as TV, radio, newspapers, websites and lectures, and whether information has been submitted to competent authorities as contribution to historic records*

Summary

One hundred and twenty sites have been registered under the scheme, mostly in the UK, with others in Gibraltar, the Maldives and Poland. Not all of the adoptees remain active, but it can be concluded that the scheme has proven successful in providing a framework for groups to fulfil the project's original aims and objectives. It is hoped that the achievements of these outstanding groups will inspire others to undertake similar projects on sites that are not yet protected and, therefore, under the jurisdiction of state management.

Trainers should note:

- *That the scheme is totally voluntary*
- *That there is an administrative process to adopt a site, between the adoptees and the concerned competent authority responsible for the site*
- *That an adoption does not result in any legal entitlement or fees payable*

Suggested Reading

Bailey, C. Georma, F. Mayger, C.M.G. Micha, P. Sa Pintao, S. Soussi, E. and Taylor, J. 1998. *Site Report on the Cannon Site at Scallastle Bay, Sound of Mull, Scotland*. Unpublished MA Dissertation, Dept. of Archaeology, University of Bristol.

Useful Websites

- *Adopt a Wreck scheme:* ***www.nauticalarchaeologysociety.org/projects/adoption.php*** *(Accessed February 2012).*

Case Study 3

The Big Anchor Project

Introduction to the Project

This project is aimed at members of the public from all age groups. The archaeological justification for this project is that although anchors are a ubiquitous symbol of maritime heritage, little archaeological work has been done to collate where they are or the information that they may contain.

Anchors have been used by seafarers for millennia and have become emblematic of the maritime landscape and represent humanity's relationship with the sea. They come in many shapes, sizes and are made of a variety of materials. Each represents evidence of technology, shipwrecks, trade and exploration.

They can be found in many locations:

- *Associated with a sunken vessel*
- *As an isolated find lost as a result of being fouled on the seabed or during a sailing incident*
- *In maritime and other local museums*
- *Private and public places*

The image of the anchor is also used in other contexts:

- *As logos for business and merchandise*
- *The fouled anchor is the symbol of the British Admiralty dating back more than 400 years and appears on equipment used by the Navy and Royal Marines.*
- *As the name of public meeting places with maritime names such as The Anchor or Ship and Anchor*
- *Decoratively in the form of body art tattoos*

Educational Resource

To help participants record anchors, the project has developed a set of recording forms that can be downloaded from the website. These records can then be uploaded to a database that can also be used for research purposes.

Specialist courses are also organised to help participants to categorize, record and date anchors.

Range of Anchor Types

The project database and the reporting procedure are currently divided into two broad categories: stone anchors and stock anchors. The database will also include information about stockless anchors in due course.

Results

To date, 500 anchor records have been submitted by the 120 registered users from Europe, Asia and the Americas.

Submit your anchor record to
www.biganchorproject.com

Iron Stocked Anchor Recording Form

Section 1: General Information

Context	
Category:	
Site:	
Location:	
Reference # :	
Ship name:	
Ship type:	
Ship size:	
Function:	
Anchor type:	
Category:	

Features	
Stock:	☐
Squaring of shank:	☐
Ring:	☐
Shackle:	☐
Number of arms:	
Inscriptions	☐

Recorders	
Names:	
Date:	
Group/Org:	
Big Anchor ID:	

Date and Origin	
Date:	
Period:	
Nationality:	
Certainty:	

Features	
Shape of flukes:	
Stock type:	
Stock section:	
Stock shape:	
Stock fasteners:	
Stock key:	
Shank form:	
Crown:	
Arms:	
Weight:	

Section 2: Anchor Dimensions (recorded in m, cm, mm units)

Shank	
Length of shank:	
Diameter of top of shank:	
Diameter of bottom of shank:	
Diameter of stock eye:	
Arms	
Length of one arm:	
Amplitude of arms:	
Height of bills:	
Distance between bills:	
Shackle	
Diameter of shackle:	
Diameter of eye of shackle:	
Thickness of shackle pin:	
Opening of shackle:	

The Big Anchor Project is coordinated by the Nautical Archaeology Society - www.nauticalarchaeologysociety.org

Key	
Height of key:	
Distance of key:	
Fluke	
Width of fluke:	
Length of fluke:	
Ring	
Diameter of ring:	
Diameter of eye of ring:	
Thickness of ring:	
Stock	
Length of stock:	
Max. diametre:	
Min. diametre:	
Max. thickness:	
Min. thickness:	
Max. width:	
Min. width:	

ABOVE: A recording form used as part of the Big Anchor Project. © Nautical Archaeology Society

RIGHT: A rare bronze stocked anchor that was recovered from Monterey Bay in 1944. © Christopher J. Underwood

A broad range of anchors have been recorded, from ancient to relatively modern stone fishing anchors, as well as various metal anchors. A significant number of these anchors are of rare patent types rather than the common admiralty pattern anchors. Some may be unique, but this needs to be verified through further research.

Future Developments

Subject to funding, the project intends to develop an interactive GIS world map of anchors featuring the records of those submitted. This would be followed by the creation of a Big Anchor App, allowing participants to record and upload submissions from smart phones, direct to the anchor database.

For more information about the Big Anchor Project see: www.biganchorproject.com/ (Accessed February 2012).

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- *British Sub-Aqua Club (Underwater Heritage):* ***www.bsac.com/page.asp?section=1006&sectionTitle=Underwater+Heritage*** *(Accessed March 2012).*
- *Cayman Islands National Museum:* ***www.museum.ky/97/Marine-Heritage_Sites.htm*** *(Accessed March 2012).*
- *Fathom Five National Marine Park of Canada:* ***www.pc.gc.ca/amnc-nmca/on/fathomfive/index.aspx*** *(Accessed March 2012).*
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- *Public Archaeology:* ***www.maney.co.uk/index.php/journals/pua*** *(Accessed March 2012).*
- *Save Ontario Shipwrecks (SOS):* ***www.saveontarioshipwrecks.on.ca*** *(Accessed March 2012).*
- *SOS Low Impact Diving Brochure:* ***www.saveontarioshipwrecks.on.ca/_Downloads/SOS_LID_brochure.pdf*** *(Accessed March 2012).*
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The Protection of the
Underwater Cultural Heritage

UNIT 18

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UNIT 18

Contents

UNIT 18

Authors Hans K. Van Tilburg and Mark Staniforth

Archaeological Publication

Core Knowledge of the Unit

This unit highlights the importance of publishing archaeological research and provides students with guidelines and best practices for writing and illustrating reports.

On completion of the Archaeological Publication unit students will:

- *Understand what formal publication is and why it is important*
- *Understand what basic elements an academic article must contain*
- *Understand how to write and illustrate an academic article*
- *Understand issues related to copyright and permissions of use for copyrighted material*
- *Understand the processes involved in getting an article published*
- *Understand the role of the editor of an academic journal*

Introduction to the Unit

What do we mean by publication? Publication means presenting your findings (results or ideas) in an organized, formal way to the public, usually in written form. There are other ways, such as presentations, exhibitions and broadcasts, but these do not have the permanency of print publication and cannot be referred to by others in the future.

Archaeological fieldwork should be fun, but it is also hard physical work and while doing it, the day-to-day activity can absorb a lot of time and effort. Despite this, it is necessary and important to think beyond the fieldwork. Fieldwork will of course achieve results in terms of understanding the site and its finds, in terms of paperwork and in terms of personal satisfaction. The fund raising required to get it going and the publicity during it, may be good for a career, but all the information that has been gained will be lost to the wider world if it is not published.

Publication is crucial, as without it the advancements in knowledge gained through great effort and often great expense may vanish in time. It is not an optional extra; it is a core part of the process of archaeology and is now recognized as such by grant-giving bodies.

According to *Bluff your Way in Archaeology*, the reasons why so many archaeologists fail to publish are:

- *Laziness, lethargy or complacency (those with tenured jobs)*
- *Incompetence (sometimes extreme untidiness)*
- *Terror (fear of exposing oneself to criticism)*
- *Being too busy (usually with career building)*
- *The conveyor belt (moving on to the next project, so you are too busy to publish the last)*

Suggested Reading

Bahn, P. G. 1989. *Bluff your Way in Archaeology*. Ravette Publishing Ltd.
Martin, P. 2008. *Writing with References*. Portsmouth, Nautical Archaeology Society.
Strunk, W. Jr. and White, E.B. 1959. *The Elements of Style*. Pearson Education Company.

1 Writing for Publication

This unit is about final publication, which involves the presentation of ideas as well as facts. There are formulas for writing straightforward archaeological reports for archiving, but what is discussed here is the writing of academic articles or monographs that require not just formulas, but also thoughts and ideas. The fieldwork may be completed, but the analysis and interpretation of that work continues into publication.

The final publication described in this unit is aimed at an academic audience familiar with the field of archaeology. Writing for an academic and archaeologically astute audience means that writing needs to contain the following elements:

1.1 Introduction

Setting the scene (succinctly), explaining why the project was undertaken, etc.

1.2 Data

Either primary data, i.e. the results of your survey or excavation, presented as objectively as possible, or a synthesis of secondary data, i.e. that is produced by others.

1.3 Analysis of the Data

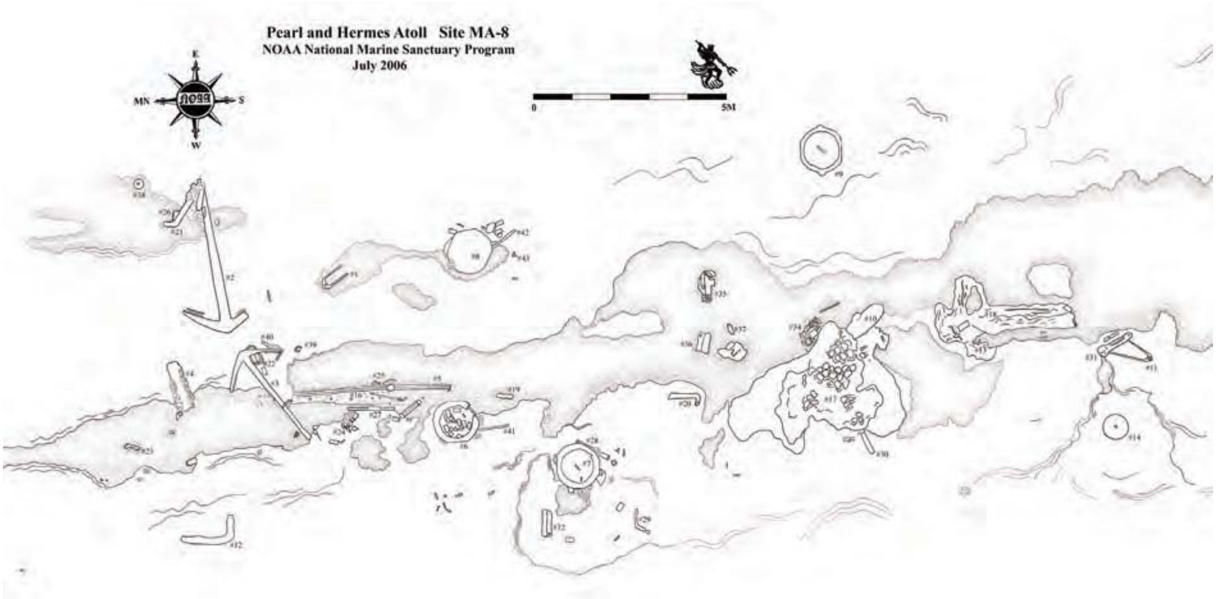
Whether it's primary or secondary data, a thorough analysis needs to include the discussion of what the data means.

1.4 Conclusions

An article should present solid conclusions which are both more original and more thorough than a top line survey of secondary sources, which might be produced as a student essay. It is also important to include more analysis than would be found in a simple archaeological report.

The best way to tackle a sizeable writing project is to break it down into manageable sections. The material needed for an archaeological publication can be divided into text and illustrations, and each of these can be subdivided into several categories. Each category has been developed over the years to provide a way of presenting information as clearly and concisely as possible.

It has been said that 'a picture is worth a thousand words'. This is often true and can also be applied to other ways of presenting information such as tables, graphs and charts.



An example of a site plan, labelled with a scale and reference compass. © NOAA Sanctuaries

An article (or monograph or book) should include most (or all) of the following:

- *Main text*
- *Tables (data)*
- *Appendices (data)*
- *Acknowledgements*
- *Captions and credits*
- *References/bibliography*
- *Graphics (charts, graphs, etc.)*
- *Photos*
- *Maps*
- *Line drawings*

Although it is relatively easy to write, to produce a successful publication it is necessary to create something which the reader wants to read. Editors assure that publications meet public demands, so we can gain additional insight by looking at publication from their perspective.

2 Hints for Writing an Academic Article

2.1 Text

The bulk of an article or monograph should consist of flowing text, avoiding abbreviations, jargon, slang expressions, bullet points or other devices which may be suitable for a report or training manual. Paragraphs should be of a reasonable length and keep in mind that it is very sloppy and distracting to use single sentence paragraphs. Good paragraphing helps guide the reader; the beginning of a new paragraph serves the same purpose as a subheading, directing the reader to the next important point.

Use inverted commas for quotations, not italics. Italics should be reserved for book titles, ships' names and occasionally for emphasis. Keep quotations as short as possible. If words are omitted from within a block of text, then the missing words should be represented by three dots, separated from the adjacent words by a space. It may also be necessary to add one or more words in square brackets to make new sentences grammatically correct. For example, if words need to be omitted ... [they] should be represented by three dots. Alternatively it may be preferable to split the quotation in two, with other words in between. It is not necessary to add three dots at the beginning or end of every quotation, though this should be considered occasionally to highlight the incompleteness of the material being quoted.

Try not to use unnecessary words and avoid flowery or emotive prose. Adjectives and superlatives are often redundant. Plan the structure of your topic and progress logically through it, establishing and building upon arguments as you go along. Long words and over elaborate sentences can detract from the clarity of an argument. Try splitting long sentences into two or more shorter ones. Varying sentence and paragraph lengths can often improve your writing. Finally, remember that correct grammar is not pedantic; it helps to write in a clear and unambiguous manner.

Unless the article is being self-published or the publisher asks for a camera ready copy, keep formatting to an absolute minimum. Leave presentational details such as these to the final editor or typesetter. Unnecessary formatting can be very time consuming to undo. This includes not using automatic footnoting unless it is all right to do so. Publishers often use different software and during the changeover it is possible for some things to get lost or distorted.

Ask for a copy of the Notes for Contributors and try to keep within the guidelines provided. This saves everyone time and energy. It is especially important to get the layout of the bibliography right, which will greatly please the editor and get the author-editor relationship off on a good footing. See *Additional Information 1*.

ADDITIONAL INFORMATION

1 Bulletin Notes for Authors: *Australasian Institute for Maritime Archaeology* (AIMA). http://www.aima.iinet.net.au/publications/aimapub.html (Accessed February 2012).

Notes for Authors: *International Journal for Nautical Archaeology* (IJNA). http://www.wiley.com/bw/journal.asp?ref=1057-2414 (Accessed February 2012).

2.2 Tables

Tables are very useful as they can present information more clearly and much more concisely, than flowing text. They can be produced in Word. Try to avoid elaborate formatting and limit the table to one page. A smaller type size than the main text can be used or alternatively the table can be turned sideways. Remember to caption tables clearly, including a reference to the source or sources of the data.

2.3 Appendices

Appendices are useful places to put blocks of data whose sum contributes to the argument, but which would be too detailed to fit into the text. It could be data which is too big to use in a table, but usually in archaeology it is specialist reports which are put in appendices. It is often fairly obvious whether this is the right solution to the problem.

2.4 Acknowledgements

Do not forget to acknowledge formally any help that has been received from others, whether scholarly, physical, financial or in kind. It never does any harm to say thank you and if in doubt as to whether to mention someone, play it safe and include them.

2.5 Captions and Credits

All illustrations should have a caption describing what it shows. It may be very simple, such as 'Location map' or it may need to explain things like the angle the photo was taken from, or the size of the divisions on a scale. Seeing things from the point of view of the reader becomes very important.

Credits should give the name of the person who created the image. The author may also need to credit the individual or institution that provided a copy of the image. If an image comes from a library, museum or archive, they may provide a precise wording to be used in the credit. Make sure to use this wording.

2.6 References and Bibliography

Keep precise notes of all references when doing research, otherwise a lot of time will be lost later tracking down missing citations or page numbers. One of the advantages of using a word processor or software such as Endnote (www.endnote.com) is that it allows the writer to continuously build up a bibliography and/or footnotes. This is a valuable facility, so be sure use it.

References have two purposes. One is to validate what has been written. The other, often forgotten, but in the long term more important, is to allow scholars, perhaps many years hence, to follow up particular points that have been made, perhaps because they coincide with or contradict their own research, or perhaps out of sheer curiosity. All references, therefore, must obey certain rules in order to be of use to future scholars.

2.7 Published Works

References should be to published material, giving enough detail for that material to be located easily. Generally this means the name and initials of all authors, full title, date of publication and place of publication. The name of the publisher is not always necessary, though it may be helpful to include the name of the organization backing a publication, or perhaps the ISSN or ISBN numbers, especially if it is part of a series. In the case of a chapter within a book, the name(s) of the editor(s) must be included as it is under these names that the book would be catalogued. In the case of a journal, the title, year and volume number must be included and it is helpful to include the page numbers of the specific article as well.

2.8 Unpublished Material

Unpublished material should only be cited if it could theoretically be consulted. It has long been acceptable to refer to an unpublished thesis, as a copy will be lodged with the university concerned (and it could also be accessed through inter-library loan). Other unpublished material, such as archaeological reports, should really only be referenced if the host institution has a library within which reports are lodged and catalogued. If in doubt, try to think whether an enquirer in twenty years time could access a copy.

2.9 Forthcoming/In Press

Reference can only be made to work not yet published if that work has been accepted by a journal or in the case of a book, a contract has been signed with a publisher and a title agreed. In other words, it is definitely going to appear within a reasonable time frame. Anything more vague, such as an article still being refereed (and therefore not even accepted) or a dissertation not yet completed (or examined) is not acceptable. Either another reference needs to be used or it has to come under 'pers. comm.'. We can all think of publications which have been 'forthcoming' for many years! If in doubt, think of the hypothetical future researcher.

2.10 Websites

Websites vary from online versions of respectable works of reference, to the obscure and the ephemeral. They should be used sparingly and only where there is no printed alternative. The name of the individual or institution responsible should be cited, the date it was last updated and the date the material was accessed. If a site does not have a clearly named responsible individual or organization, avoid it.

2.11 Personal Communication

All other material must be referred to as 'pers. comm.'. This category covers not only conversation with the person concerned or unpublished papers heard at a conference, but also conference posters and all similar material. If in doubt, think about the hypothetical scholar in years to come. Personal communications or 'pers. comm.' should be used as little as possible, as it is unverifiable and the whole point of referencing is to verify what has been written. Some people are now including 'pers. comm.' information within their list of references. This has attractions as it allows the author to give additional information such as date, place, title of conference paper/poster, or the institution to which the person is attached (thereby explaining the reasons the person is qualified to provide such information). The disadvantage, however, is that it encourages such references to be regarded as proper references.

References

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Smith, R., Richards, J. and White, S. 1990. *The Flora and Fauna of Europe and Africa*. London, Hutchinson.

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UNESCO. 2006. *What is Gender and why is it so important?* Gender in education unit, UNESCO Bangkok. http://www.unescobkk.org/index.php?id=4572 (Accessed 30 January, 2007)

United Kingdom. British Library. 1992. *The State of Libraries Today*. London, The Stationery Office.

Sample references. © UNESCO

2.12 Checking the Work

This vital process will almost certainly take more time than expected. Be prepared to go through several drafts, each time improving both the tightness and flow of the written argument and its presentation.

Spell checkers are excellent tools, but they cannot:

- *Tell whether a word makes sense in its context*
- *Pick up typing errors which are correct words, but not what are intended, for example, an instead of and, or it's instead of its*
- *Tell that the author is being inconsistent. If authors have built a Custom Dictionary, it is essential that only one version of a word is entered*
- *Tell that a correctly spelled word is used, but its meaning has been misunderstood*

If in doubt, consult an old fashioned dictionary. Allow plenty of time for final corrections and improvements. It is easier to be self-critical if there is the time to take a break from the material for a few weeks and come back to it fresh. This helps it to be read as others will. Another good way to check the writing is to read it out loud. Alternatively, let a sympathetic (but honest) colleague read and comment upon it.

This should have given some idea about what needs to be considered before submitting an article to an editor or publisher. It is a duty to publish, and for career building, it is in the author's best interests to do it well.

Suggested Reading

Bowens, A. (ed.). 2009. Presenting, Publicizing and Publishing Archaeological Work. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp. 189-197.

3 Illustrating the Article

Bar Charts, Graphs, etc. are easy to create in Excel. Once again, keep them as simple and straightforward as possible. Remember to include a caption (separately, not within the chart or graph) and any reference to source(s).

If the final version will be published in black and white, then the author will need to be aware of this and make suitable changes. In grayscale, for example, four lines are about as many as a small graph can handle. But the facility to create graphs and bar charts on the computer is wonderful, especially as their proportions can be altered to show a trend without exaggerating it and see what it looks like at every stage.

3.1 Photos and Drawings

It is very easy when writing essays or assembling PowerPoint presentations to download images from the web or copy them from books. For proper publication you cannot do this for two reasons: one is quality, the other is copyright.

3.2 Quality

All images for publication should be of a suitable resolution. This is normally at least 300 dots per inch (dpi) for color photographs, 600 dpi for black and white photographs and at least 800 dpi for line drawings. Images should have this resolution or higher at publication size, the size they will be reproduced. It is no good thinking that the resolution of an image can be increased in Photoshop; you cannot create more pixels than are in the original image; all that can be done is enlarge the whole image, which reduces the quality.

It is necessary to think carefully about background, lighting, composition and scale, as well as the overall quality. Let's look first at the question of background.

3.3 Background

Here is an example of a bottle fragment taken against two different backgrounds. Which do you think looks best?

The red background in the ship's wet lab is too overpowering, too dominant and therefore distracting. The white background under controlled lighting conditions reveals the most details on the artefact itself.

ABOVE: Bottle fragment found at a whaling vessel wreck site (Pearl and Hermes Atoll). © NOAA Sanctuaries

Here is another example, a wooden sheave from a small block. The patterned background is too similar to the patterned object, confusing the image.

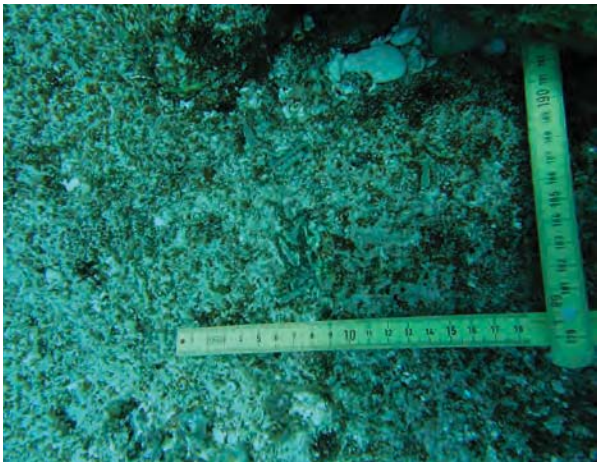
Wooden sheave associated with a British whaling wreck, 1822. © NOAA Sanctuaries

Although contrast, brightness and color levels all can be adjusted in image software programs like Photoshop, it is always better if the original photograph is high quality. All manipulation of images means a subsequent loss of original image data; there are limits to what can be achieved by photo manipulation.

3.4 Lighting

The aim of photographic lighting is to highlight the key features of the object, while avoiding distracting reflection and minimizing shadows. For an initial record photograph, daylight may well be best and simplest. It is easiest when there is good light, but not direct sunlight. Lighting is most difficult to control underwater, meaning that the most care should be given to the selection of *in situ* artefact photographs.

The underexposed image of these brass sheathing tacks, embedded in the coralline reef substrate, make them almost unnoticeable. Over exposing the image of the sheathing tacks can lead to the same result, a poor image.

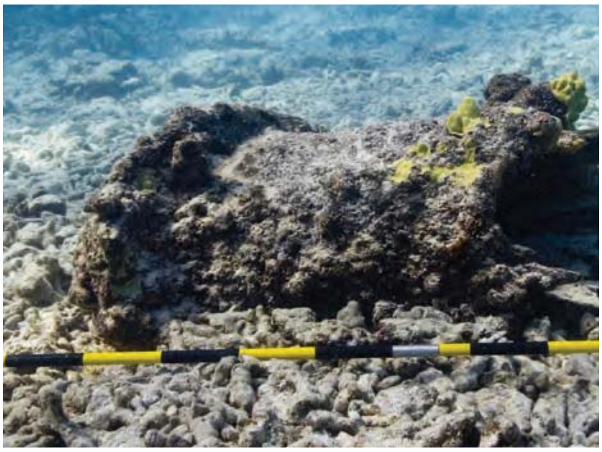


Small sheathing tacks embedded in the coralline algae. © NOAA Sanctuaries

Indoors, using photographic lights means that you can control the direction the light is coming from and use reflectors to minimize shadows. However, it is necessary to adjust the camera to artificial light for the best results.

3.5 Composition

Images should be crisp, clear and framed, concentrating on the central feature without a large blank surround, or distracting and irrelevant material in the photo. These images of a ship's hawse pipe and a ship's block have a single artefact in the centre.



Short encrusted hawse pipe, wreck site of the schooner Churchill, lost at French Frigate Shoals 1917. © NOAA Sanctuaries

Sailing vessel's small block, wooden components deteriorated. © NOAA Sanctuaries

In this poor quality image of copper sheathing partially buried in the sediment, the data on the magnetic sign board is centered in the picture, but the artefact itself is cropped, cut off at the top.

Copper sheathing, torn and bent in sediment. © NOAA Sanctuaries

Good image composition underwater can be essential to dealing with another challenge; contrast. Particularly on wreck sites where artefacts and features are heavily encrusted, it may be difficult to discern objects from the natural background. Changing the perspective (angle) from which the image is taken and altering the height above the artefact, can lead to better contrast through composition. In the first image of the heavily encrusted iron cannon at the edge of a sediment channel, it is difficult to discern the artificial feature. The cannon, though encrusted, is more apparent in the second image.

A heavily encrusted iron cannon at the wreck site of the British whaler Pearl, *lost at Pearl and Hermes Atoll (1822). © NOAA Sanctuaries*

3.6 Scale

By scale we mean two things. The first is getting things in scale with each other. For instance, measuring small objects with much larger references is a poor practice. The second is how and when to use a photo scale. The answer is, is that one must be used if it is a record photograph. In the field, it is important to take a bit of time to get it right. Try not to rely on a convenient coin or diving knife, but instead take the trouble to carry a scale in your camera bag. However, sometimes for publication purposes, images without a photo scale are desired and as an alternative, measurements can be included in the text of the caption.

Some thought should be given to the careful placement of the photo scale in record shots. Scales should be close and alongside (not obscuring) the artefact or feature. Black and yellow tape is often used for marking scales, as white tape can, under certain conditions, 'wash out' and be over exposed in the photograph.

Of course, to be at all useful, the photo scale must be perpendicular to the lens of the camera. Photo scales recorded at extreme angles to the camera are meaningless and cannot be used as references.

It is often useful in popular publications to include divers in the underwater images, helping to maintain reader interest and make a more human connection to the site. Instead of photo scales, which may be overly academic to the layperson, divers can be used in the composition to give a general sense of scale to large features.

Anchors at the wreck site of the schooner Churchill, *lost at French Frigate Shoals 1917. © NOAA Sanctuaries*

3.7 Resolution and File Types

Images should be saved as .tif or tiff files. They may be captured as jpegs and converted later. In fact many digital cameras can do nothing else other than produce a jpeg format. However, jpeg is a compressed format and each time any changes or manipulations are made to an image, some of the original image data will be lost. As a result, when transferring photographs from the camera to a computer, or when being manipulated on the computer the first thing to do is save the original images as tiffs.

Keel fasteners emerging from the sediment. © NOAA Sanctuaries

The general resolution rule for publishing digital images is that images need to be at least 300 dpi at their full publication size or greater. Guidelines for authors will have specific instructions regarding image resolution.

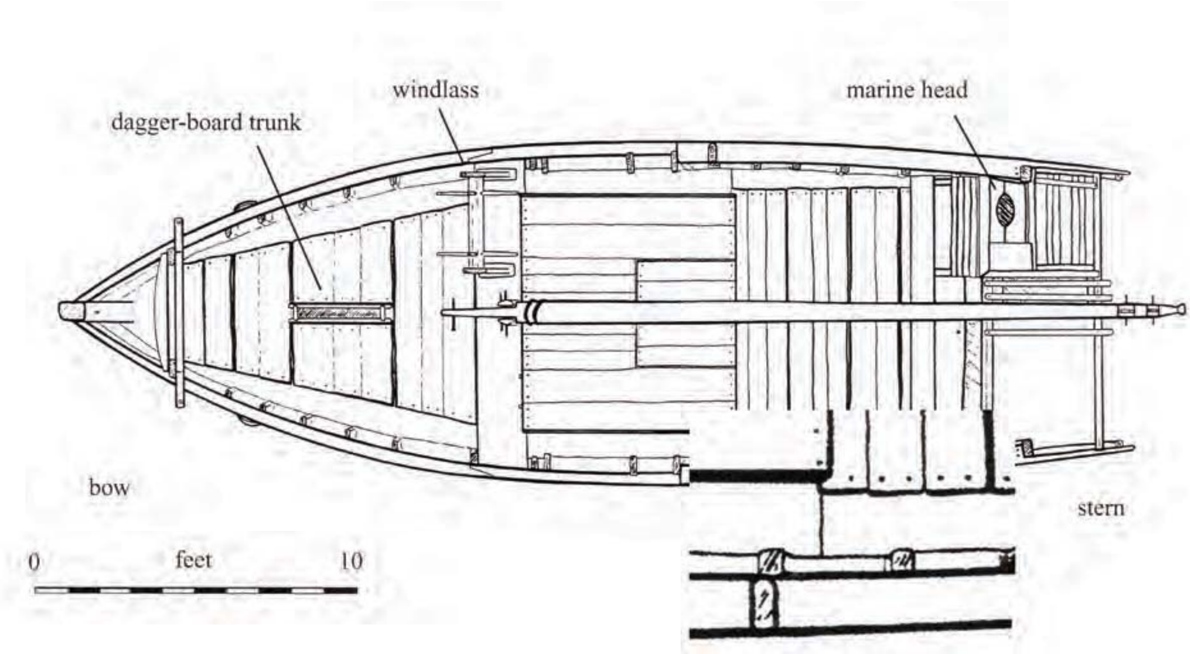
3.8 Drawings

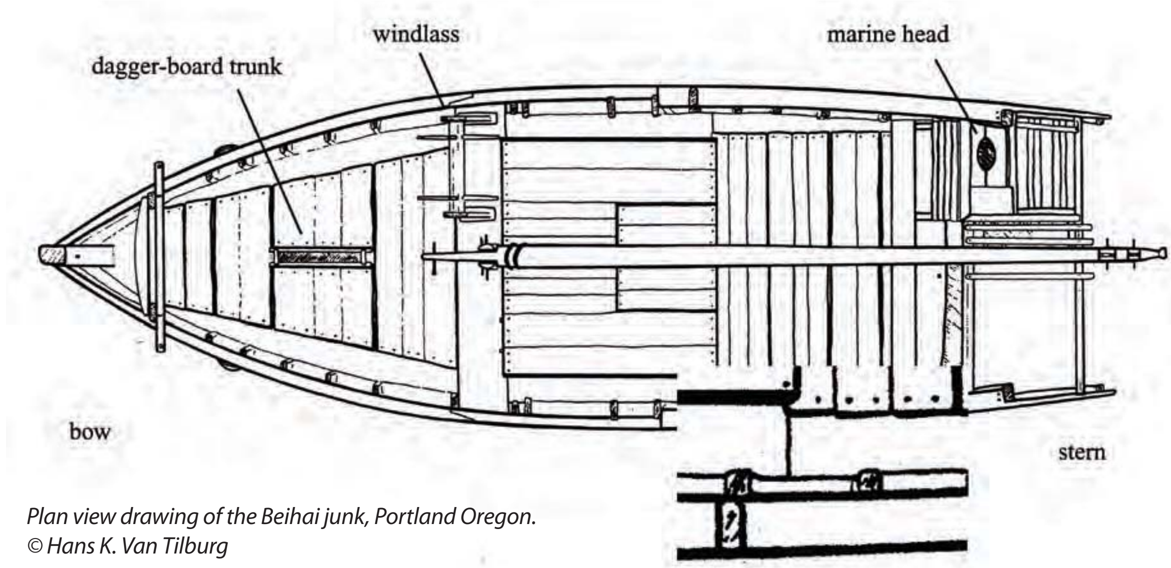
Everything we have said about composition, size of scale, etc. in photographs also applies to drawings, though much more alteration can be done on the computer.

Diver near the rudder of the wrecked navy vessel USS Macaw, *lost at Midway Atoll 1944. © NOAA Sanctuaries*

3.9 Scanning Line Drawings

The first rule with line drawings which are not computer-generated is to scan them the right way and to high enough quality. Often publications require line drawings to be scanned at a much higher resolution than photographs (for instance, 1200 dpi). Guidelines for authors will have specific instructions regarding line drawing resolution.

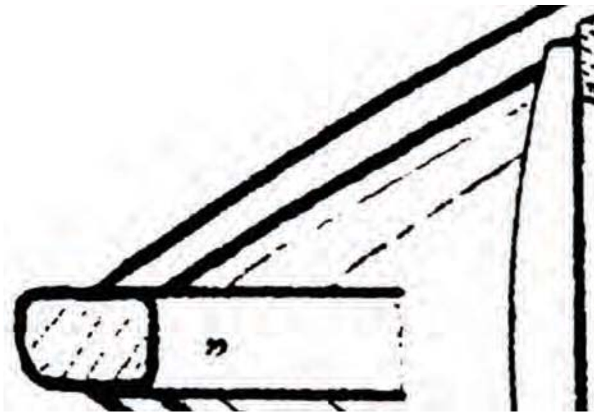


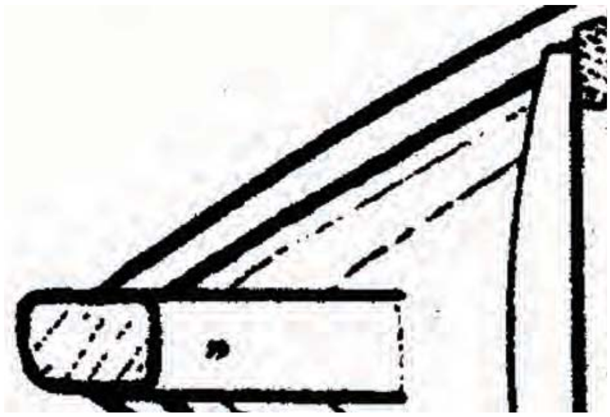


Plan view drawing of the Beihai junk, Portland Oregon.
© Hans K. Van Tilburg

It is very important to use grayscale rather than line art to scan line drawings. Here is the same drawing scanned two ways; the first is grayscale and the second is line art (raster or vector black and white scan).

To further illustrate this, here is a drawing in both formats. Notice how the lines in the second line art image are stepped.

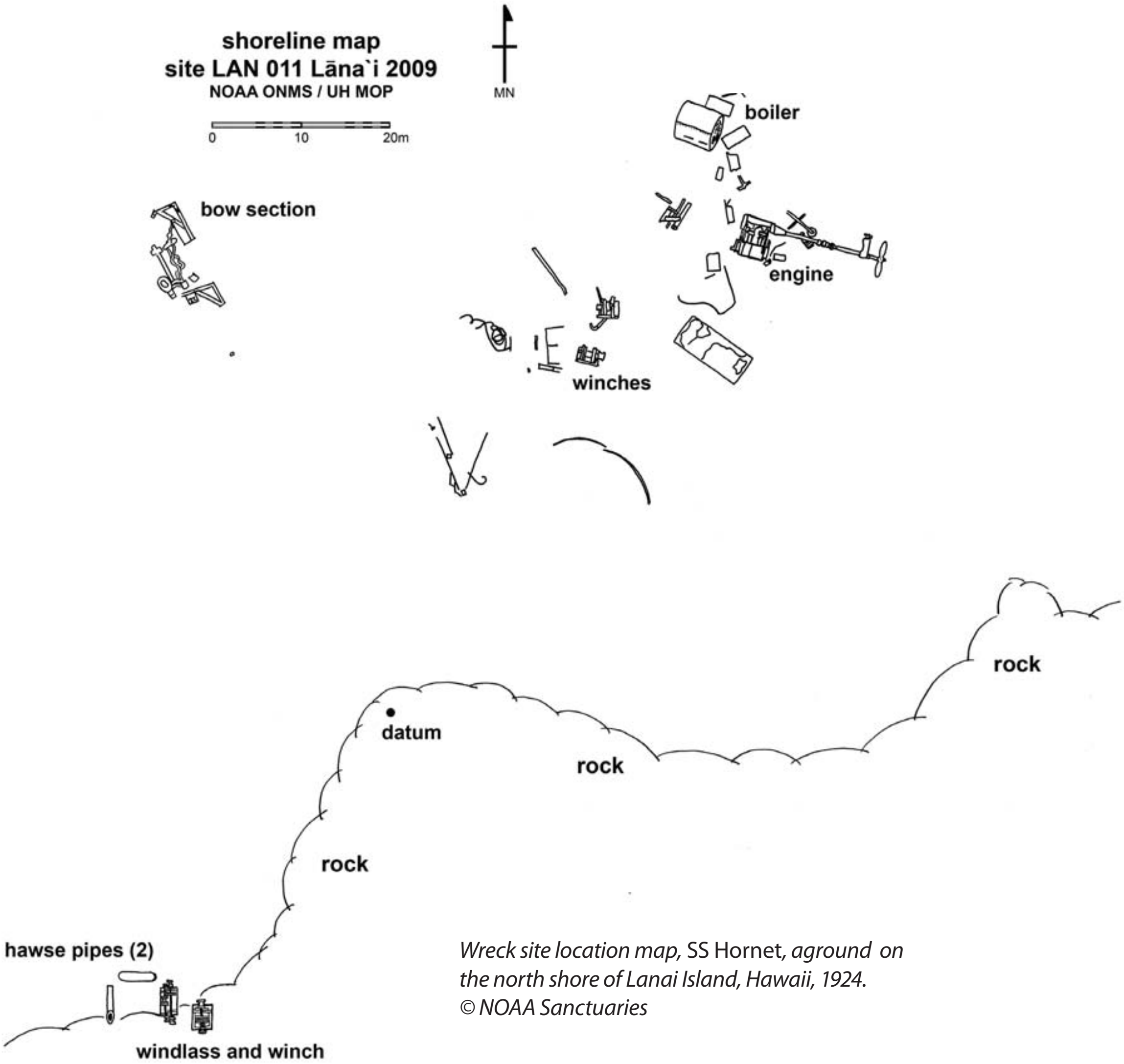




© Hans K. Van Tilburg

The irregularities on the grayscale image are due to the shaky hand of the illustrator and could be cleaned up a bit in Photoshop, but there is nothing that can be done to improve the stepped line of the line art image.

Images, titles, scales, compass arrows and labels should be as large as necessary to be clear. Reproductions of old maps, for example, can be a total waste of space if reproduced so small as to be illegible. It is also common for people to waste space by putting a caption, scale or north pointer a long way from the main drawing. These elements can be copied and moved in the drawing, allowing for larger scale images and easier reading.

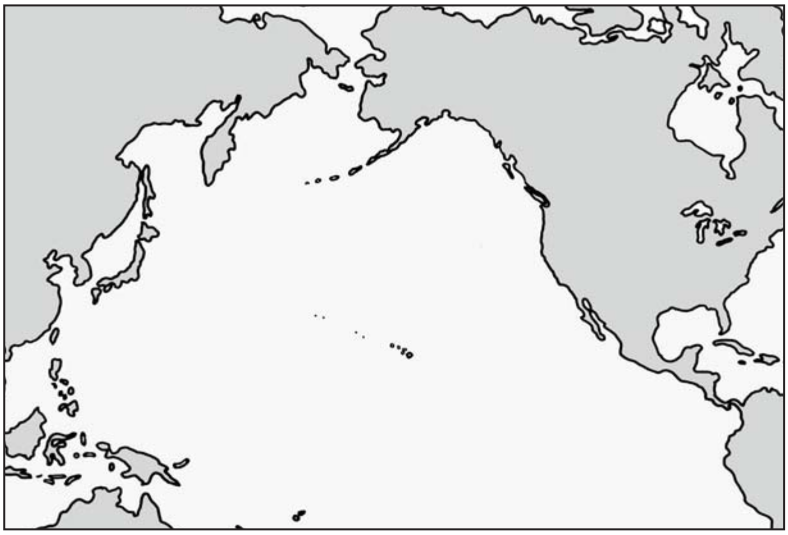


Wreck site location map, SS Hornet, *aground on the north shore of Lanai Island, Hawaii, 1924.*
© NOAA Sanctuaries

3.10 What Should You illustrate?

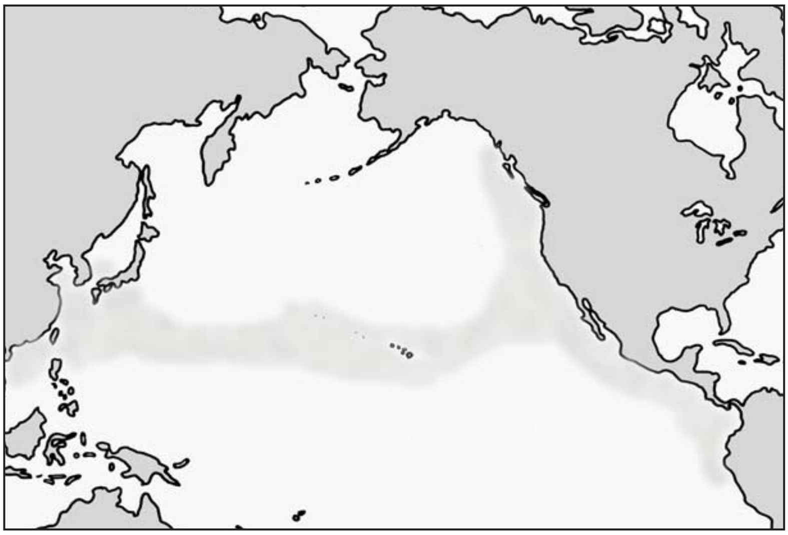
Obviously the number and type of illustrations depends on what is available and any limitations imposed by the editor or publisher. There are, however, some essentials which include a location map. Ideally every place mentioned in the text should be located, either visually on a map or by giving information such as the county, so that it could be found on an easily available map (such as a road atlas). Producing original maps is the best way to focus on the applicable information.

Here is an outline of the North Pacific Ocean region, one which has been used to describe the international movements of a particular vessel.

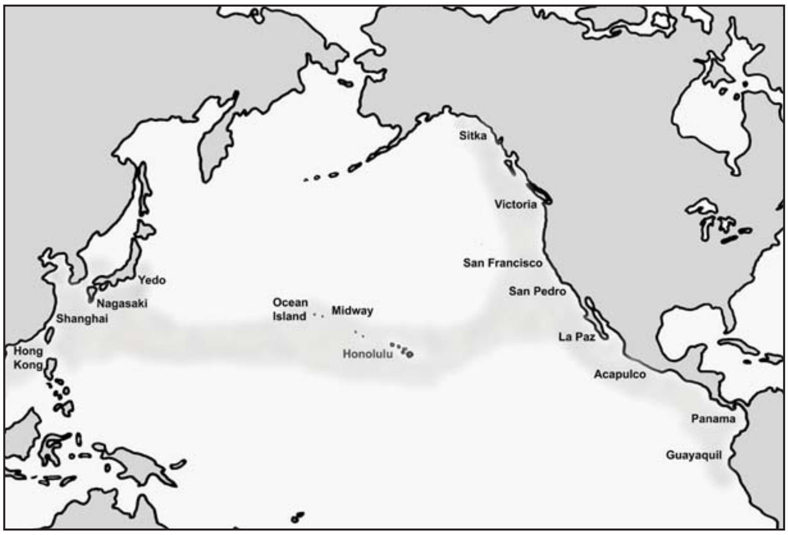


Outline sketch of the North Pacific region. © Hans K. Van Tilburg

The ship's service areas can be shaded (or coloured).



Specific ports of call can be labelled. Additionally, symbols and further information can be added to highlight any necessary aspects.



Suggested Reading

- Bowens, A. (ed.). 2009. Archaeological Illustration. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp.170-180.
- Bowens, A. (ed.). 2009. Photography. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp. 71-82.

4 Copyright and Permissions

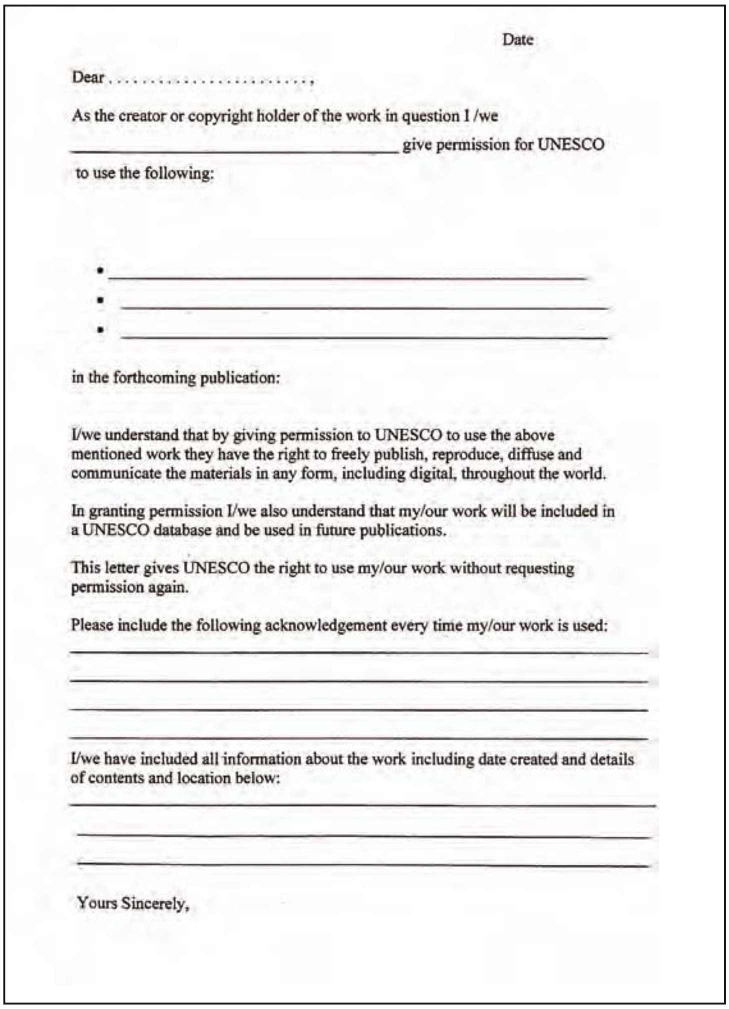
Copyright covers all forms of publication, including broadcast and electronic. It is automatic and does not need to be formally registered. In many cases, the author will also have the right to be identified on their work and to object if that work is distorted. The copyright of an image belongs to the photographer or illustrator, unless they had produced the image for an employer who holds the copyright.

Copyright is a form of intellectual property rights and like physical property, can be bought and sold, inherited or otherwise transferred. Copyright is not held by the publisher of the image, nor by the editor or the author of the book within which the image is published, unless it specifically says so in the book. The author (emphatically) does not acquire copyright by taking his or her own photograph of someone else's image.

Copyright exists independently of the medium on which a work is recorded. So, if say one buys or inherits a painting, they only own its copyright, if that also has been transferred to them. Otherwise, the copyright still rests with the artist. Sometimes copyright expires. For instance, in the United States, copyright in a literary, dramatic, musical or artistic work (including a photograph) lasts until seventy years after the death of the creator.

There is no universal copyright law, so be aware of changes from country to country.

Permissions are often required by the copyright process. Written permission is needed from the copyright holder in order to legally reproduce their work. If a work is rare or unique, permission may also be needed to reproduce it from the individual or organization which holds the work and supplied the image, even if the work itself is out of copyright. This is usually a library or museum, but might also be the private owner of a painting or drawing.



Date

Dear . . . . ,

As the creator or copyright holder of the work in question I /we
____________________ give permission for UNESCO
to use the following:

- ____________________
- ____________________
- ____________________

in the forthcoming publication:

I/we understand that by giving permission to UNESCO to use the above mentioned work they have the right to freely publish, reproduce, diffuse and communicate the materials in any form, including digital, throughout the world.

In granting permission I/we also understand that my/our work will be included in a UNESCO database and be used in future publications.

This letter gives UNESCO the right to use my/our work without requesting permission again.

Please include the following acknowledgement every time my/our work is used:

I/we have included all information about the work including date created and details of contents and location below:

Yours Sincerely,

UNESCO example of a copyright permission form. © UNESCO

It is permissible to copy a drawing and then alter it for your purposes. In this case, credit should be clearly stated as 'after' A. N. Other, with a precise reference to where you could find the original. This is sometimes done when re-drawing just part of a larger drawing. You cannot legally put 'after' meaning 'exactly copied from', therefore, you should never use 'after' to describe a photograph. Nor should you alter a drawing just to avoid copyright, but thereby diminish the original.

The copyright process is very similar to using quotations and references in written work. Some publishers are becoming lax in this respect, but the legal and moral position is absolutely clear and it is the author's responsibility to be clear about copyright issues. Every image should have a caption and a credit, even if it is the author's own, so that readers and future researchers can be guided as to where the copyright rests.

If despite all the effort, copyright for a necessary image still cannot be located, it may still be permissible for use in the publication. In this case, the editor may suggest language, such as, 'A best effort was made to locate the original copyright for each of the images in this publication. If you have additional information, please contact the publisher'.

5 What Happens after the Article is Submitted to a Publication?

Authors need to be familiar with the submission process and the editorial role in publication. What does the editor of an academic journal do?

1. *The editor acknowledges everything that is received, most often via email. Usually this is a formal submission, but occasionally people will send a proposal to the editor for comment. The editor may also be approached about the suitability of a topic or be asked about deadlines for submissions.*
2. *The editor reads the text thoroughly, in order to make an assessment and to think about who might be a suitable referee.*
3. *The editor looks at the pictures, assessing them in terms of quality and in terms of copyright or permissions.*
4. *At this point the editor may reject the submission outright or it might be sent back for better presentation of either words, or pictures, or both. Otherwise it will be sent on to a referee.*
5. *When the referee's report is received by the editor, it is made anonymous if necessary and forwarded to the author, usually with the editor's comments as well. Sometimes these are general, but sometimes a marked copy of the text sent back. The editor then waits for a reaction.*
6. *If the referee recommends rejection, the editor will compose a sympathetic and encouraging covering letter. If the article is to be accepted, it will be made clear and an Exclusive License Form enclosed. Copyright will be discussed later.*
7. *Usually the author should accept most, if not all, the referee's comments and make the necessary changes. This can take some time, as for most people this has to be fitted into a busy life. Just as fieldwork is more exciting than writing up, so doing the final changes to an article is not as exciting as getting it written in the first place.*
8. *When the revised text comes back, the editor checks that the referee's comments have been thoroughly considered. If they have, the editor may then suggest further minor changes to the text or may make adjustments to fit the house style. The amount of work needed to do at this stage varies enormously. Some of it is nit-picking and checking that every reference in the text matches a book in the bibliography and vice versa. Email makes this dialogue much easier.*

This all sounds very organized, but of course the editor is handling a large number of articles all at different stages and if they are not dealt with quickly enough, then there is a risk of forgetting where they have got to in the process and doing some things twice. The editor has devised checklists to help minimize this, as well as remind the author of all the things that need to be checked.

One result of this experience is that the editor is ideally placed to give some hints about what not to do.

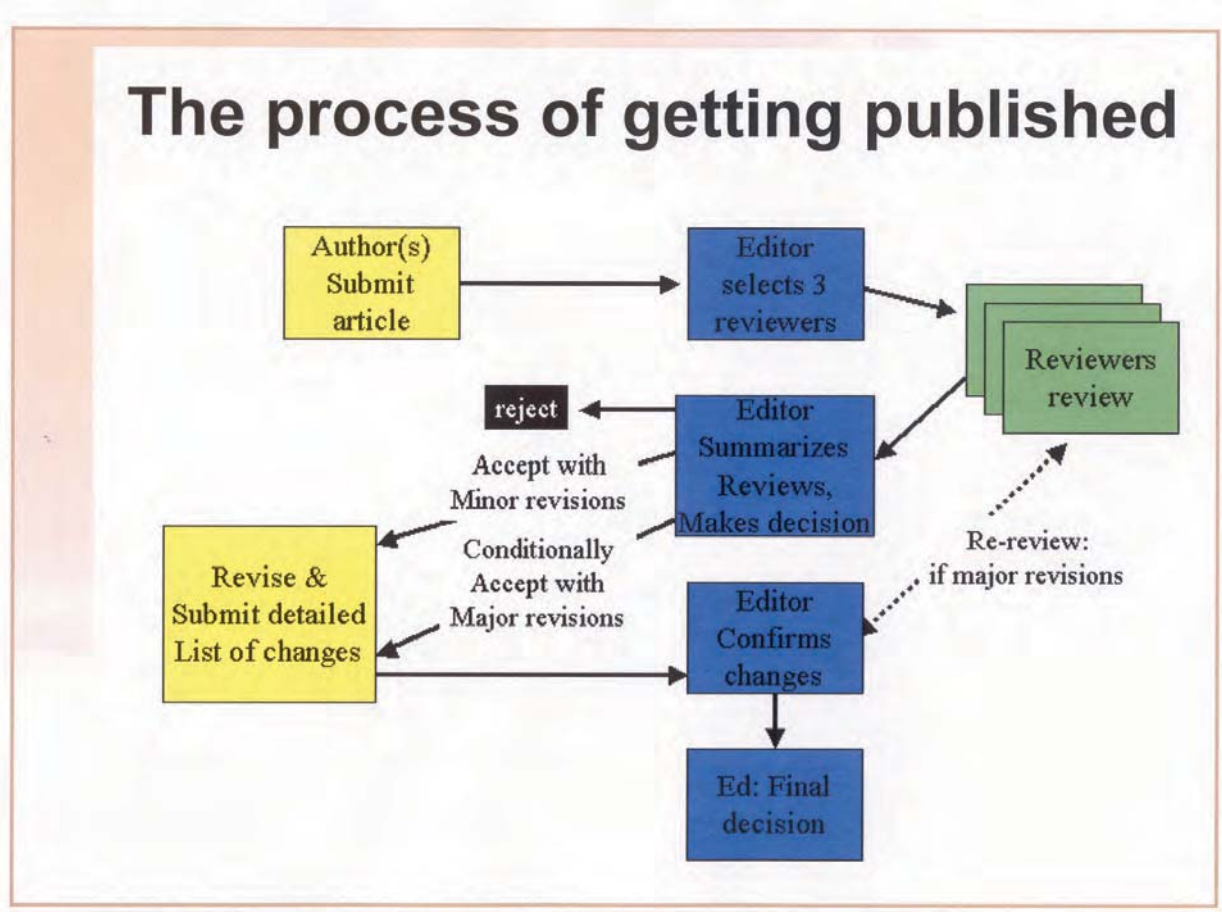


Diagram of submission steps in article publication. © Mark Staniforth

6 Conclusion

Always remember that the purpose of both text and illustrations is to convey an argument accurately and convincingly, not to impress or overawe readers. Simplicity of expression is the keynote, especially if the concepts under consideration are difficult and the evidence complex. Clear, objective and explicit writing comes naturally to very few authors; it has to be worked at with energy and patience and demands a high level of understanding and logic. Badly structured, circumlocutory or pompous wording is the antithesis of good scholarship and invariably reveals a muddled and uncritical mind behind the argument.

Unit Summary

Upon completion of this unit, students should have an understanding of: 1) what is meant by publication; 2) the processes involved in getting an article published; 3) best practices for illustrating articles for publication; and 4) issues related to copyright and permissions for us of copyrighted material.

There are many aspects to successful publication and so it is important to become familiar with the basic components that should be included in an academic article:

Introduction: setting the scene (succinctly), explaining why the project was undertaken, etc.

Data: either primary data, i.e. the results of a survey or excavation, presented as objectively as possible, or a synthesis of secondary data, i.e. that is produced by others. Whether it's primary or secondary data, a thorough analysis needs to include the discussion of what the data means.

Conclusions: it is also important to be familiar with all of the elements which enhance those components:

- *Tables (data)*
- *Appendices (data)*
- *Acknowledgments*
- *Captions and credits*
- *References/bibliography*
- *Graphics (charts, graphs, etc.)*
- *Photos*
- *Maps*
- *Line drawings*

Sometimes publication is perceived as an extra or optional step. Publication of the results of your fieldwork, however, is a core component of archaeology and a professional responsibility.

Suggested Timetable

90 mins	Basics of Publication - *Writing for publication* - *Hints for writing an academic article* - *Illustrating an article* - *Copyright and permissions* - *What does the editor of an academic journal do?* - *Conclusion*
	Break
60 mins	Selected Publications for the Asia-Pacific Region
30 mins	Concluding Remarks and Closure

Teaching Suggestions

Trainers should present the various aspects of formal publication to the students during a 1.5 hour lecture. Ideally, the lecture should be followed by a secondary session where students are asked to evaluate a selection of articles from regional publications. Trainers should have students to break into small groups and discuss both the exemplary elements of each article and those that need further work.

Suggested Reading: Full List

Bahn, P. G. 1989. *Bluff your Way in Archaeology*. Ravette Publishing Ltd.

Bowens, A. (ed.). 2009. Archaeological Illustration. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp.170-180.

Bowens, A. (ed.). 2009. Photography. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp. 71-82.

Bowens, A. (ed.). 2009. Presenting, Publicizing and Publishing Archaeological Work. *Underwater Archaeology: The NAS Guide to Principles and Practice*, Second Edition. Portsmouth, NAS, pp. 189-197.

Joffe, A.H. 1999. *Archaeology's Publication Problem*. Hershel Shanks (ed.). The University of Chicago Press Stable. http://www.jstor.org/stable/546163 (Accessed March 2012).

Martin, P. 2008. *Writing with References*. Portsmouth, Nautical Archaeology Society.

Strunk, W. Jr. and E.B. White. 1959. *The Elements of Style*. Pearson Education Company.

United Nations
Educational, Scientific and
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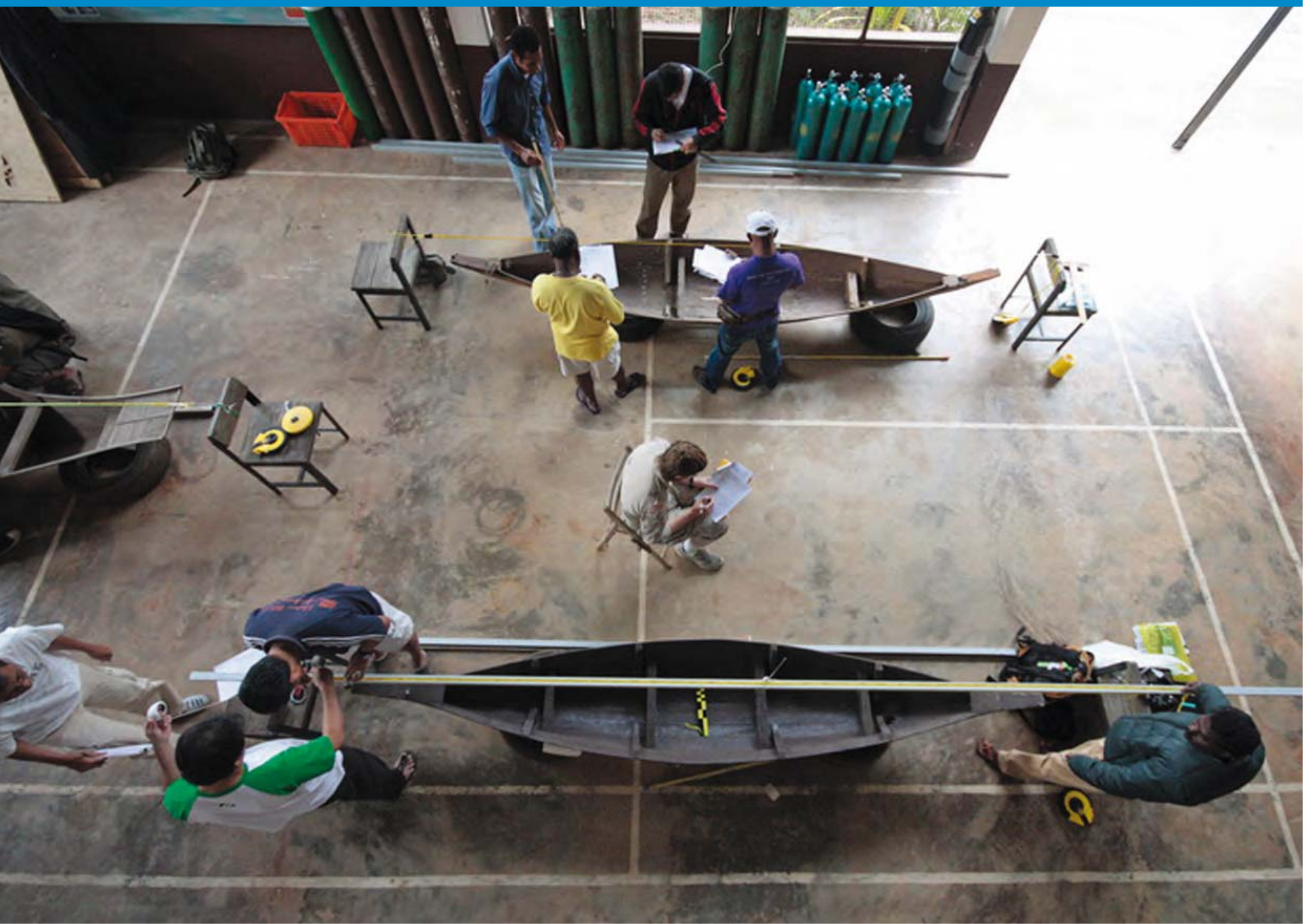
The Protection of the
Underwater Cultural Heritage

APPENDIX A

Author Charlotte Minh-Hà L. Pham

Ethnographic Boat Recording Practicum



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APPENDIX A

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APPENDIX A

Author Charlotte Minh-Hà L. Pham

Ethnographic Boat Recording Practicum

Core Knowledge of the Appendix

This appendix introduces students to the practice of maritime ethnography and demonstrates how it can be a valuable research tool.

On completion of the Ethnographic Boat Recording Practicum, students will learn:

- *Understand what maritime ethnography is and its advantages and potential*
- *Understand how to plan boat recording sessions*
- *Understand how to take the measurements required to make a traditional line drawing*
- *Have knowledge of which key elements need to be addressed in a report*

Introduction to the Appendix

Although maritime trade was central to the development of South-East Asia and the body of knowledge is growing, there is still little information about the vessels that facilitated these activities. Historical documents, iconography or archaeology provide some insight, but seldom address the boats used in accurate detail.

In the absence of archaeological evidence, maritime ethnography can provide a rich alternate source of data to inform us about ancient seafaring and early boat building traditions. It provides a key to forming a clearer picture of the actual shipbuilding process, navigation techniques and the diversity of boat use.

When financial support or specific training is not available to conduct underwater excavations or surveys, it is still possible to build knowledge of boat traditions and develop an understanding of the maritime aspects of culture, through the practice of maritime ethnography. This approach can be a stepping stone in the development of maritime archaeology in regions where the discipline is not yet practiced to its full potential. When done accurately, maritime ethnography can be a powerful research tool to complement our understanding of the role of boats and boatbuilding in a historical, political, economical, environmental and cultural context.

In this appendix the definition, potential and advantages of maritime ethnography are discussed, as well as its practical application and preparation. Although a full record of a boat cannot be conducted during this practicum (which would include recording a full construction sequence, specific vocabulary or interviewing the boat builder or boat owner), it will address the practical aspects of preparing a systematic recording, and outline the essential steps required to produce an accurate drawing.

This practicum adopts a traditional recording method that can be conducted with limited budget, time and materials.

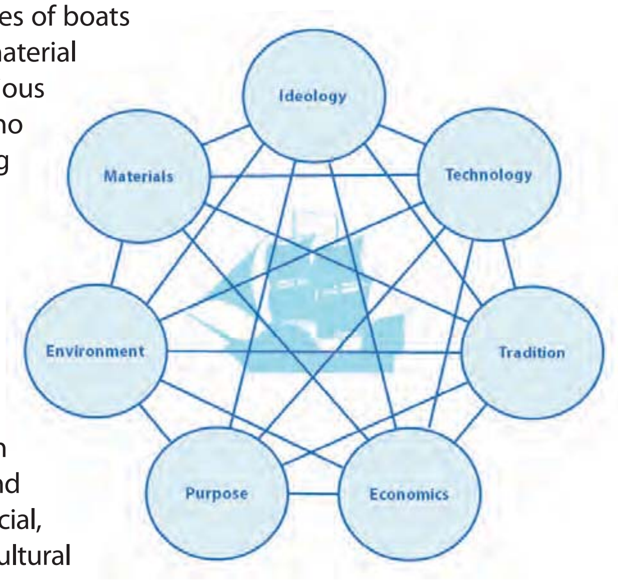
See Unit 14: *Asian Shipbuilding Technology* and Appendix B: *Basic Terminology of Shipbuilding*.

1 Maritime Ethnography

Maritime ethnography 'is the study of contemporary maritime cultures and their materials, through first hand observation' (Blue, 2003, pp. 334) and simply aims to record present day maritime material culture.

Maritime ethnography enables the study of boat building traditions, relating them to cultural elements of a society. Not only can this kind of study help us to understand more deeply the reasons for technological changes or choices, but can also show how the story of the boat can mirror history, social change and organization, beliefs or customs. Because a boat is not only a means of transportation solely dictated by function or environment, its study can provide additional data and a more practical understanding of boat use and production, reflecting the associated culture that influenced its shape, construction and use. As Mckee (1997, pp. 44) explains, 'The shape of boats must depend a great deal upon the personality of the men who build and use them'.

The factors that are thought to influence the features of boats most particularly include function, technology, material resources, environment, economy and socio-religious context or ideology (Adams, 2001). 'Some criteria no doubt are more important than others in dictating boat shape; all have different roles to play' (Blue, 2003, pp. 335). Maritime ethnography can help to examine each of these variables that are intertwined with culture and can contribute to a holistic understanding of a boat.



Various variables can be reflected in boat building traditions (after Adams, 2001, pp. 301). *© UNESCO/Montakarn Suvanatap*

From a practical perspective, the accurate recording of vessels requires both research and field work. Research has to take into consideration historical documents and iconographic data, as well as the environment, social, economic and historical factors that shaped the cultural background in which the boats were built.

Maritime ethnography consists of systematically taking measurements, photographs and noting the main features and specific details regarding a boat. This information is then complemented by additional interviews with the boat builders and owners about the tools, materials, use, cargo types, distances, navigation capabilities, design and concepts (McGrail et al., 2003).

The benefits of maritime ethnography are:

- *It provides more information than archaeological remains because it treats complete representatives of specific boat types and, therefore, offers a clearer idea of the shape, details, materials or tools related to boat use and production.*
- *It creates a baseline from which to undertake retrospective study, providing the knowledge required to understand or compare eventual boat finds.*
- *It prepares us for future excavations by increasing the knowledge of boat technology necessary to identify eventual shipwrecks or boat finds on land. 'Such a systematic record when analysed and synthesized can provide a twentieth century datum from which to undertake maritime historical and archaeological research' (Blue et al., 1997, pp. 189-190).*
- *It adds to the identification of earlier boat types.*
- *It enables us to draw parallels with past conceptions and methods of construction, as well as comparisons with neighbouring traditions.*

Maritime ethnography can connect through an analogy of human behaviour and material culture by suggesting relationships that might not be otherwise apparent (Wylie, 1985). By studying living traditions and compiling present data, it increases the sources of information that we can use to understand boats as artefacts, therefore, revealing unfamiliar aspects of the community under study (Kramer, 1979; Wylie, 1985). Such studies also reveal cultural reasons that are not always identifiable from material culture (Kramer, 1979). This type of research offers a holistic appreciation of boat use and production and allows researchers to reveal the essence of boat building traditions. As Chilton (1999, pp. 2) explains, 'In many ways ethno-archaeology is the mother of all constitutive theories of material culture. [Ethno-archaeologists] have shown that artefacts reside in a complex web of meanings and can only be interpreted with respect to their unique historic and cultural context'.

Finally, maritime ethnography is an essential tool for the preservation of maritime cultural heritage and can contribute to the development of maritime archaeology by building on the existing knowledge of boat traditions. For example, ethnographic boat recording was conducted in South Asia (India, Sri Lanka and Bangladesh) by McGrail, Blue, Kentley and Palmer (1997, 1998, 1999, 2000, 2003). They recorded a vast array of traditional boats that up until then were only known by the local communities or very few aficionados. Amongst the various traditions they put forward (stitched boats, hide boats, frame-first plank boats) their work introduced the specific and relatively rare reverse clinker construction technique of the Patia. This study not only provided detailed information about this particular technique, but in turn also furthered our knowledge on other boat types and completes, for example, our understanding of the construction of the medieval Hulk from northern Europe, whose construction and evolution are still relatively unknown (Greenhill, 2000).

Work conducted in Bangladesh (Greenhill, 1957, 1966, 1971, Jansen et al., 1989, Blue and Palmer, 2010) which commenced in the 1950s, also documented aspects of water transport which had not been brought to attention before. These studies provided the most complete record of the boat types that were in operation at that time.

Gerhard Kapitan (2009) produced a series of remarkable scale drawings (with model building enthusiasts in mind) and photographs of boats from Sri Lanka. His recordings and classification system are the most comprehensive body of work on the boats of Sri Lanka. Kapitan's strong belief in the necessity to preserve the craft tradition of the region, also led to the founding of a museum in 1992 (which was unfortunately destroyed during the 2004 tsunami).

Other isolated studies include the work of Tom Vosmer on the coast of Oman (1992, 1997). His work is so far the most extensive in relation to the traditional boats of the region. The expertise and understanding of Omani craftsmanship that Vosmer provided, led to the construction of a replica of a ninth century stitched sailing ship, called the Jewel of Muscat (see: www.jewelofmuscat.tv).

Another notable contributor is Kurt Stenross who spent a number of years during the 1970s in Madura (Indonesia), recording local boat use and construction. This data formed the basis of a recently published book that examined the local salt and timber trade, demonstrating how material culture and maritime history, past and present, feed into each other.

All of this work demonstrates how the accurate recording of boat traditions can help build knowledge on maritime cultural heritage and create a more complete image of ancient seafaring activities, abilities and boat construction techniques. Traditional water transport is fast disappearing alongside related craft traditions and ways of life, so there is an urgency to record them. By doing so, 'not only can today's maritime cultures and technology be documented but also indirectly, the past can be illuminated' (McGrail et al., 2003, pp. 8).

Once an overall understanding of the context of boat building is acquired, contemporary boat construction can be recorded and an interpretation of past use and construction can be suggested. 'The standard to be aimed at when recording a traditional boat is the same as in a boat excavation: to compile a record from which a competent model builder could build an accurate model and from which a detailed account of the boat's routine uses could be written' (McGrail, 2001, pp. 18).

A full ethnographical study of boat building tradition should include:

- *Measuring and producing accurate drawings (plan view, profile view and sections)*
- *Taking notes on the main features*
- *Photographing the features and details of construction*
- *Recoding the construction sequence (video and notes)*
- *Interviewing the boat builder and the boat owner, discussing subjects such as:*
    - *Materials (choice of materials and supply)*
    - *Costs (materials and workforce)*
    - *Apprenticeship*
    - *Work time*
    - *Uses, cargo load, distances*
    - *Operational performances (sailing methods)*
    - *Traditions and ceremonies*
- *Listing the specific vocabulary related to particular boat types, complemented with drawings and pictures*
- *Observing the types of tools that are used in the construction and describing how they are being used*

Ethnographic boat recording in Vietnam. Mr. Toan Huyen's boat yard, Huong Hoc village, Quang Ninh Province.
© Michel Girard

2 Preparing the Boat Recording Session

The following methodology is based on McGrail *et al.* (2003) and is specifically related to ethnographic boat recording in the field. The methodology is supplemented with information from Steffy's (1994) guidelines that are most essentially related to boat excavation.

2.1 Selecting the Boat to Record

There are many variables to consider when selecting which boat to record. For example, during their project on boats of South India, McGrail *et al.* chose to record three distinct boat traditions for the following reasons:

- *Because they constituted an important regional tradition*
- *Because they had unusual features*
- *Because they appeared likely to provide interesting insight into maritime history and archaeology*

Having defined the general boat tradition to be documented, a representative example (an archetype) has to then be identified. If time allows, variants of one specific type can also be recorded, or at least, their distinctive features need to be precisely documented.

Scouting to find the best location for work is crucial. The recording can be conducted at a boatyard (ideal as it simultaneously provides the possibility to observe a construction sequence), at a port or harbour, at the house or boat shed of a collaborative boat owner or even in a museum where traditional boats are stored.

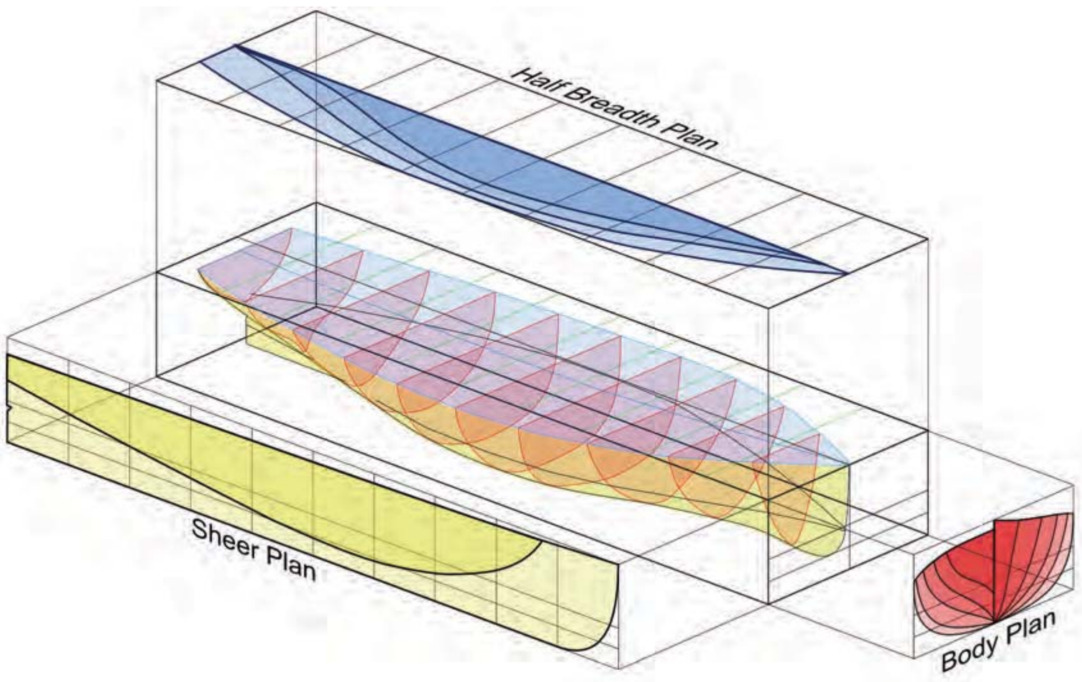
It is mandatory to reach an agreement with the owner for the use of a boat for the required period. McGrail *et al*. (2003, pp. 22) notes that most essentially, it is necessary to ensure that the boat will not be moved during documentation (this is where photo modelling and other innovative recording materials have a distinct advantage).

Once it is agreed, the chosen archetype should be positioned at a suitable site for working (above high water and preferably under shade). Next, the boat must be levelled and the reference lines rigged, these reference lines (datum lines) should also not be moved during documentation.

2.2 Setting Up: Understanding the Drawing

A measured drawing of a boat's hull can be compiled in several ways. Offsets from horizontal and vertical datum lines are needed to produce a plan, alongside several transverse sections and a longitudinal section. This is the preferred method, as would be found at an archaeological excavation (McGrail *et al*., 2003, pp. 19).

A minimum of three drawings are necessary, each depicting a different view of the boat:



Three basic views: middle view (plan view), sheer plan (longitudinal view) and body plan (cross section). © Tosaka

APPENDIX A

1 Plan View (*View from the Top)*

Sometimes, only half of the boat is drawn, Steffy (1994, pp. 15) explains,

> *The top view is known as the half-breadth plan because only half of the hull is shown, as if it had been sawn right down through the centreline. On some drawings this view is called the waterline plan or level-line plan. This shows the hull contours as seen from above or beneath one-half of the hull … To begin with, lines drawings are made with the assumption that both sides of the hull are identical. They seldom are, but they are usually similar enough that the lines of one side are reasonable indicators of those on the other.*

This is useful if apprehending hull remains that are partially preserved. However, in boat ethnography, considering time constraints and practicalities, a full plan should be drawn.

2 Sheer Plan or Longitudinal View *(View from the Side)*

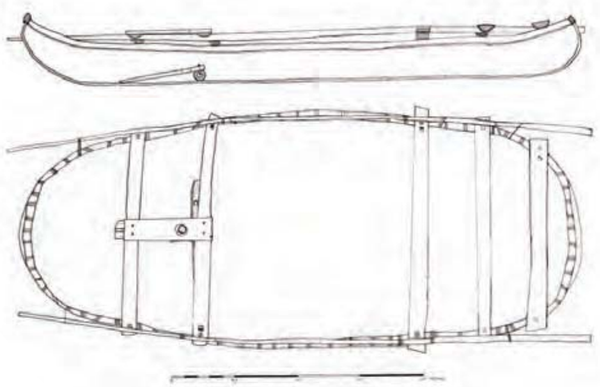
Steffy (1994, pp. 15) writes,

> *The side view is called the sheer plan. Sometimes it is referred to as the elevation plan or the profile plan. Both are acceptable, although the sheer plan is more traditional and practical; the other two terms can become confusing in archaeological descriptions. The sheer plan presents the broadside view of the geometry of the hull. It can be as elementary or as sophisticated as the draftsman deems necessary to explain the design.*

3 Cross Sections *(View from the Bow or Stern, Through the Structure)*

A cross section is, 'The body plan, sometimes called the section plan, reveals the cross-sectional shapes of the hull as seen from afore or abaft' (Steffy, 1994, pp. 15).

A number of cross sections are more informative than one. It is usually recommended that a minimum of three need to be taken: at the bow, the midships and the stern.



*Example of a plan view (bottom) and of a sheer plan (top).
Boat No. 165, Eyemouth.
© Alexandre Poudret-Barré/Charlotte Minh-Hà Pham*

2.3 Time Frame: Making the Schedule

It is possible for one person to compile a drawing on site, but such a detailed measured drawing can take a very long time. Although as Anderson (2004) states, 'the level of detail to which a drawing set may go is heavily dependent on what is significant about a vessel and the goals of your project'. Selected measurements are usually recorded (including at least three transverse sections) that can be subsequently used off site, in conjunction with notes and photographs.

A team of two to three persons is ideal to record a boat. One person to take the measurements, one to draw, and a third to take pictures, record vocabulary, inquire about the construction sequence and to do alternate tasks. This third person can also concentrate on establishing the internal stratigraphy of the boat, so that the sequence of building can be deduced (McGrail, 2003, pp. 19).

The construction sequence should be documented or discussed by the three team members in order to provide the most complete sequence in the final report. With experience and an adapted work dynamic within the team, a skin boat could be documented in three hours. However, experience suggests that more time should be allowed to take into account of unavoidable logistical problems, for example, the lack of shade on the foreshore, the inevitable difficulties of having to work through an interpreter, missing or breaking equipment, datum line moving, etc. A two person team should generally allow five days to document an open boat in the tropics, while a three person team might take three and a half to four days, rather than five.

McGrail et al. propose the following recording schedule:

- ***Day 1:*** *reconnaissance.*
- ***Day 2:*** *recording day.*
- ***Day 3:*** *recording day, to complete the recording, compile technical notes, complete the photographic record.*
- ***Day 4:*** *draw a fair version of plans and sections to identify what is missing, note anomalies, write a brief description of the boat and record any gaps in the narrative.*
- ***Day 5:*** *return to the site to record missing data and resolve anomalies.*

Additional recording activities might be needed to compile a complete record of the boat tradition under study, such as the sea passage, an interview with the boat's crew, a visit to a boatyard and an interview with one builder can take a minimum of one day, even if the team splits in two groups. Dividing the group is seldom desirable, as extra auditors to an interview provide much needed crosschecks when an account of what was said is subsequently compiled.

Once all this has been done, the examination of similar and related boats need not take more than three or four days, depending on how extensive the survey is to be. This wider enquiry is probably best done in the following season of fieldwork, when the knowledge gained in the first survey has been assimilated, a draft of the reports has been written and a fair drawing of the archetype boat has been compiled (McGrail et al. 2003, pp. 23).

Materials Necessary for the Recording

- *Drawing board*
- *Graph Mylar paper (polyethylene terephthalate (BOPET) polyester film). Mylar is moist resistant and very practical when working in the field. It is important that transfer paper, is not used, as humidity will make it wavy.*
- *Pencils, erasers and indelible markers*
- *Tape measures (at least one that is fixed during the whole recording process and is long enough to encompass the overall length of the boat (10 metres). Another two smaller tapes (3 metres) to take transverse measurements and heights. At least one tape should be able to be locked.*

- *A plastic spirit level*
- *One or two line levels (a small level that can be hung on a datum line, tape measure or rope) to ensure that they are maintained horizontal*
- *A plumb bob to measure vertical offsets*
- *A set square*
- *Rulers (specifically 1 metre rigid rules)*
- *Large clips to tie the tapes and lines*
- *Nylon rope or synthetic line that can be tightly extended without stretching and slackening*
- *Stands to attach the tape measures and ropes*
- *Small paint brushes to clean the boat and specific features to be drawn*
- *Notebook to record construction sequence, vocabulary, etc.*
- *Pre-prepared recording forms*
- *Camera, photographic scale and photo log sheet*
- *Video to record the construction sequence*
- *Examples of previously made drawings for reference and to share with the boat builders, so that the aims of the present recording session can be explained*
- *Copies of pictures, paintings, carvings, drawings or ethnographic descriptions that depict the boat type, so that the current model can be compared with more ancient types*
- *Glossary of terms*

Example of a stands system used to fix and keep level the baseline around the boat.
© Charlotte Minh-Hà Pham

Boat Tuong 14 with stands along which measure tapes and references can be strongly fixed. Mr. Toan Huyen's boat yard, Huong Hoc village, Quang Ninh province. © Charlotte Minh-Hà Pham

3 First Steps: Ethnographic Boat Recording Form

It is recommended that before starting the drawing, a 'reconnaissance' tour is made to compile general observations and to begin to formulate how the boat should be recorded.

Next, recording sheets need to be completed, overall dimensions taken and a rough sketch drawn. Some general and context photographs need to be taken and notes compiled on the main features to help familiarize the team with the boat.

First steps: the 'reconnaissance tour' and completing the Boat Recording Form. © Randall Sasaki

The following is an example of a recording form that needs to be partially filled in the field and then completed with additional data gathered by each of team members. The outlined categories are by no means exhaustive and are simple aids to remember certain types of information that need to be complied while in the field. Before starting the practical recording, it is essential to identify the research questions that will need to be asked, the details that will require specific attention, etc.

4 Drawing and Taking the Measurements

Once the first reconnaissance visit is complete and the recording form is filled in, the drawing can begin. There are specific differences between a sketch and a drawing:

Sketch: rough outline, may be drawn freehand or with straight edges and is usually not drawn to an accurate scale. A sketch is usually good enough for small subjects; it can form the basis for a more technical drawing. It is important to provide a quick overall view and to understand the subject under study.

Drawing: picture or likeness of a subject drawn to accurate scale with pencil, ink or computer driven printer devices. It is useful for conceptual ideas, plans and technical projects. A drawing usually depicts different perspectives of the same subject.

Making a line drawing of a boat based on measurements. © Charlotte Minh-Hà Pham

4.1 Preparation of the Recording Paper

Always indicate on the graph paper:

- *Name of the boat/identification number of the archetype/reference name*
- *Date*
- *Name of each of the team members (initials)*
- *Location*
- *Overall dimensions*
- *Scale*
- *Key to features coding*

It is important to first establish a system to code the different features that will be recorded on the drawing. All planks, timbers and fittings will need to be identified and given a codename. For example, strakes may be labelled P1 to Pn to port, and S1 to Sn to starboard, from the keel or foundation plank outwards. Framing timbers may be similarly labelled F1 to Fn, while beams can be labelled B1 to Bn, from bow to stern.

These codes then can be related to all photographs, drawings and notes.

4.2 Scale for the Drawing

The whole drawing process needs to be thoroughly planned before starting in order to select the appropriate size of paper, the appropriate scale and to plan the drawings and the measurements.

For boats up to approximately 12 metres in length, a scale of 1:10 results in a drawing of manageable size, but still with well defined features (McGrail et al. 2003, pp. 19).

The scale enables the recreation of large objects on paper or computer aided design (CAD) system on a computer, respecting their relative sizes. Measurements are scaled down to fit on the page and the scale uses a ratio to show how the size of the real object compares to the size of the same object on the paper. The ratio is very important to note and there is a specific convention to note it down:

Scale of a drawing = drawing length : actual length

Examples:

- *If 1cm equals 1m in reality, the scale is 1:100, i.e.*

1cm to 1m	*= 1 cm:1m*
	= 1 cm:100 cm
	= 1:100

- *If 5 mm equals 1 m in reality, the scale is 1:200, i.e.*

5 mm to 1 m	*= 5 mm:1m*
	= 5 mm:100 cm
	= 5 mm: 1000 mm
	= 1 mm: 200 mm
	= 1:200

- *If 2 mm equals 1 mm in reality, the scale is 2:1, i.e.*

2 mm to 1 mm	*= 2 mm:1 mm*
	= 2:1

The drawing is double size, two times larger than in reality

- *If 1 cm equals 1cm in reality, the scale is 1:1, i.e.*

1 cm to 1 cm	*= 1 cm:1 cm*
	= 1:1

The drawing is the exact same size as in reality

- *If 1 cm equals 2 cm in reality, the scale is 1:2, i.e.*

1cm to 2cm	*= 1 cm:2 cm*
	= 1:2

The drawing is half the size as in reality

Usually, there is a scale of 1:10 or 1:20 or 1:25 for boats of about 10 metres on A3 paper

1 metre equals 5 cm = 5:100 = 1:20
1 metre equals 4 cm = 4:100 = 1:25
1 metre equals 10 cm = 10:100 = 1:10

4.3 Setting the Boat and the Baseline

If possible, the boat should be positioned at a location where it will be easy to work on (preferably in the shade, in a quiet location and with enough room to manoeuvre around).

Ideally, the boat should be level athwartships, not heeled, tilted to one side or on a slope, and above all it should not be moved during the whole recording process.

Once the working space is determined and the boat is stable and upright, the baseline (also known as datum line) needs to be rigged. The closer the line is set to the sheer line, the easier it is to draw. This baseline is very important since it is the line from which all the measurements will be taken. The baseline needs to be horizontal and levelled with a line level, as it will become the reference line that will be plotted on the drawing.

The line has to be extended (as tightly as possible to reduce slack in the line) between the stem and stern posts. If this is not possible, then the line should be extended between two stands, chairs, poles or any steady device. Ideally, the main reference line should be attached to the boat, as if it is necessary to go back to verify measurements, it is less difficult than trying to recreate the same baseline.

Like the vessel, it is imperative that this main reference baseline does not move a centimetre during the recording process and its position should be checked periodically to ensure it is still level.

A nylon or synthetic line which is pale in colour (so that reference points can be marked on it with a pen) should be set up between the two fixed points (often called datum or control points). A measuring tape needs to be pulled tight, (but not stretched) and carefully attached alongside this line. A tape cannot always be adequately positioned, so should not be used as the main reference line.

Before starting to draw the plan view, the location of the control point (datum point) must be determined and plotted on the graph paper. Once the baseline has been drawn on the graph at an appropriate scale, the measuring of the outline of the hull can begin.

The baseline needs to be firmly fixed in place and kept level.
© Charlotte Minh-Hà Pham

4.4 Taking Measurements with Offsets

In order to produce the plan view, the longitudinal section, additional cross sections and offsets are used. From a horizontal baseline the plan view can be created with offsets, while accurate height measurements taken from a vertical baseline (or plumb bob) can be recorded.

An offset is a measurement at a right angle between a point (significant feature on your boat) and the baseline. The offset measurement can be taken using a measuring tape or a rigid ruler. The distance along the baseline (where the offset measurement 'cuts' the baseline) from the zero point also needs to be recorded.

The accuracy of this method relies on judging right angles. The most accurate way is to hold the tape on the point to be plotted and move the other end along the baseline, until the shortest distance is noted, thus giving a line perpendicular (90°) to the baseline. To check the right angle, place a recording board (if it is rectangular) or a set square in the angle created by the offset measurement and the baseline.

Offsets must be taken in the horizontal plane. The horizontal distance is measured at a right angle from the baseline, to a vertical line that is dropped to the point to be measured. The horizontal offsets of the sheer line cannot be measured directly from the centre line reference, as it will almost always be higher, so verticals have to be dropped from it.

When taking a measurement, an easier option than trying to hold a tape in position while taking a measurement, is to use an indelible marker to mark the baseline.

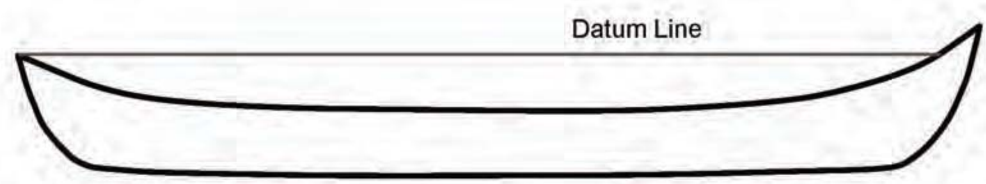
Example of how to measure offsets from the baseline, creating the plan view. The middle line corresponds to the main baseline and the left line helps to keep reference while measuring at right angle. Mr. Toan Huyen's boatyard, Huong Hoc village, Quang Ninh province. © Jun Kimura

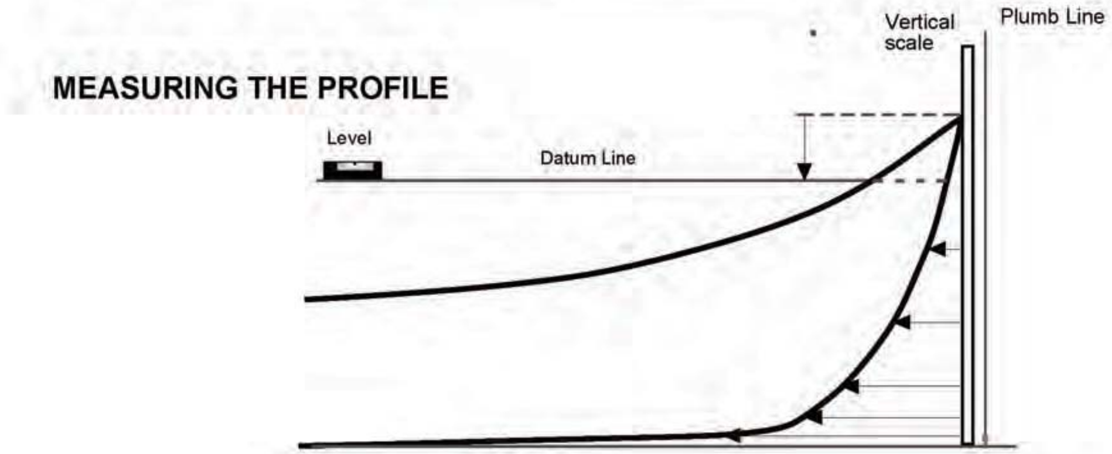
To measure heights down to the object to be documented, (e.g. the cross sections), use a plumb bob and a ruler dropped from the baseline at chosen points along the reference tape. This method will provide the measurements for the inside of the boat, the sheer line (longitudinal plan) and the hull shape (cross sections).

By using a plumb bob, a straight line can be followed from the baseline to the point, to gather the most accurate measurement. It is not recommended to measure heights with a set square due to the impracticalities of working around the boats fixtures and fittings.

RECORDING A TRADITIONAL BOAT

SETTING UP CENTRELINE BASELINE OR DATUM LINE





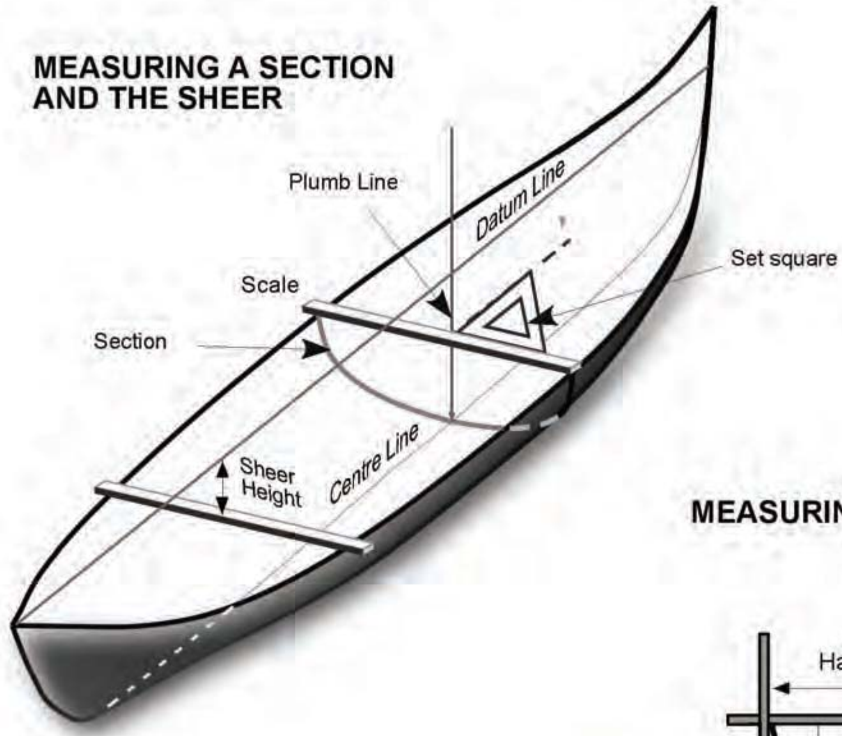
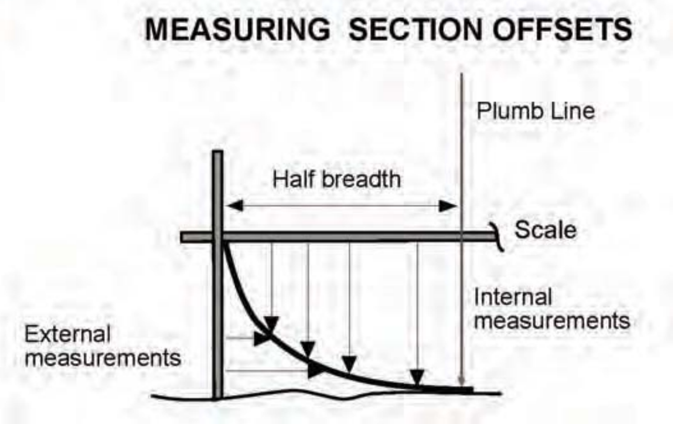


Diagram to illustrate the standard method of recording information for a measured drawing of a traditional boat.
© Colin Palmer



4.5 Drawing the Plan View

To start creating the plan view, horizontal offsets are taken from the baseline. When recording the outline, make sure the distances between the reference line and the points on the sheer, are always measured using the same side of the tape (i.e. the side of the incremental marks). Measure to the port side and then, from the same point on the tape to the starboard side. This is to avoid accidentally increasing the breadth of the boat by at least a centimetre (if the tape is 1 cm wide).

Offsets should be taken every 10 cm when there is rapid change (bow and stern). If there is not a rapid change, an offset every 30 cm or 50 cm should be adequate.

Start with the outline of the boat (including bow and stern) and then record the transverse elements (frames, thwarts, cross-beams, etc.). Finally, the remaining elements should be recorded, such as plank runs, mast step, oar ports, etc.

4.6 Drawing the Longitudinal Section

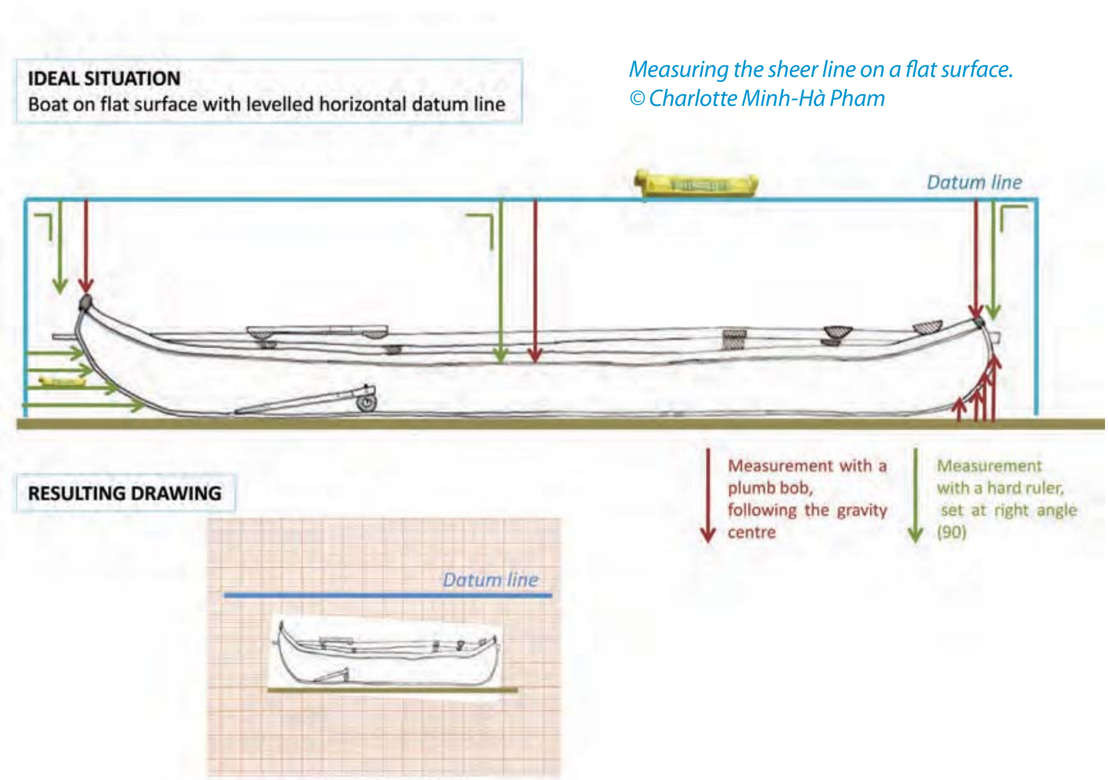
For the longitudinal section, vertical measurements down to the sheer line and then to the inside of the hull are taken from the baseline. This allows you to draw the bottom line, as well as the gunwale.

Start by marking out the sheer line, by measuring its height from the baseline, every 30 cm, reducing to every 10 cm when there is rapid change. As the baseline is situated over the centre of the boat, a simple way of measuring the heights of the sheer line is to lay a batten across the vessel (transversally) at regular intervals. Measure from the baseline down to the batten, taking into account, the batten's thickness. You can also stretch a string line across the vessel and plot the sheer line by measuring the distance between it and the baseline.

Next, the bottom line of the hull and the inside curve of the bow and stern are recorded. Measurements are taken down from the baseline using the plumb bob.

To draw the outer contour of the bow and stern, a measuring tape can be fixed along stands. Longitudinal measurements can then be taken from the stand to the boat, every 10 or 15 cm. The stand needs to be perfectly vertical and a spirit level needs to be used to make sure the offsets are horizontal. Heights can also be taken from the ground up. Having a horizontal batten on the ground is helpful to measure if the ground is uneven.

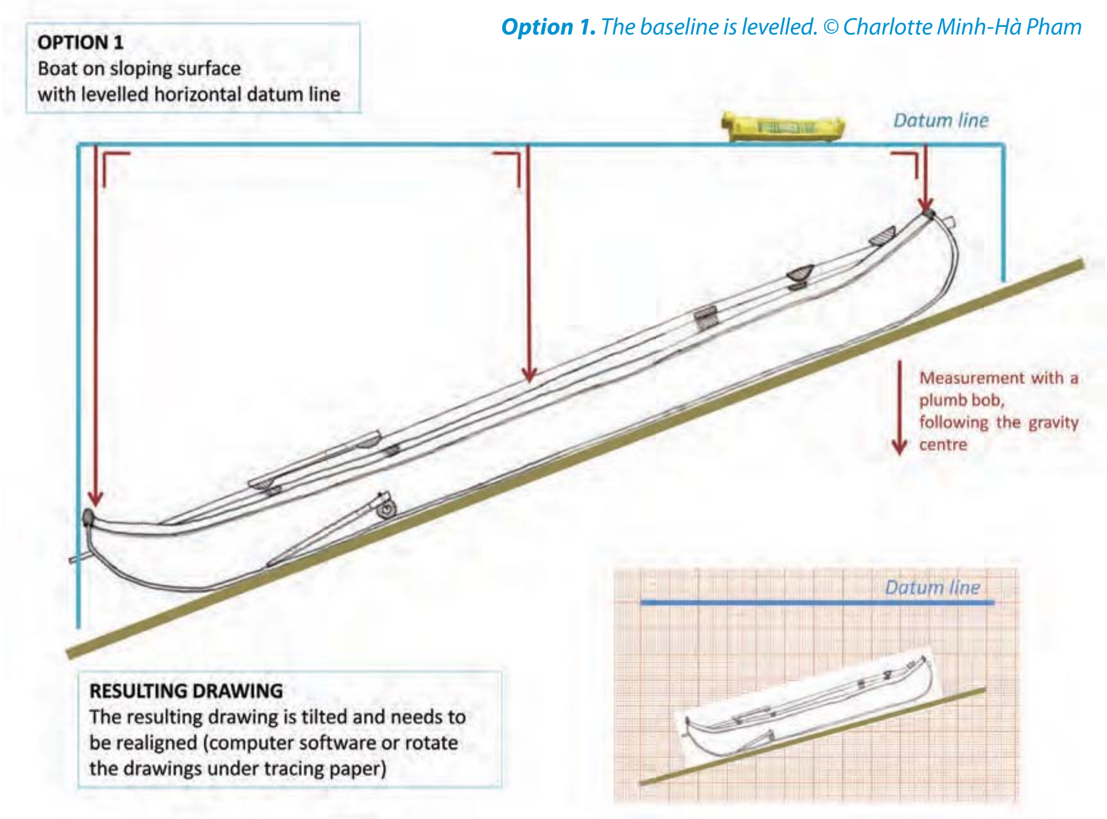
Internal elements can then be added to the longitudinal plan (i.e. the crossbeams or frames). Sometimes, the surface on which the boat is lying is sloping (such as a slipway or shore) and this can affect the drawing of the longitudinal plan, as the plumb bob responds to gravity.



Measuring the sheer line on a flat surface. © Charlotte Minh-Hà Pham

While in the field, there is no easy practical and efficient solution to this. The simplest approach is to the set a levelled baseline externally to the boat, to produce a tilted drawing on the graph paper. Later, by means of rotating the drawing under tracing paper or through computer software, align the longitudinal plan to the plan view for the final report.

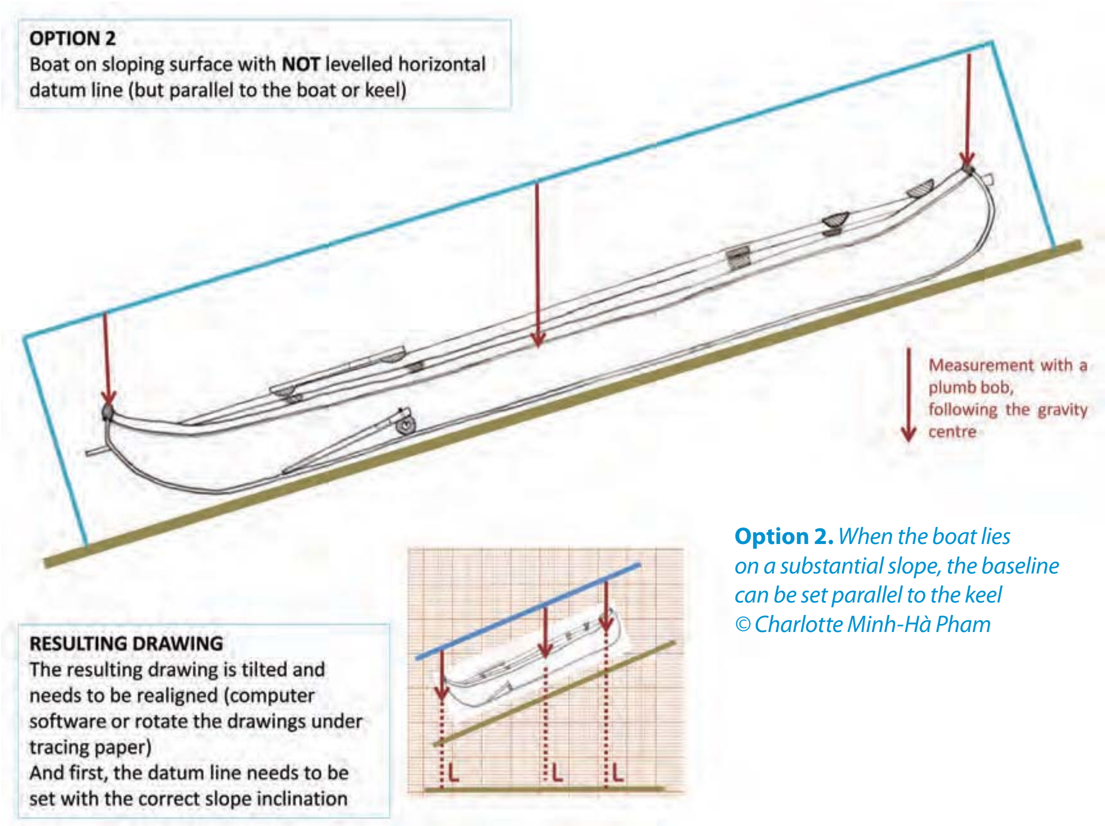
Alternatively, if the boat lies on a substantial slope, the reference line should not be horizontal, but set in line with the slope itself. The line should be stretched over the boat, between two stands that are at



***Option 1.** The baseline is levelled. © Charlotte Minh-Hà Pham*

the same height or directly attached to stem and sternpost. In that way, the baseline is set according to the keel (if there is one) or to the plan of the boat itself.

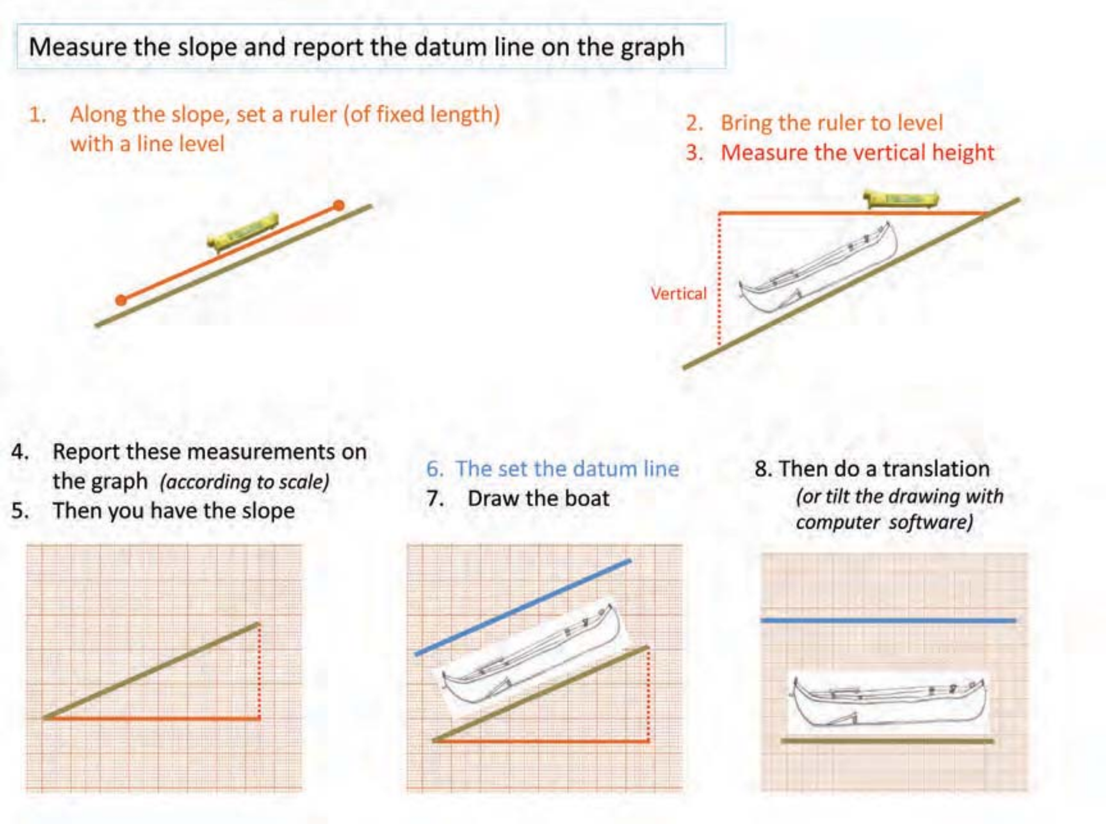
The direct lines taken with the plumb bob will not fall perpendicular to the reference line. Do not be tempted to use a ruler set at 90 degrees, instead of a plumb bob and the spirit level, as mentioned previously, this method is not accurate and will inevitably produce errors.



Option 2. *When the boat lies on a substantial slope, the baseline can be set parallel to the keel © Charlotte Minh-Hà Pham*

Once the slope is recorded, the baseline can be drawn on the graph with an accurate gradient. The result of this method is also a tilted drawing that needs to be realigned with the other views for the final report.

Recording the datum (baseline) and the slope on the graph paper. © Charlotte Minh-Hà Pham



4.7 Starting the Drawing: The Cross Sections

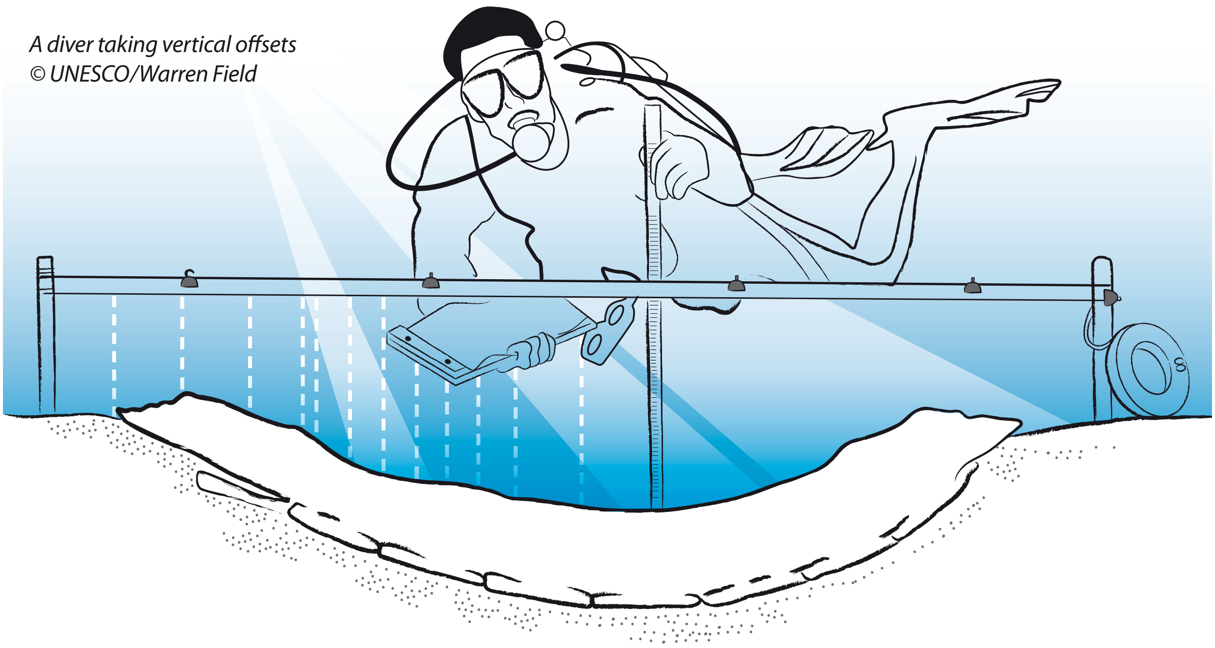
To begin to create the cross sections, their location needs to be marked both along the baseline and on the graph paper.

Vertical heights are then taken from transverse data lines that need to be fixed at these points. Battens, a solid bar with graduations or a calibrated stick can be laid athwarthips. Measurements are then taken using a plumb bob.

Some of these points should coincide with frames and some should be located in between frames. Where the shape of the boat changes rapidly, such as towards the bow, points should be placed closer together than elsewhere.

Boats are usually symmetrical, so only a little more than half of each section needs to be recorded, unless asymmetric fittings or features have been identified. If time allows, it is worth recording both sides of a boat to provide the most accurate form of the hull at different locations.

A minimum of three cross sections are necessary (near the bow, midship and the stern) and if possible, they can be taken at thwarts, cross-beams or at the mast step to show the relationship between these elements.



A diver taking vertical offsets
© UNESCO/Warren Field

There are a few rules to respect when planning to draw these three different, yet complementary views:

- *All plans show the same side*
- *All plans show the hull shape to the inside of the planking. As hulls can vary in thickness and there can be various external attachments, it can be often difficult, to express external hull shapes in the form of free flowing lines. The inside surfaces of planking are usually smooth, but to find the extreme dimensions of a portion of the hull, the planking thickness must be added at that location.*
- *All plans are to the same scale*

As Steffy (1994, pp. 17) explains, 'The beauty of all this is that each plan serves as a check on the accuracy of the other two'.

4.8 Taking Additional Direct Measurements

Some additional direct measurements for the dimensions of some features and fittings that are especially important have to be recorded, such as the thickness of planking, moulded and sided dimensions of key timbers, spacing (centre to centre) of fastenings and of frames.

Scarves, other joints and the details of fastening methods are also best recorded in a diagram which includes measurements.

4.9 Recording Propulsion and Steering

Certain aspects of the propulsion and steering arrangements should appear on the hull drawing, such as the mast step or the pivots for the oars. It will also be necessary to draw and photograph the mast, yard, sail, rudder and oars. Diagrams with measurements should be made of the rowing geometry and of the rigging.

5 Inking Up

The US National Park Service's guidelines for Recording Historic Ships are as follows (Anderson, 2004):

- *Organize a drawing set into a progression of similar views: line plans, deck plans, profiles, sections, details, exploded views, process diagrams and schematics*
- *Lay out drawings with distinguishable zones for line work, scales, labels and verbal annotations*
- *Use proper line widths to emphasize major components of the vessel and delineate fine details*
- *Use appropriate rendering symbols and techniques to indicate and distinguish different materials in the vessel in plan, profile and section*
- *Use drawing scales appropriate to the size and significance of vessel being recorded*
- *Use lettering sizes and styles that are easily legible in the full size drawing or in reduction to 25 per cent of full size*
- *Use verbal annotations to provide information not readily presentable or discernable in a drawing, e.g. names of spaces, parts; historical data important to interpreting a drawing; significant field or documentary data affecting a drawing's content or accuracy; labels for match lines, baseline, etc.*
- *Use number keys (or tags) with arrows to annotate features which are too close together or in spaces too confined by significant line work to annotate directly with labels*
- *Cite and explain anything in drawings which differs from the condition of the vessel*
- *Include graphic scales to indicate actual dimensions of the recorded vessel*

Lettering

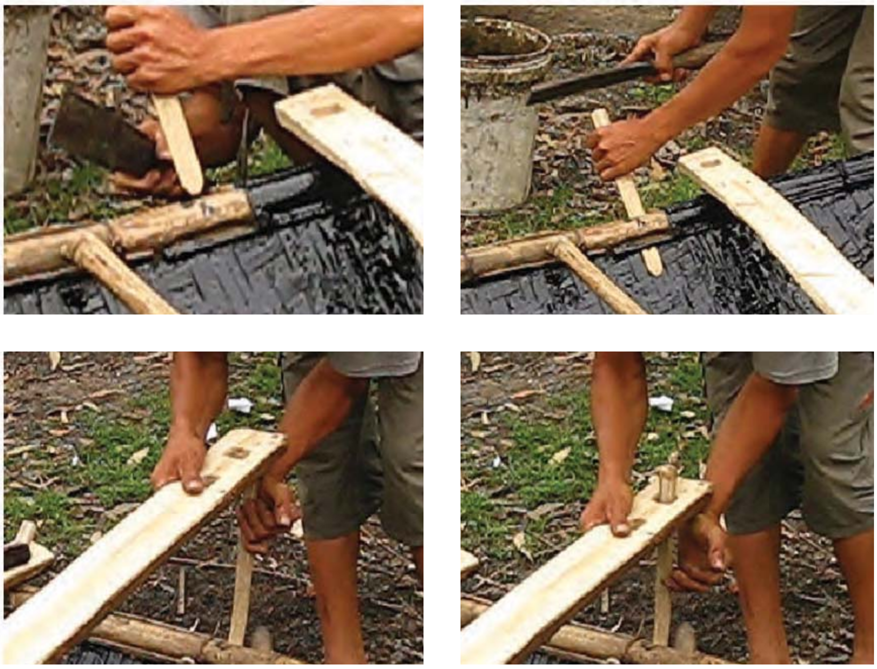
- *Use neat, printed lettering*
- *Upper case*
- *Use light horizontal lettering guides (trace lines) to assist with lettering*

6 Ethnographic Recording

6.1 Documenting the Sequence of Construction

If it is possible, visit a boatyard to observe the boat being constructed. Try to understand the sequence of construction, identifying the key moments in the process, for example: the setting of the stem and sternpost, the laying of the first strakes, the fitting of the ribs, the fastening of the planking, caulking phase, etc.

Take note of all of the different phases of building, identify each essential move and finally, make sure to compile pictures to illustrate each event for the final report.



Example of a construction sequence documented step by step. Mr. Toan Huyen's boatyard, Huong Hoc village, Quang Ninh province. © Charlotte Minh-Hà Pham

6.2 Recording the Vocabulary

Anderson (2004) explains,

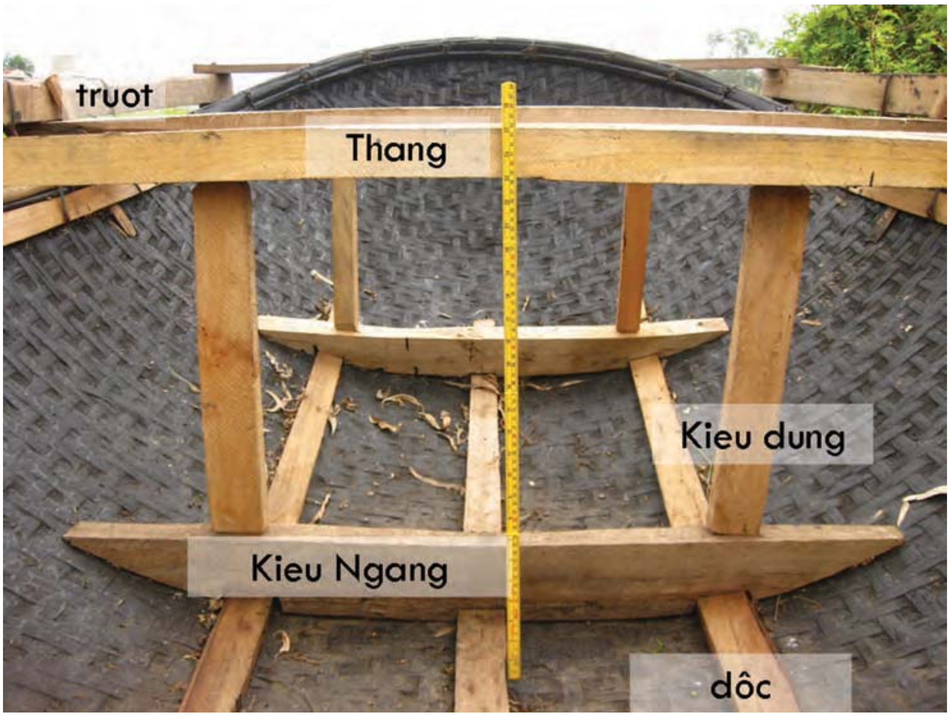
> *Ship (nautical) terminology may seem to be a world unto itself, especially when you begin to encounter the details of construction, rigging, etc. If you do not know what something is called, or if you do not understand what a new term refers to, ask. Be prepared for local variations in meaning, pronunciation, spelling, etc., and be diligent about recording these terms in your field notes. Eventually, sea terms will come easily, and you will need to know them in order to make sense of records, drawings, shipwrights' explanations, and the like without wasting time. Be prepared to encounter local variations, and be sure to keep a more extensive glossary handy for further details. Local terms must be shown on final drawings, and where they vary from more generally used terms, the general terms must also be given in parentheses. A European glossary may be needed for European-built vessels.*

6.3 Interviewing the Boat Builder

In comparison to an archaeologist studying an excavated boat, the individual who records traditional boats has several advantages, not least that the representative nature of a particular boat can be determined, that the boat structure is generally complete and that the uses of the boat can be established. The greatest advantage is that the owners of the boat and often also the builder can be questioned.

Questions to be asked include:

- *How do you handle the sails when tacking/wearing?*
- *How deep do you load the boat?*
- *What types of fish do you catch?*
- *How do you keep your reckoning when out of sight of land?*
- *What is the function of that notch on the inner face of the stem?*
- *Why was this boat given that shape of a bow?*
- *Why was reverse clinker planking used and not some other form of planking?*



Detail of the internal structure of a basket boat and the related vocabulary. Mr. Toan Huyen's boatyard, Huong Hoc village, Quang Ninh province. © Charlotte Minh-Hà Pham

An experienced recorder can build up a comprehensive picture of the boat building process, from felling the trees to launching and her uses and operational performance. This is a picture which archaeologists working within their own domain perceive only dimly, but this perception can often be improved by using comparative data derived from traditional rafts and boats (McGrail et al., 2003, pp. 17).

Ideally, several builders involved in the construction of the boat being documented should be interviewed. The aim should be to discuss the design of the boat and the building process, alongside studying the boatyard for clues, such as the tools and techniques used. Moreover, incomplete boats will reveal details of hull structures that cannot be seen on a working boat (McGrail et al., 2003, pp. 21).

The features of the landing place from which the boat generally operates should also be discussed and documented: landward access, nature of beach, aspect, predominant winds, tidal pattern, offshore hazards, etc.

It is important that a journey on the boat is recorded, so that the way the boat is handled and other aspects of life on the water can be observed. These observations can then form the basis for an interview with the crew after returning to the landing place. If a voyage is not possible, then a demonstration by the builders or owners can be the next best option.

In 1948, Jean Poujade developed an initial questionnaire to address boat traditions. In addition to sections relative to hull shape (Section 1), propulsion (Section 2) which includes navigation features and specific recorded vocabulary (Section 5), Poujade suggested two other sections that are worth outlining here:

Section 3: Life and Personality of the Boat

Life on board:

- *Material life: social and economic status of the owner, settling of the crew, wives and children on board, family life on board. If the vessel is a boat house, the kitchen, hearth, water, food storage, type of navigation, trajectories, maritime routes, night or day navigation, length of travels should also be examined*
- *Spiritual life: superstitions, cults, altar, statues, etc.*

At mooring and on land:

- *Mooring and anchorage devices*
- *Dry docking*
- *Boat shelters*

Boatyards:

- *Beginning of construction to launching*
- *Work conditions, temporary or fixed staff, itinerary builders, organization, sequence of construction, system for fixing the first elements, the opening and closing ceremonies*
- *Refitting in the dry dock*

Personality of the boat:

- *Gender and name*
- *The eyes and other decorations: description of shape and size, direction of the gaze, material, proportions in comparisons with the rest of the boat, colours, who 'opens the eyes' the builder, a shaman or the owner? Is the eye related to a mythological figure?)*

Section 4:
Role of Boats in the Culture and Life of the Community under Study, Nautical and Solar Myths.

Boat representations in art:

- *This can relate to temple reliefs, etc. Who are the artists who depict them? What are the related myths?*

7 Report Write Up

Based on the papers of Blue, Kentley and McGrail (1997, 1998) we can identify the various sections that need to be included in a report, so that each of the different aspects of a boat are addressed.

1. Introduction and research background

2. Environmental background (weather, climate, monsoon, currents, winds, etc.)

3. Maritime history of the coast or locality (ancient ports and harbours, boatyards, trade, etc.)

4. Evidences, previous works and references

5. Field work (details, locations, people, duration, etc.)

6. Distribution of the boat

7. Sizes and shapes

8. Building the boat

- *Design*
- *Building sequence*
- *Backbone*
    - *Planking*
    - *Framing, cross-beams, top strake*
    - *Decking*
    - *Other equipment (outrigger, balance board, leeboards, etc.)*
    - *Caulking*
- *Decoration and ritual*

9. Other types

10. Boat operation:

- *Sailing the vessel*
    - *The crew*
    - *Under oars*
    - *Under sail (masts, fastening points, standing rigging)*
    - *Towing*
    - *Steering*
    - *Mooring*
    - *Fishing*

11. Social and technological context

12. Discussion about boat type or construction, potential comparisons or comments about technological evolution

13. Conclusion, future work, boat recording and maritime archaeology

8 Example of an Ethnographic Boat Recording Form

Location	Field crew

General Information

Name of the boat	
Identification number	
Local name	
Type of boat	
Condition of boat	

Overall dimensions	
Length	
Max breadth at bow	
Max breadth at midships	
Max breadth at stern	
Depth	
Tonnage	

Preliminary sketch

General Description

Picture	**Boat type (use)**		**Comments** (Reference to picture/drawing, small sketch, description, etc.)
	Construction type e.g. shell first/frame first		
	Fastenings e.g. iron nails, treenails, lashings, etc.		
	Hull shape and overall hull structure e.g. V-bottom, sharp deadrise, round bottom, flat bottom, flat floored, etc. Mid-section, horizontal plan, differences or similarities between bow and stern.		
	Longitudinal structure e.g. keel, bottom plank, etc. and number of strakes, dimensions.		
	Transversal structure e.g. beam, ribs, bulkheads, frames (numbers and spacing, etc.)		
	Bow and stern structural information e.g. how are they fitted, sizes, decorations, etc.		
	Thickness of planking		
	Steering e.g. type of rudder, location.		
	Additional anti-leeway devices? e.g. centreboard or outriggers, balance boards, etc		

	Propulsion e.g. oar, paddle, describe their fittings, shapes and sizes		
	Rigging e.g. type and materials		

Additional Features

Picture			**Comments**

Materials

	Material Type e.g. wood, bamboo, iron, etc.	**Material Details** e.g. species, amount of material required, lengths, quantities, etc.
Hull		
Frames		
Crossbeams		
Fittings		
Tree nails		
Caulking		

Important Questions Arising

Supporting Documents

This should include a list of pictures (photographs or drawn images), the storage location of relevant documents, who did what, etc.

Photographs	
Videos	
Drawings	Plan Longitudinal profile Cross sections

Boat History

Local Name	
Date of construction (if known)	
Origin/provenance e.g. if different from the present location	
Story of that boat e.g. if relevant, where it comes from, used for what, age, number of repairs.	
Informants Location *(Full address for future re-contact)* Details each individual involved in the construction or who can provide information about the boat use and construction (Name, age, contact details if possible)	

Construction Phases

(Ensure a photograph or video is taken of each single phase of the construction)

	Brief name	Brief description	Photo	Video
Phase A				
Phase B				
Phase C				
Phase D				
Phase E				
Phase F				
Phase G				
Phase H				
Phase I				

Vocabulary and Details

Word (English)	Word (Local language)	Description

Type of Environment for Boat Use

Social Aspects

Ceremonies	
Prices e.g. for selling, for materials, etc.	
Life span of the boat e.g. how and when to replace certain parts, painting, caulking, etc.	
Resale process e.g. about the boat builder, the boat user, etc.	
Boat uses	
Construction time	
Construction and distribution e.g. how many boats are constructed and sold per year?	
Number of workers required to build the boat and task repartition	
Education, passing of knowledge and tradition. e.g. where did the builder learn to build the boat?	
Conception of the boat e.g. blue prints, drawings, discussion, concept and how to apprehend changes.	
Tradition in the region e.g. how long has this tradition been followed here and why specifically here?	

Appendix Summary

The aim of this practicum is to demonstrate how simple it can be to start building knowledge of boat traditions, when there is very little preliminary documentation or evidence available. However, an ethnographic recording is not just about producing a drawing, it also involves further in depth research and data gathering on not just boat features, but the whole maritime tradition.

Maritime ethnography consists of systematically taking measurements, photographs and noting the main features and specific details regarding a boat. This information is then complemented by additional interviews with the boat builders and owners about the tools, materials, use, cargo types, distances, navigation capabilities, design and concepts (McGrail et al., 2003).

When financial support or specific training is not available to conduct underwater excavations or surveys, it is still possible to build knowledge of boat traditions and develop an understanding of the maritime aspects of culture through the practice of maritime ethnography. This approach can be a stepping stone in the development of maritime archaeology in regions where the discipline is not yet practiced to its full potential. When done accurately, maritime ethnography can be a powerful research tool to complement our understanding of the role of boats and boat building in a historical, political, economical, environmental and cultural context.

In this appendix the definition, potential and advantages of maritime ethnography are discussed, as well as its practical application and preparation. Although a full record of a boat cannot be conducted during this practicum (which would include recording a full construction sequence, specific vocabulary or interviewing the boat builder or boat owner), it addresses the practical aspects of preparing a systematic recording, and teaches students the essential steps required to produce an accurate drawing.

Experiencing the boat use under oars. © Nguyen Thi Mai Huong

Suggested Timetable

Day One

60 mins	Introducing Maritime Ethnography
	Break
	Transfer to the location of the practical session
90 mins	Practical session - *Reconnaissance tour and completing the recording form* - *Photograph the boat and complete the photographic log* - *Set up the boat and fix the baseline* - *Prepare for the drawing task*
	Break
120 mins	Complete plan view drawing Start longitudinal view drawing
	Break
120 mins	Complete longitudinal view drawing

Day Two

90 mins	Start series of three cross section drawings
	Break
90 mins	Complete three cross section drawings
30 mins	Concluding Remarks and Closure

Teaching Suggestions

It is recommended that trainers schedule one day to prepare for the lecture and practical recording sessions. Trainers need to select the different boats to be recorded by the students, organize, clean and position the boats at the chosen location and ensure that all the materials and equipment are ready. Always brief the location staff (i.e. boat or property owner) regarding the structure of the practical sessions, prior to the training day.

The introductory lecture should be divided into two, the first half introducing students to maritime ethnography, its advantages and the scope of an ethnological study and the second, an introduction to preparing a boat recording session.

Alongside the information covered in the appendix it is important to emphasize to students that recording sessions can be useful to document boat traditions and maritime culture in their respective countries. Even using only a small number of recording sessions conducted with tight budget, an insightful article can be put compiled and submitted to international journals, so bringing the boat traditions of the student's country to the maritime archaeology community.

When presenting how to prepare the boat recording session, it is useful to provide example of the kinds of drawings that will need to be produced and the type of information that could be gathered during the field work. Trainers should provide a clear idea of time frames required for making a good recording, the necessary materials and a guide to what to consider before getting into field, e.g. preparing the interview, choosing the boat, etc.

Trainers should carefully demonstrate how to draw and taking the measurements of each part of a boat, step by step. Be sure to review with students how to choose the most appropriate scale and how to measure it.

The accurate completion of the ethnographic boat recording form is the most crucial important step in the recording process. Not only does it enable to familiarize oneself with the boat to record, but also to apprehend the whole drawing process and plan the different steps. During the lecture, trainers should read through each of the different sections that need to be filled in when on site, emphasizing the importance of conducting interviews and gathering as much data as possible in a short time.

Facilitating the Practical Session

Trainers should ensure that they have all the equipment required to facilitate the practical session, including A3 white boards, graph paper and print outs of the recording form. It can also be helpful to have additional print outs of general boat terms to help students identify parts of the boat. A full day and a half should be sufficient time for students to draw a small (4 metre) boat.

Trainers should divide the students into small groups and ensure that every student take turns with the tasks. Groups should not exceed four to five students in size. This is the maximum number needed to produce a clear and accurate drawing and to develop an efficient measurement system. Two persons can draw simultaneously the same boat, but on two different drawings so to compare the result, while two other team members (three maximum) take the measurements to be plotted on the drawings.

Ideally working groups should be situated near to each other, so that problems can be discussed and solutions shared. The boats should be selected carefully so that they present a challenge to the students. Dugouts, for example, are of simple design and can be too easy to draw. As the students have produced relatively coherent quality drawings and recording forms, it is suggested that during each training course, different boats are recorded, so over time it is possible to build a database of regional boat traditions.

Trainers should emphasize the importance of choosing the appropriate scale for the drawing and carefully identify location and sizes of the drawings that need to be produced, according to the size of the boat.

Once each group has been allocated a boat, the students to need to begin their 'reconnaissance tour.' Each student must complete their own recording form and take photographs using a photographic scale (as an exercise for potential report). Trainers should ensure that the photographs provide a clear image of each section, details and boat as a whole.

Trainers should:

- *Discuss the scale with the students and select the one most appropriate.*
- *Help the students set up the baseline*
- *Start students drawing the plan view (first the shape and then the internal elements)*
- *Then draw the longitudinal view. Offsets from baseline to the inside contour, then the sheer line, then setting a vertical offset line to take outer contour, and finally, setting a baseline on the floor to take the outside contour.*
- *Tackle the cross sections last. Remember to ask students add the direction of the view*
- *Ensure the name, location, date, etc. are clearly printed on the drawing*
- *Once the practical session is complete, ensure that the students have scanned and distributed their drawings to the rest of the group. Each member of each group should have a copy of their drawing. It is useful, however, for students to have all the drawings so that they can compare and contract the details in each.*

Equipment Required for Practical Session (per group)

- *Two A3 plastic drawing boards*
- *A3 graph paper (or smaller sheets and sticky tape!)*
- *A 15 m tape (to use as datum line)*
- *Rope (to use as datum line)*
- *Clips to fix the datum line*
- *A plumb bob*
- *Two metal measuring tapes*
- *Pencils and erasers*
- *Two chairs or net posts or stands to fix the datum line*
- *Photographic scale*

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The Protection of the
Underwater Cultural Heritage

APPENDIX B

Author Charlotte Minh-Hà L. Pham

Basic Terminology of Shipbuilding

(Appendix to Unit 14: *Asian Shipbuilding Technology*)

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APPENDIX B

Contents

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Author Charlotte Minh-Hà L. Pham

Basic Terminology of Shipbuilding

(Appendix to Unit 14: *Asian Shipbuilding Technology*)

Core Knowledge of the Appendix

This appendix provides additional information to support Unit 14: *Asian Shipbuilding Technology* and to some extent overlaps and complements, Appendix C: *Introduction to Metal Shipbuilding Technology*.

On completion of the Basic Terminology of Shipbuilding appendix student will:

- *Understand that nautical terms are a technical language*
- *Have knowledge of the terminology and function of the main structural components of wooden vessels*
- *Have knowledge of the terminology and function of the basic rigging elements of a sailing vessel*
- *Have knowledge of the terminology and function of boat accessories*
- *Understand some of the characteristics of Asian boat design that differ from western boat building traditions*
- *Understand that there are different sequences in how a boat is constructed*

Introduction to the Appendix

As in any specialized profession, it is mandatory to use the appropriate vocabulary when describing the various elements of a ship. It is true that there are many good marine dictionaries (see Steffy (1994) on which this exhaustive list is based), but there are always limitations, and often the available terms do not always apply to ancient shipbuilding, much less than to South-East Asian constructions, concepts and local terminology.

Therefore, it is important to take note of any specific terminology used when visiting a boat yard or meeting a boat builder, in order to attain the most appropriate vocabulary. By describing vessels using authentic terms we not only help preserve national maritime heritage, but also provide keys for interpreting ancient written sources or for enabling linguistic connections.

Although it is impossible to standardize nautical vocabulary, there is basic terminology that can be addressed. It is important to use this terminology and to understand the purpose of each element, so that boat remains can be described and/or interpreted as accurately as possible.

1 Direction and Positions

Fore and aft: relative to the ends of the ship; fore is located at the front and aft is located at the back.

Athwartships: across the ship, relative to the sides, perpendicular to the keel.

Amidships: the middle of a vessel, either longitudinally or transversely.

2 Around the Hull

'In naval ethnography, it is the hull, stable element, which characterises the boat' (Admiral Pâris cited in Amos, 1998, pp. 33), indeed, the shape of a boat is the direct expression of the hull design. It is the main structural component; a watertight body that provides buoyancy to the boat. Its construction is affected by the extent of technical knowledge, available materials, intended routes, cargoes, economics, environment, social structure, political influences and a host of other prevalent factors. There is, therefore, a direct relationship between hull forms and historical periods, even if ships cannot be dated exclusively on the basis of hull design.

It is important to be able to understand and describe hull forms; to notice how the various curvatures served a unique purpose, depending on the type of vessel and the period and geographical area it originated from. Hull form is also directly associated with site distribution of cargo, artefacts, and timbers (Steffy, 1994, pp. 12).

Bow: refers to the forward section of a hull. The point that is most forward when the vessel is underway, specifically from the point where the sides curve inwards.

Stern: is the rear or aft part of a hull.

The bows and sterns once formed the 'hearts and minds' of ships. This is where the crews lived and the gear and valuables were stored. Personal artefacts, anchors, cable, tools, money, scales and other items reflecting ownership and operation are normally found in these areas. Their construction is even more impressive; it changes constantly, timber after timber set in different sizes and directions to satisfy the demands of seaworthiness. The best shipwrightry was required here. This is where we can learn about the disciplines, the economics, the technology and the philosophies of societies, and how each society approached these problems in different ways (Steffy, 1994, pp. 11).

Sternpost: a vertical or upward curving timber, or assembly of timbers, that are stepped into or scarfed to the after end of the keel, or heel, at the stern (Steffy, 1994, pp. 280).

Stem or stem post: a vertical or upward curving timber or assembly of timbers, scarfed to the keel or central plank at its lower end, into which the two sides of the bow are joined (Steffy, 1994, pp. 280).

The prow is also the name given by seamen to the beak or pointed cutwater of large ships. The upper part of the prow is usually furnished with a grating platform.

Starboard: refers to the right side of a vessel, perceived by a person on board, facing towards the bow.

Port: refers to the left side of a vessel, perceived by a person on board the ship, facing towards the bow.

Bilge: the area of the hull's bottom on which it would rest if grounded (Steffy, 1994, pp. 267).

Flat bottom/chine: the bottom of a ship may be round, flat or flat floored, with a single or double chine, and with a slight or sharp deadrise. The chine is the 'angular junction of the bottom and side of a vessel' (Steffy, 1994, pp. 269) and can also refer to the longitudinal timber located just inside the junction.

The deadrise is the angle at which the bottom planking lies to the horizontal. Most flat bottomed boats, such as most traditional Chinese vessels, have no keel.

Transom: one of the athwartship (transversal) members, fixed to the sternpost that shaped and strengthened the stern (Steffy, 1994, pp. 281). It is the surface that forms the stern of a vessel. Transoms may be flat or curved and they may be vertical, raked forward or raked aft. Chinese ships usually have a flat transom at the stern.

Bowsprit: a spar projecting forward from the bow (Steffy, 1994, pp. 268). Its purpose is to provide an anchor point for the forestay (a piece of standing rigging which keeps a mast from falling backwards), allowing the foremast to be stepped farther forward on the hull.

3 Longitudinal Structure

Strakes: single plank or a combination of planks that stretch from one end of the boat to the other.

Plank: components of strakes that are not all constructed in one piece.

Keel/keelson/keel piece: the keel is the main longitudinal timber of most hulls, upon which the frames, dead woods and ends of the hull are mounted; it is the backbone of the hull. The keel runs through the middle of the ship, from the bow to the stern and serves as the foundation or spine of the structure, providing the majority of structural strength for the hull.

A keelson is an internal longitudinal timber, mounted atop of the frames along the centreline of the keel. It provides additional longitudinal strength to the bottom of the keel, acting as an internal keel. It is fastened to the keel partly to give additional longitudinal stiffness to it, but principally to bind the longitudinal members (keel and hog) to the transverse members (frames and floors).

Hog timber (rising wood): a fore-and-aft structural member of the hull fitted over the keel to provide a fixing for the garboard planks (first strakes, near the keel).

Gunwale: is the upper edge of a vessel's side. In sixteenth century vessels, the wale is against which the guns rest (Steffy, 1994, pp. 272). It is a strengthening wale or a structural band added to the design of the ship, to accommodate the stresses imposed by the use of artillery.

Stringer/side stringers: general term describing the longitudinal timbers along the inside of the planking. They are usually fixed to the inside surfaces of the frames (Steffy, 1994, pp. 281) to reinforce the structure.

Bulwark: the extension of the ship's side above the level of the weather deck.

Freeboard: height of the ship's sides above the waterline.

Sheer: the upward curve of a vessel's longitudinal lines as viewed from the side.

Double-ended: a vessel whose bow and stern have approximately the same horizontal shape, such as rounded, pointed or square ends (Steffy, 1994, pp. 270).

4 Transversal Structure

Frames: transverse members that are made up of more than one piece of timber, usually floor timbers and pairs of futtocks, set against the planking.

Floor timbers: transverse structural members lying across the keel and tying the frames on either side of the keel together. They are also the central futtock or futtocks of a sawn frame, lying across the keel. Floor timbers join both sides of a vessel together and make up the sub-structure for external keel fastenings, engine beds and mast steps.

Timber: general term to describe any piece of wood used in shipbuilding. One piece of ribs or frames, especially those steamed or bent into place, are frequently called timbers.

Rib: a small transverse member, often flexible and composed of one or more pieces, that stiffens the outer skin of a hull (Steffy, 1994, pp. 278). Although often used for frame, rib is more properly applied to small craft, such as canoes or small boats.

Futtocks: a frame timber (that is not a floor timber, half frame or top timber) that constitutes one of the middle pieces of a frame. They are pairs of timbers which, with a floor timber, constitute a frame and essentially support the side planking.

Beam: a timber mounted athwartships to supper decks that provide lateral strength. Large beams are sometimes called baulks (Steffy, 1994, 267).

The breadth of a ship is the width of a hull, sometimes called beam because it is technically the length of the main beam.

Thwarts/benches: transverse structural members that support masts, provide lateral stiffness and that are often used as a seat in small boats.

Bulkheads: a vertical partition that is either fore and aft or athwartships (Steffy, 1994, pp. 268). It usually applies to every vertical panel aboard, apart from the hull itself. In South-East Asian technology, they usually refer to the Chinese design of forming watertight compartments.

At some point during the fifteenth century, sailors and builders in Europe realized that walls built within a vessel would prevent cargo from shifting during passage. The word bulki meant 'cargo' in old Norse and any vertical panel was called a 'head'. As a result, walls installed abeam (side to side) in a vessel's hull came to be known as 'bulkheads'.

There is evidence of bulkheads in Chinese shipbuilding technology since the Tang Dynasty.

5 Decks & Deck Features

Deck: is a permanent covering over a compartment or a hull of a ship. The primary deck is the horizontal structure which forms the 'roof' of the hull and both strengthens the hull and serves as the primary working surface. Vessels often have more than one level within the hull itself.

Poop: is the highest and aftermost deck of a ship (Steffy, 1994, pp. 277). The name originates from the French word for stern, *la poupe*. In sailing ships, with the helmsperson at the stern, it is an ideal elevated position for both navigation and observation of the crew and sails.

Quarter deck: extends forward from the stern to the main mast. The poop is located at the hind part of the quarter deck and often serves as roof for the captain's cabin.

Forecastle: refers to a short, raised foredeck, the forward part of the upper deck, between the foremast and the stem, or the quarters below the foredeck (Steffy, 1994, pp. 271).

6 Steering and Propulsion

Oar or paddle: the main practical difference between a paddle and an oar is that an oar is attached to the boat, through an oarlock or rowlock, while a paddle is loose. Oars are also usually longer than paddles.

In rowing, a boat is manoeuvred with an oar, when paddling a paddle is used. A paddle is hence shorter and broader in the blade than an oar, and is equally employed for rowing and steering.

Sculling oar/steering oar/yuloh: 'to scull' is to cause a boat to move forward by operating a single oar over the boat's stern. A sculling oar is a kind of short oar, the loom of which is equal in length to half the breadth of the boat. A steering oar is used to steer a small vessel, either from the side or the stern. A steering oar should not be confused with a quarter rudder, which is permanently mounted and turns about a fixed axis.

The yuloh is a Chinese sculling oar. It is a large, heavy sculling oar with a socket on the underside of its shaft which fits over a stern-mounted pin, creating a pivot which allows the oar to swivel and rock from side to side. The weight of the oar, often supplemented by a rope lashing, holds the oar in place on the pivot. The sculler primarily moves the oar by pushing and pulling on this rope, which causes the oar to rock on its pivot. This system allows multiple rowers to operate one oar, allowing large, heavy boats to be rowed if necessary.

Rudder: a timber or assembly of timbers that can be rotated about an axis to control the direction of a vessel (Steffy, 1994, pp. 278). This term is used for any kind of vessel, boat, submarine or aircraft.

Various types of rudders can be seen in South-East Asia, including the Chinese axial rudder, the South-East Asian lateral rudder (or quarter rudder), the caisson helm and also some basic types of western helms.

Chinese axial rudder: Is attached to the hull by means of wooden jaws or sockets, or can be suspended from above by a rope tackle system so that it can be raised or lowered into the water.

Chinese rudders are sometimes bored with diamond shaped holes (fenestrated rudders), which are believed to decrease the force of the water on the rudder, easing the task of the helmsperson, without affecting its efficiency. The Chinese invented these stern mounted rudders almost one millennium before the pintle and gudgeon rudder appeared in Europe.

Axial caisson helm: this type of rudder is derived from the concept of the suspended sliding rudder, which slides in a water compartment. It protects the long, narrow rudder from the blows of the sea and makes it easy to retract. Pegs or crossbars enable the rudder to be fixed at a chosen depth.

South-East Asian lateral rudder: this type of rudder is mounted on the side of the boat at the quarter aft. The strength of a quarter rudder lays in its combination of effectiveness, adaptability and simplicity (Burningham, 2000).

Basic helm with braces: in the western tradition, rudders are hung on the sternpost, supported by a pintle and gudgeon rather than being suspended like the Chinese types. A pintle is a pin or bolt, usually inserted into a gudgeon, a circular fitting often made of metal, which is affixed to a surface. It allows for the pivoting of another fixture.

Tiller: is a wooden or metal lever fitted into the rudder head, by which the rudder can be moved from side to side (Steffy, 1994, pp. 281).

Helm: is a general term that usually includes the tiller, the steering wheel and the actual rudder.

Guares/centreboards/lee boards/anti-leeway devices: a centreboard, drop keel or sliding keel, is a wooden or iron plate that can be raised and lowered within a watertight housing called a trunk. The trunk is built over a slot in the keel or in the hull (Steffy, 1994, pp. 269). The centreboards help direct a vessel as it increases lateral resistance, therefore, reducing leeway when tacking or sailing off the wind.

Some seagoing rafts from Thanh Hoa (Viet Nam) were fitted with three centreboards. These particular vessels featured mixed hulls and because the basket hull could not be pierced, the centreboards were fitted in the grooved stem post, forming the unique feature of a 'bow board'.

Outrigger: the outrigger float, which could be a simple cylinder of wood or something of much more complex shape, is held out of the boat (at a distance equivalent to a third of the boat's length) by booms fastened to the hull's framing. These booms and their connectives act as transversal stabilizers. Outrigger assemblages can vary in innumerable ways and have been studied in some detail by Haddon and Hornell (1975). Their use in South-East Asia is thought to date as far back as the eighth to ninth century, as evidence of them can be seen in images found at the temple complex of Borobudur.

7 Rigging

Rigging: is the whole apparatus through which the force of the wind is used to propel sailing boats or ships forward. This includes masts, yards, sails and cordage.

Masts: the vertical pole or spar that supports the boom and sails. The mast head is located at the top of the mast.

In a three masted, square sail carrying ship each mast has a specific name. From bow to stern: foremast (the first mast), mainmast (tallest, usually located near the centre) and the mizzenmast (the shorter, third mast or the mast immediately aft of the mainmast). There are other names given to masts in ships carrying other types of rig, for example, the bonaventure mizzen (fourth mast on sixteenth century galleons) or jigger mast (the shortest, the aft-most mast on vessels with more than three masts).

The mast partners: are the ship's timbers that are fitted between the deck beams located around the opening in the deck where the mast passes through. Essentially they are under the deck planking. When the mast is stepped, it is wedged into place at deck level, the wedges going between the partners and the mast itself. This serves to stiffen the installation, so that the mast doesn't move around and damage itself or the deck.

Maststep: is the fitting in the bottom of the boat, in which the bottom or heel of the mast sits.

Yard: a spar suspended from a mast, from which the head of a square sail is suspended.

Boom: a spar attached to the foot of a fore-and-aft sail.

Shroud: a rope or wire support used to steady a mast to the side of a hull. They lead from the masthead to the sides of the vessel, to support the mast athwartships.

Deadeyes, pulley blocks and halyards: halyard is a line used to hoist and lower a yard and sail/ deadeye; a thick disk of hard wood, strapped with rope or iron, through which holes (usually three) are pierced for the reception of lanyards. They are used as blocks to connect shrouds and chain plates.

Fore-and-aft rigging: sailing rig that consists of sails set along the line of the keel, rather than perpendicular to it. Fore-and-aft rigged sails include stay sails, Bermuda sails, gaff sails, gunter rig, lateen sails and lug sails.

Evidence from South-East Asia indicated the use of fore-and-aft sails of unspecified form, set on two or more masts since third century at the latest (McGrail, 2001, pp. 309). The canted rectangular sail first appeared in the eighth or ninth century and continued to be in use until recent times. From at least the sixteenth century they were matted or made from woven rattan (Manguin, 1980, pp. 272).

Gaff rigged sails: this kind of sail is four cornered, fore-and-aft rigged and hoisted at the head by a gaff. The sail's upper edge is supported is by a spar (pole) called the gaff. The gaff enables the sail to be four sided, rather than triangular.

Gunter rig: similar to a gaff rig, except that the spar forming the gaff is hoisted up to an almost vertical position, extending well above the mast.

Lateen sail: triangular sail set on a long yard, mounted at an angle on the mast (very characteristic of Arabic civilization).

Lugsail: a four sided fore-and-aft sail, supported along the top by a spar and fixed to the mast at a point some distance from the centre of the spar.

Square sails: primary driving sails that are carried on horizontal spars, which are perpendicular or square to the keel of the vessel and to the masts.

Battened sail: is a type of sail where rigid members, called battens, span the full width of the sail and extend the sail forward of the mast. They appear to have been mainly, if not exclusively Chinese, from the twelfth century onwards.

Canted rectangular sail: one of the most primitive forms of fore-and-aft sail is the rectangular Indonesian canted (tilted) sail which is rectangular in shape.

Patent reefing gear: is a manoeuvre that facilitates the reefing of the sail (Paris 1942, pp. 395). A cross handle on the guy enables the crew to roll down the sail. This feature may originate from Indonesia, where sails made of palm are more easily lowered by a simple turn of the handle, which winds the foot of the mainsail onto the boom (Pietri, 1943, pp. 7).

8 Accessories and Other Related Terminology

Balance board: consists of a plank laid athwartships and projecting a considerable distance out to either side. It can be connected with outrigger boats and can provide stability to crafts that are otherwise too narrow or unstable, to attempt long voyages.

Anchors: there are three main types of anchors found in South-East Asia, each corresponding to a different period of time (see Kimura *et al*, 2011).

Stone weight anchors are often little more than a simple stone weight with a hole for the anchor line. Compound anchors are made of a wooden body and one or two stone stocks. The compound anchors can also be sub-divided into two groups: anchors with a single stone stock and anchors with two separate stone stocks. Both feature a stone stock in the middle of the shank (Kimura *et al*, 2011, pp. 365). 'Compound anchors became prominent during the Song to the Ming Dynasties (960-1644 CE) and compound anchors with both separated and non-separated stocks coexisted throughout the thirteenth century'. The compound anchor was gradually replaced by anchors with a round wood (or possibly iron) stock placed lower in the shank. Usually compound stone stock anchors are formed by a minimum of four elements: the shank (shaft of the anchor), the arms that end with flukes (or palms, that are pointed or chisel shaped and are designed to dig into the seabed) and by a stock. The stock is the crossbar at the top of the shank, positioned at right angles to the arms. Evidence for iron grapnel anchors is also found in Asia and South-East Asia during the same period. It is generally understood that seafarers along the northern Chinese coast preferred iron grapnel anchors, while wooden variants were the anchor of choice along the country's southern coast (Kimura *et al*, 2011, pp. 370).

Windlass: is a horizontal cylinder supported by bitts or brackets, used to haul anchors and hawsers.

Length Overall: often abbreviated as (LOA, o/a, o.a. or oa). This measurement refers to the maximum length of a vessel from two points on the hull, measured perpendicular to the waterline.

Overall lengths can vary enormously depending on the type of vessel. A small coaster or fishing vessel from the coast of Viet Nam reaches a length of between 10 to 25 meters, while the Javanese jongs of the sixteenth century had a length of about 50 meters. In comparison, the treasure fleet of Zeng He had a length that supposedly reached 125 meters.

Loaded Waterline Length (LWL): or the waterline length, is a measurement that denotes the length of the vessel at the point where it sits in the water. It isn't equal to the total length of the boat as it excludes various parts of the vessel, such as features that are out of the water. Most boats rise outwards at the bow and stern, so a boat may be quite a bit longer than its waterline length. This measurement is essential in determining many of the vessel's properties, such as how much water it displaces, where the bow and stern waves are, hull speed, amount of bottom-paint needed, etc.

Breadth or beam: the width at the widest point. This can also vary depending on the type of vessel. A small boat has a beam of 5 meters, while the treasure fleet of Zeng He supposedly had a beam that reached up to 50 meters.

Displacement: refers to the ship's mass when it is loaded to its maximum capacity. A ship's displacement is its mass, generally expressed in metric tonnes or long tons. Using the same examples, a small boat has a tonnage of 25 to 100 tons, while the Javanese jongs of the sixteenth century had an average burthen of about 300 to 500 tons. In comparison Zeng He's ships had a displacement that could supposedly reach 1,500 tons.

Net tonnage: often abbreviated as NT, N.T. or nt. Is a calculated representation of the internal volume of a ship's cargo hold. It is expressed in tons, which are units of volume defined as 100 cubic feet.

Draft (draught) and drag: the draft is the depth to which the hull is immersed (the vertical distance between the waterline and the lowest point of the hull), while the drag is the difference between the draft of a vessel's stern and it's bow.

Expressing distances and speed: Distance at sea is always measured in nautical miles. Speed at sea is measured in nautical miles per hour called knots.

1 nautical mile = 1.85 km

0.1 nautical mile = 100 fathoms = 200 yards

20km/h = 10.8 knots

9 Boat Constructions

Boats are built using different construction sequences which vary from region to region. Often boats in Europe are built frame first, while in South-East Asia, boats are often built shell first. It is, however, not possible to generalize from region to region.

Frame first/skeleton built: as the name suggests, the skeleton of the vessel is built first, which means the framework of keel, posts, and frames is set up and fastened before the planking is fashioned.

Shell first/plank first: process by which all or part of the outer hull planking is erected before the frames are attached to it. In pure shell built hulls, outer planking is self-supporting and forms the primary structure; the framework fastened to it forms the secondary or stiffening structure.

It seems that in South-East Asia, there is a predominance of shell first constructions over frame first, despite shell first being more difficult to achieve as it requires advanced skills, due to the finer tolerances that need to be maintained.

Clinker/reverse clinker: a way of setting the planks so that the outer planking overlaps and is fastened to the plank immediately below it. When planks overlap with the ones above them the procedure is known as reverse clinker. This method is seen notably in Bangladesh (McGrail *et al*, 1999).

Carvel planking: means that the seams are smooth or aligned, as opposed to clinker built.
Northern European scholars reserve 'carvel built' for frame first forms of constructions. Note that this term is confusing and best avoided, as it is sometimes taken to be synonymous with frame first building using flush-laid strakes (McGrail, 2001, pp. 467).

Flush-laid: planking in which adjoining strakes are butted edge-to-edge without overlap.

To caulk: is an essential phase in boat construction. It consists of inserting material between two members and rendering the junction watertight. Whether this is done before or after planking is fastened, may be an important diagnostic trait (McGrail, 2001, pp. 467). Caulking materials and recipes are essential in identifying the available materials to a shipbuilder.

10 Joining Methods

Iron nails: are used to fasten the planks, edge to edge. The use of iron nails for fastening the planking is a major difference between the Chinese and the South-East Asian shipbuilding traditions. Nails appear with the Portuguese in Indian traditions (late fifteenth century).

Bolt: a cylindrical metal pin used to fasten ships timbers together.

Treenails: (pronounced 'trunnels') are round or multisided pieces of hardwood, driven through planks and timbers to connect them. They are used in a variety of forms: with expanding wedges or nails in their ends, with tapered or square heads on their exterior ends, or completely unwedged and unheaded. When immersed, treenails swell to make a fit.

Tenon and mortise: a tenon is a wooden projection cut from the end of a timber or a separate wooden piece that is shaped to fit into a corresponding mortise (a cavity cut into a timber designed to receive a tenon).

Pegs: are tapered wooden pins driven into a pre-drilled hole to fasten two members or lock a joint. Pegs come in a variety of sizes and tapers: square, round or multisided cross sections. The important difference between dowels and pegs in ancient construction is that the former were of constant diameter and lightly set, while the latter were tapered and driven with appreciable force. The most common use of pegs in ancient construction was to lock mortise and tenon joints.

Wooden dowels: are cylindrical pieces of wood (of constant diameter) used to align two members by being sunk into each. Unlike treenails and pegs, dowels served an alignment function only, additional fastenings being necessary to prevent separation from the joint.

Scarf: an overlapping joint used to connect two timbers or planks without increasing their dimensions.

Lashed lugs and stitching method: there is a difference between stitched boats and sewn boats. Many examples of stitching can be found in South-East Asia. For example, in Viet Nam three techniques are described in the written accounts, yet the main principle remains the same. Essentially, holes are drilled in the planks through which threads pass to lash the planks together. A pad is placed on the seams, ensuring that the hull is water tight. Bamboo laths are then laid longitudinally over the pads. Flat wedges are inserted between them and the straps, overlapping each other like tiles, in order to compress the pad. The gaps are then sealed with a mix of tree bark and coal tar or mangrove bark, or a compound of resin and ground bamboo. The holes can be made in different ways (see Manguin, 1985).

The most common South-East Asian ship building technique is known as the 'lash-lug tradition', which is when lugs or cleats protrude and the lashing is fastened around them. Treenails support the fastening by maintaining the strakes edges to edge (see the Pontian boat, dated to between the third and fifth century). This technique evolved towards the later typical South-East Asian technology, where only wooden pegs maintain the strakes together, fully dowelled.

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The Protection of the
Underwater Cultural Heritage

APPENDIX C

Author Christopher J. Underwood

Introduction to Metal Shipbuilding Technology

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APPENDIX C

Contents

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Author Christopher J. Underwood

Introduction to Metal Shipbuilding Technology

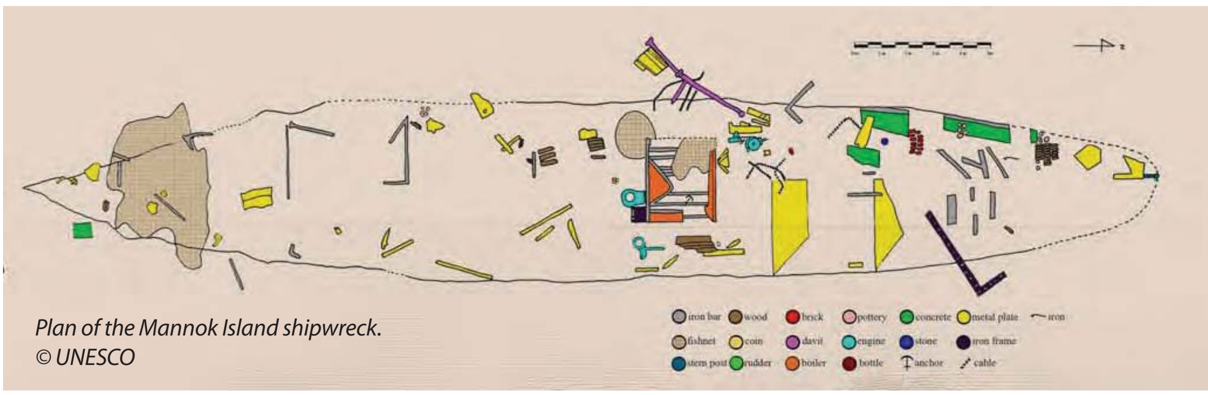
Core Knowledge of the Appendix

On completion of the Introduction to Metal Shipbuilding Technology appendix students will:

- *Understand the various factors that influence the design of vessels*
- *Understand how vessels gradually evolved from wood to metal and from sail to steam in different geographic regions*
- *Have knowledge of the terminology and function of the main structural components of metal ships*
- *Have knowledge of the terminology and function of the propulsion system of a metal steamship*
- *Have knowledge of the terminology and function of deck fixtures and fittings*
- *Understand how nautical terms are a technical language*
- *Understand how a shipwreck can be identified by the study of its structure*
- *Understand how a metal shipwreck's structural integrity will deteriorate at varying rates according to the site's environmental conditions*
- *Have knowledge of where and in what condition, structural components, fixtures and fittings are commonly found on wreck sites*

Introduction to the Appendix

This appendix provides students with sufficient knowledge of metal shipbuilding technology to enable an assessment of the Mannok shipwreck site *(see Additional Information 1)* and is in addition to Unit 14: *Asian Shipbuilding Technology.*



Plan of the Mannok Island shipwreck.
© UNESCO

This appendix assumes that students have a low level of prior knowledge of the subject and is therefore aimed at providing an introduction to metal ship construction, propulsion, fixtures and fittings.

Although some components referred to, such as the lower structural features, (keel, keelson, floors and the propeller) are not currently visible on the Mannok wreck site they are fundamental parts of a metal steam powered vessel and so are included.

1 Metal Ship Construction

For the purposes of the Foundation Course, students require the knowledge to:

- *Identify, interpret and assess the condition of the main structural components of the Mannok shipwreck including parts of the propulsion system and other fixtures and fittings*
- *Recognize and interpret the cultural objects that form part of the site, plus other material that although forms part of the wreck site, is not an original part of the site.* (See *Additional Information 2*)

To place the content in a cultural heritage/ archaeological context, and although Unit 14 has covered these topics, this lecture also reminds students that the same relationships apply to metal shipwrecks:

- *How the relationships between factors such as ideology, technology, tradition, economy, use, climate and materials, influence the construction of (metal) vessels*
- *The importance of studying material cultural remains from different perspectives, including historical, technological and social*
- *The transition from wooden to metal vessels is not the same in all geographic regions* (See *Additional Information 3*)
- *In common with wooden vessels, metal vessels are designed for specific purposes, for example, war and trade and fishing, but within these categories there is a large variety of shape, size and design*

ADDITIONAL INFORMATION

1 The assessment forms part of the development of a management plan for the wreck site, as well as providing information for the storyboards in Unit 16: *Museology*.

2 Within the wreck site there are numerous objects associated with fishing, including small clusters of rocks roped together or in small nets to form anchors or net weights, larger fish traps, as well as detritus such as bottles, cans, plastics, etc.

3 Transition from wood to metal and from sail to steam. These factors are particularly important for courses in other geographic regions where there might be different traditions.

This is illustrated using the example of copper nails in the Bronze Age wreck Kyrenia and the use of iron fastenings in predominantly wooden constructed European vessels, dating from the fifth century AD. (See Suggested Reading: Milne, G. McKewan. C. and Goodburn, D. (1998). This then evolves into the use of more substantial structural ship components, such as iron knees from the seventeenth century (See Suggested Reading: Goodwin, P. 1997), iron-clad steam powered vessels in the mid-nineteenth century, to the metal steam powered vessels characteristic of the late nineteenth and early twentieth century.

As this appendix is part of the preparation for the fieldwork, it is important that trainers explain and illustrate to what extent components can be expected to survive in a typical wreck site. (See *Additional Information 4).*

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2 Description of the Main Structural Features

In relatively simple terms a ship can be considered a box that is strengthened by numerous parts that join, brace or provide support. The strength of the box is dependent on each of these individual components, noting that some parts are more important than others in keeping the vessel afloat and is only as strong as its weakest component. (See *Additional Information 5).*

LEFT: *The badly eroded bow section of the Mannok Island shipwreck. © UAD, Thailand*

ADDITIONAL INFORMATION

4 Deterioration of wreck material. The survival and rate of change is dependent on a number of factors:

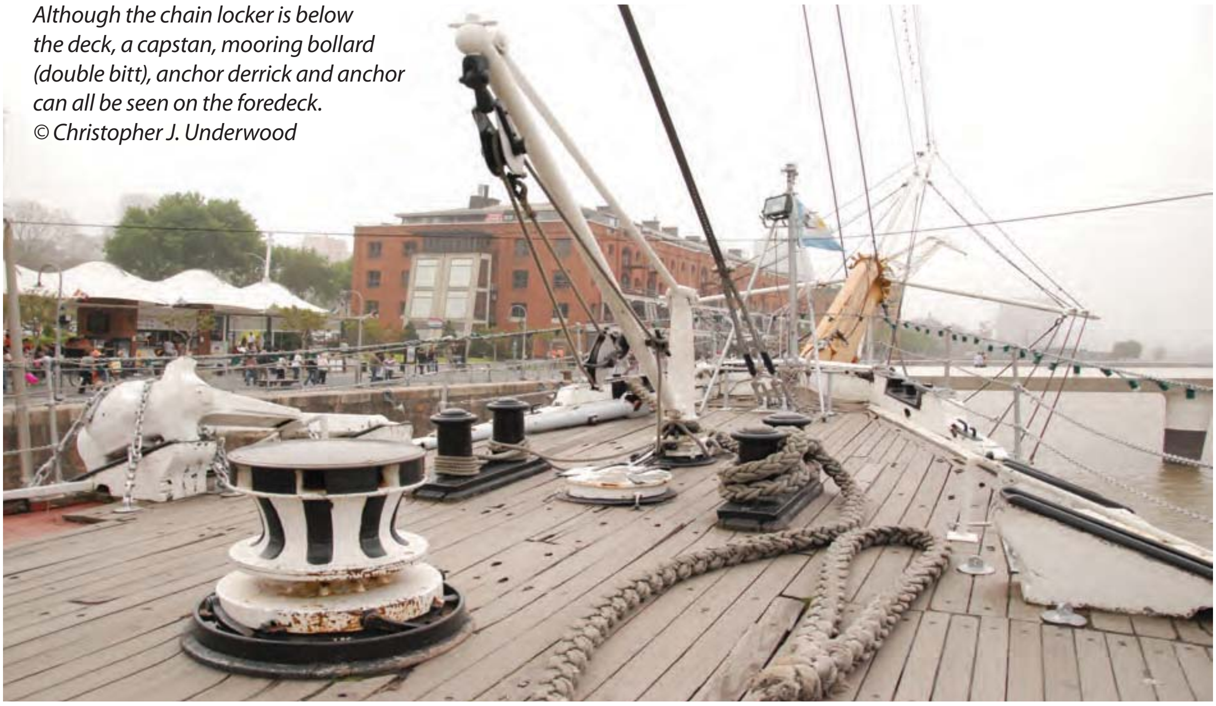
- The length of time underwater
- Dynamic nature of the sinking
- Human impacts to the site, such as salvage and fishing

Combined with the site's specific environmental characteristics, such as:

- Salinity
- Temperature
- Oxygenation
- Light
- Marine growth
- Water movement
- Burial by sediments

NB. This description is aimed at stating that ferrous metal objects will usually be more corroded and, therefore, are less easily recognizable than non-ferrous objects. It is not a detailed explanation of the physical, biological or chemical processes, which are covered in considerable depth in Unit 11: *Finds Handling and Conservation.*

5 The aim of a nautical architect is to design a vessel that is 'fit for purpose' and to be economical in the use of materials in its construction and conform to regulations.



Although the chain locker is below the deck, a capstan, mooring bollard (double bitt), anchor derrick and anchor can all be seen on the foredeck.
© Christopher J. Underwood

Bow: the forward part of a vessel's hull.

Other ancillary parts of the ship and equipment associated with the bow include: the chain locker, anchors, anchor chain, hawse pipe(s), cargo derrick, capstan(s), windlass, and mooring bitts.

Forecastle: is often where the crew's cabins are located and can be defined as the section of the deck that is forward of the foremast (if one is present).

Stem: the leading part of the bow. It is joined to the keel and rises to the forecastle.

Stern: the rear part of a nineteenth century vessel's hull that includes the stern frame, steering gear, rudder and propeller.

Stern frame: consists of the rudder post, body post and connecting arch, with an extension for the connection to the keel.

TOP RIGHT: The bow section of a late nineteenth century vessel's hull. © Christopher J. Underwood

MIDDLE RIGHT: Stern of a nineteenth century vessel showing the stern frame arch and top of the rudder.
© Christopher J. Underwood

RIGHT: Stern frame arch and the top part of the rudder on the Mannok Island shipwreck. © UAD, Thailand

From left to right, ship's navigation compass, ship's wheel and telegraph. © Christopher J. Underwood

Ship's bridge. © Christopher J. Underwood

Other parts of the vessel and equipment associated with stern include: the steering gear, propeller, capstan(s), windlass and mooring bitts.

Rudder: hangs on the stern frame by hinges which are formed by two parts, pintles and gudgeons. The weight of the rudder is normally supported by the lower gudgeon.

Gudgeons: attached to the stern frame or can be cast or forged as an integral part of it.

Pintles: part of the rudder assembly.

Middle or midship: the remaining portion of the hull between the bow and stern sections. Usually a more rectangular box shape containing components such as the cargo holds, fuel and water tanks, boilers, engine room. On the upper deck are located the cargo hatches, cargo winches, bridge and smaller fitings, such as scuppers (fittings that allow excess water to run off the decks) that often survive on shipwrecks.

Keel: is located along the exterior centre line of a vessel's hull between the stem and stern frame. The keel can have a flat profile known as a flat keel plate or it can be a distinct rectangular shaped section, known as a bar keel.

Keelson: the corresponding reinforcement plate or beam that is located down the interior centreline of the vessel between the stem and stern. The keelson is fixed to the transverse structural components, such as floors.

Floor(s): vertical plates that extend laterally across the vessel from the keelson to where the ship's hull begins to form the side of the vessel, providing latitudinal strength to the structure.

Frame(s): formed from angle bars that rise upwards from the floors to the gunwhale (normally the upper edge of the side of the vessel, on the upper deck). Frames are located along both sides of the vessel from stem to stern and are also commonly known as the 'ribs' of a vessel.

Side keelson(s): perform a similar function to the keelson, but are located parallel to the centre keelson.

Bilge keelson(s): similar to side keelsons, but they curve upwards and inwards following the shape of the bow and stern.

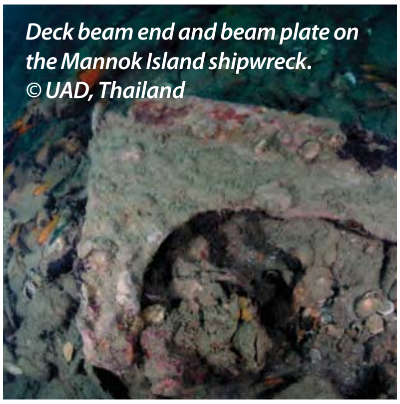
Stringer(s): angle bar fixed along the interior longitudinal axis of the vessel's hull, usually riveted or welded to the frames.

TOP: Floor section of a steamship wreck. © Christopher J. Underwood

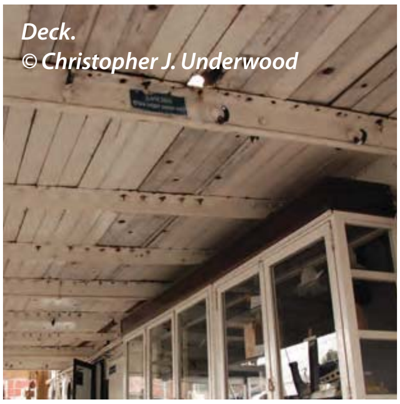
MIDDLE: Frames and deck beams. © Christopher J. Underwood

LEFT: © Frames of the Mannok Island Shipwreck site. © UAD, Thailand

Deck beams. © Christopher J. Underwood



Deck beam end and beam plate on the Mannok Island shipwreck. © UAD, Thailand



Deck. © Christopher J. Underwood

Pillars supporting the main deck of the SS Sarmiento. © Christopher J. Underwood

Deck beam(s): placed transversally across the vessel, they prevent the frames spreading outwards and also support the decks. They are riveted or welded to the ship's frames on the side of the vessel.

Beam knee(s): end section of a beam that allows it to be attached to the frame. They can be an integral part of the beam or as is the most common method, a separate piece (built knee) that is riveted or welded to the beam and frame.

Deck(s): constructed from flat metal plates (or wooden planking) that lay over the beams. There can be one or more decks depending on the size and purpose of the vessel.

Pillar(s): hollow or solid vertical posts that provide support for the deck(s). Where a central pillar is fitted, it will significantly increase the load capacity of the deck.

Small section of a deck or walkway in the engine room of the Mannok Island shipwreck. © UAD, Thailand

Bulkhead(s): longitudinal or transverse partitions that divide the vessel into compartments and can be made watertight to prevent flooding from spreading throughout a vessel.

Plating: forms the exterior shell of the hull, cabins partitions, decks and bulkheads. The plating is riveted or welded to structural components, such as frames and beams.

Riveting: the traditional method for joining the various components of metal ships prior to welding. Most joints are made by overlapping plates to form a lap joint.

There is archaeological evidence of riveting that dates to the Bronze Age in the construction of daggers (See Useful Websites: Portable Antiquities Scheme 2011).

Watertight bulkhead (across the beam of the vessel).
© Christopher J. Underwood

ABOVE LEFT: Riveted hull construction.
© Christopher J. Underwood

ABOVE MIDDLE: Riveting pattern of an overlapping hull plate joint.
© Christopher J. Underwood

ABOVE RIGHT: Butt strap riveted joint of non-overlapping hull plates.
© Christopher J. Underwood

RIGHT: Hull plating of the Mannok Island shipwreck. © UAD, Thailand

Welding: a heat process that joins two pieces of metal together.

Welding was increasingly used during the First World War and became the predominant construction method as the twentieth century progressed. The *Fulegar,* built by the British shipbuilder Cammell Laird in 1920, was the first vessel with an entirely welded hull, and more than 2,700 Liberty ships of the Second World War were constructed fully utilising the process. As the riveting process absorbed a third of a vessel's production budget, replacing riveting with welding significantly accelerated the construction process and reduced labour costs.

Propulsion: The major components of a steam vessel's propulsion are found in the following order from bow to stern: boiler, engine, drive shaft, propeller and rudder.

NB. The engine and boiler can be positioned in the midship or stern sections depending on the size and function of the vessel.

Boiler(s): generate steam power that drives the engine(s). There can be single or multiple boiler units.

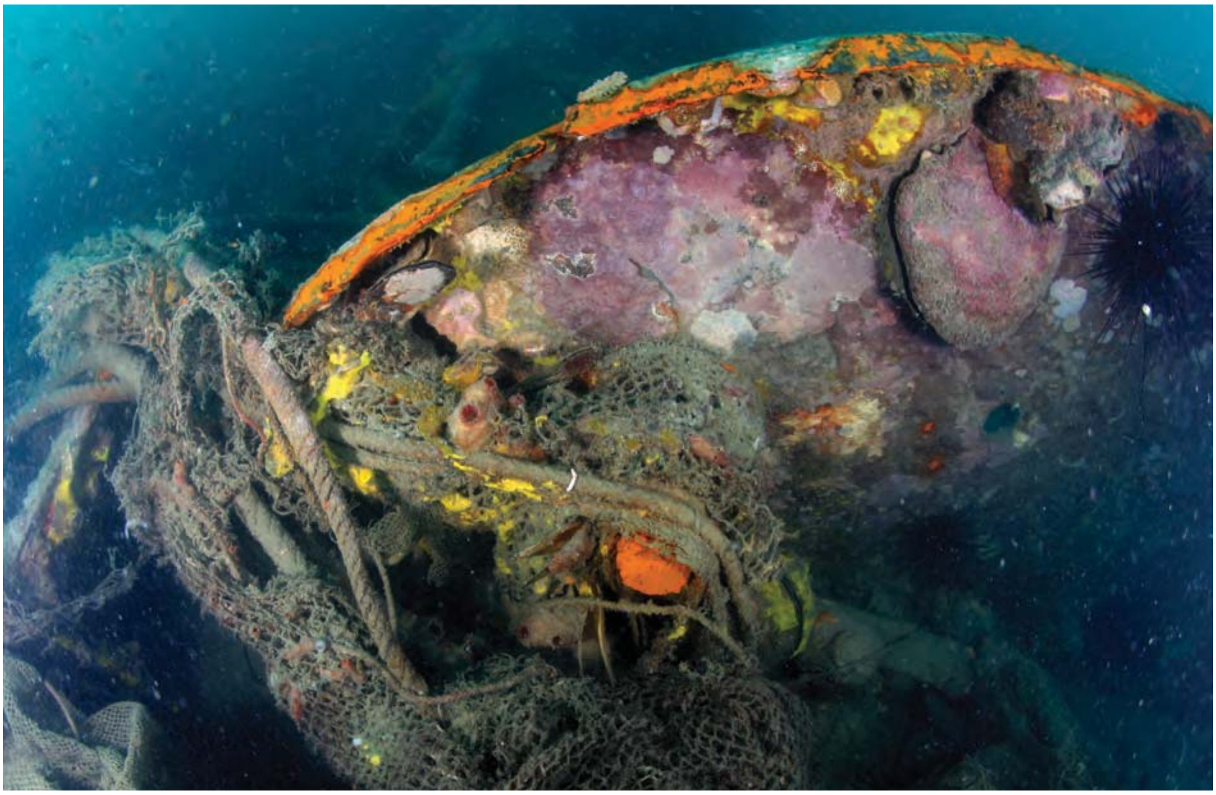
Although boilers with a similar design to the Scotch boiler appeared around 1830, it was the Scotch boiler that became the most common from the 1850s to the 1920s and can still be found in use today.

Steam engines: suitable for commercial (industrial) use and were first produced in 1712 by Thomas Newcomen. The original design was improved by James Watt between 1763 and 1775, but it was the emergence of the high pressure steam engine in the early 1900s that resulted in a rapid expansion of the use of steam power.

ABOVE AND BELOW: Front and starboard side views of a steam (Scotch) boiler. © Christopher J. Underwood

A section showing the steam pipes from a broken boiler. © Christopher J. Underwood

Damaged boiler on the Mannok Island shipwreck. © UAD, Thailand



Trunk engines: were common in warships as they could be installed horizontally below the waterline and therefore, be protected from gunfire.

HMS *Warrior* (1860), for example, is a single large capacity piston, mounted transversally across the vessel. It provided 1250 nhp (nominal horse power) giving 14.3 knots, with a maximum of 17.5 knots combining wind and steam.

A high powered version of the trunk engine was recovered in 1985 from the wreck of *Xantho* (1872) discovered in Australia. The engine had originally been designed for use in Crimean gunboats and was installed in the *Xantho* in 1871. The use of trunk engines began to decline with the introduction of higher pressure expansion engines in the second half of the nineteenth century.

Compound engine: the design was originally patented by Arthur Wolf in 1804. There are various claims about the invention of the marine compound engine and its first use that range between 1824 and 1850.

Double expansion or compound engines reduce the steam pressure in two stages, making them more powerful than earlier engines that only utilized the steam once. Although the name implies that they have two cylinders, these engines can have more than one operating at the same pressure, reducing to one or more at a lower pressure.

Triple expansion engine: is a compound engine that reduces the steam pressure in three stages. Each stage can have multiple cylinders.

The first multiple expansion engine was patented by Daniel Adamson in 1861. Triple expansion engines remained in widespread use from the 1880s until the middle of the twentieth century. These engines powered more than 2,700 Liberty ships during the Second World War and there are examples of working historical vessels continuing to be powered by the triple expansion engines, such as the SS *Shieldhall*.

The triple expansion engine of the *Fragata Sarmiento* (1893) produced 1800 horse power at 100 revolutions per minute, giving a maximum speed of 13 knots.

Other engine room components include the condenser, pumps, valves, auxiliary engines, gauges and many sections of steam pipe that join various components of the propulsion system.

Drive shaft (or propeller shaft): a cylindrical tube linking the engine to the propeller. The shaft passes through a watertight gland between the internal to the external part of the hull.

Thrust block or box: is a substantial metal component that is located on the drive shaft. The thrust block transfers the power of the propeller to the hull to prevent damage to the drive shaft.

Propeller(s): the origin of which is credited to Archimedes, is located at the end of the drive shaft and changes the rotational movement of the shaft that propels the vessel forwards, or backwards (if the movement of the drive shaft is reversed). They can have two, three, four or sometimes even more blades, which can be made from cast iron or bronze.

Steering gear: equipment for moving the rudder.

Drive (propeller) shaft. © Christopher J. Underwood

Thrust block (box). © Christopher J. Underwood

Two-blade bronze propeller. © Christopher J. Underwood

BELOW: *Boat davits. © Christopher J. Underwood*

Davit(s): used to lower or raise a ship's lifeboats.

Derrick(s): located on the upper deck. Used for loading and unloading cargo from the cargo holds or moving equipment.

Pump(s): used to remove unwanted water from a ship's hull and to improve stability by transferring water from one part of a vessel to another.

Ship's pump. © Christopher J. Underwood

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Appendix Summary

It is important to recognize that this appendix is aimed at providing sufficient information to enable students to carry out an assessment of the wreck site that is then used in the development of a management plan. The additional information is provided to place the content in an archaeological or historical perspective and is not intended to be a detailed study of naval architecture.

Suggested Timetable

The information provided by this appendix can be presented in three parts; two in the classroom prior to the diving project, with the third part during the fieldwork.

10 mins	Introduction to Metal Shipbuilding Technology - *The various factors that influence the design of vessels* - *How vessels gradually evolved from wood to metal and from sail to steam in different geographic regions*
40 mins	**Part 1: Lecture** - *Terminology and function of the main structural components of metal ships* - *Terminology and function of the propulsion system of a metal steamship* - *Terminology and function of deck fixtures and fittings* - *Technical language concerning nautical terminology* - *Demonstration of how a shipwreck can be identified by the study of its structure* - *Discussion of how a metal shipwreck's structural integrity will deteriorate at varying rates according to the site's environmental conditions* - *Illustration of the condition of structural components, fixtures and fittings that are commonly found on wreck sites*
30 mins	**Part 2: Knowledge Review** - *Class participation session using an existing example drawing of a typical steamship. Students will be asked to list out main features of the vessel from the drawing.*
10 mins	Concluding Remarks and Closure

Part 3: Practical Assistance to help students understand and interpret the various features found on the wreck site, provided as required during the field project.

Teaching Suggestions

The information on ship construction is kept at a generic level to avoid students becoming overwhelmed with the nautical terms and complexities of metal ship design.

Due to the commonality of many metal and wooden ship component names, trainers should highlight those parts of metal ships where there is overlap with wooden vessels introduced in Unit 14: *Asian Shipbuilding Technology* and its appendices

Useful Websites

- *HMS* Victory*:* ***www.hms-victory.com*** *(Accessed November 2011).*
- *HMS* Warrior*:* ***www.hmswarrior.org*** *(Accessed November 2011).*
- *Liberty Ship* Jeromiah O'Brien*:* ***www.ssjeremiahobrien.org*** *(Accessed November 2011).*
- *Portable Antiquities Scheme: use of riveting during the Bronze Age* ***finds.org.uk/database/artefacts/record/id/276077*** *(Accessed November 2011).*
- *SS* Xantho: ***museum.wa.gov.au/broadhurst/xantho-Shipwreck*** *(Accessed November 2011).*
- *SS* Shieldhall: ***www.ss-shieldhall.co.uk/Shieldhall/Technical.html*** *(Accessed November 2011).*

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The Protection of the
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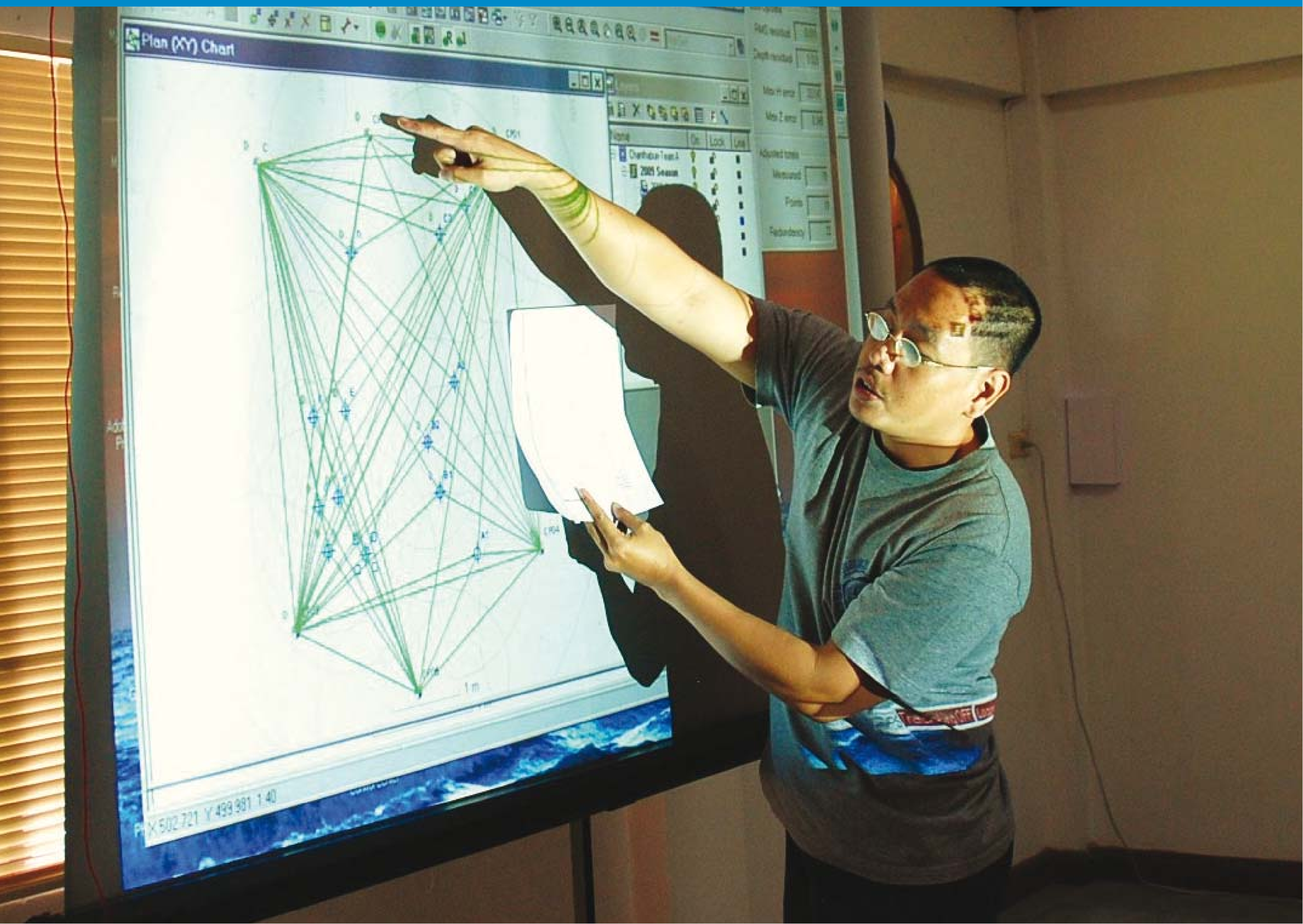
APPENDIX D

Author Peter R. Holt

How to Use Site Recorder



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APPENDIX D

Contents

APPENDIX D

Author Peter R. Holt

How to Use Site Recorder

Core Knowledge of the Appendix

This appendix introduces students to using Site Recorder in preparation for the practical dive session in Unit 12.

Upon completion of the How to Use Site Recorder appendix student will:

- *Be able to understand the scope of Site Recorder*
- *Be able to use Site Recorder to complete a site survey project*

Introduction to the Appendix

Although Site Recorder is a multi-featured and versatile Geographic Information System (GIS) specifically designed for use in underwater and coastal archaeology, it was chosen for the Foundation Course to primarily fulfil its function as a tool for processing, storing and displaying survey data.

During Unit 2: *Back to Basics: Introduction to the Principles and Practice of Foreshore and Underwater Archaeology,* students have the opportunity to practice 2-dimensional survey techniques and are shown how to transfer the results to paper by using scale rules, drawing compasses and pencils. Following this, students are instructed in the use of the Site Recorder and shown how the same tasks (and much more) can be achieved using an alternative 'computer' method.

Students can practice using the software by downloading the demo version from 3H's website, which enables most of the tools to be used or by utilizing the licensed copy held by the training centre.

During the practical diving session students have the option to use the application for storing site information, dive logs and survey results that contribute to the development of the management plan and site plan.

The following appendix, which should be read in conjunction with Unit 7: *Data Management in Maritime and Underwater Archaeology*, has been included as a teaching resource so that trainers can familiarize themselves with the software. However, trainers should note that there are other options and the ultimate choice of which to use is their own decision.

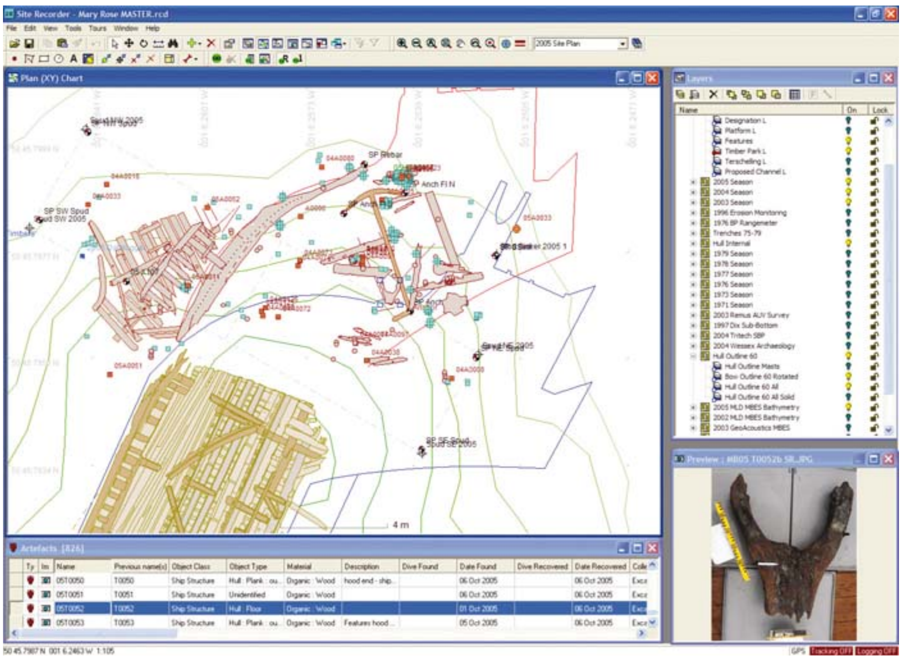
1 Site Recorder

Site Recorder can store and manipulate different categories of data collected on site and is an ideal practical tool for supporting the dive teams working on the Mannok wreck site. All of the captured data can be processed, stored and used to support the development of the management plan and the site plan during the practical dive session.

The typical applications for Site Recorder include:

- *Resource evaluation and management*
- *Site survey planning and recording*
- *Geophysical survey post-processing*
- *Search planning and post-processing*
- *Excavation planning and recording*
- *Archiving site data*
- *Site publication and reporting*

Once all of the information about a site is captured in a 'site file' it can be used as a basis for creating reports or exported for further processing in other programs. Complete sites and associated image and source files can be published on CD or DVD, along with a free reader program called Site Reader. As the entire site information can be held in one place and linked together, this also forms an ideal method for archiving site data.



A typical screenshot from Site Recorder shows the site of the Mary Rose, with the main section of the hull shown in the lower part of the image.

The more recent discoveries associated with the bow sections are shown in the upper part of the image.
© Peter R. Holt

Suggested Reading

Bowens, A. (ed.). 2009. *Underwater Archaeology - The NAS Guide to Principles and Practice*. Second Edition. Blackwell Publishing.

2 Object Types

Artefact: the Artefact object is used to record information about a single artefact or find. All of the information about that one find is recorded within one single object.

Feature: Feature objects are used to record features and contexts found on the site. Features are commonly used to record information about concretions that contain other Artefact objects.

Sector: Sector objects are used for defining an area of the site, such as a trench.

Sample: Sample objects are used to record information about samples taken for environmental evidence or type identification. Environmental samples can give clues about the potential survival of artefacts and the detail of an object's burial environment can give clues to the conservation required.

Survey Point: Survey Point objects are used to represent the control survey points and detail survey points used for positioning on site.

Measurement: individual measurements made between survey points are recorded in separate Measurement objects. Supported measurement types include distance, depth, offset, ties, radial and position.

Image: Image objects are used to record information about any object including photographs, drawings and video clips.

Image Basemap: Image Basemap objects are used to record information about base map pictures such as side scan sonar traces, georeferenced multibeam echo sounder (MBES) images, scanned site plans or photo-mosaics.

Dive Log: dive logs are used to record information about dives. They are often used to tie together objects that have been recovered with location information.

Contact: Information about people associated with the site, such as archaeologists and divers can be recorded in Contact objects

Event: Event objects are used to record things that have happened on site or to the site, such as survey work, excavations and site assessments.

Source: Sources such as documents, reports and letters can be recorded, along with a link to the source if available in a digital form.

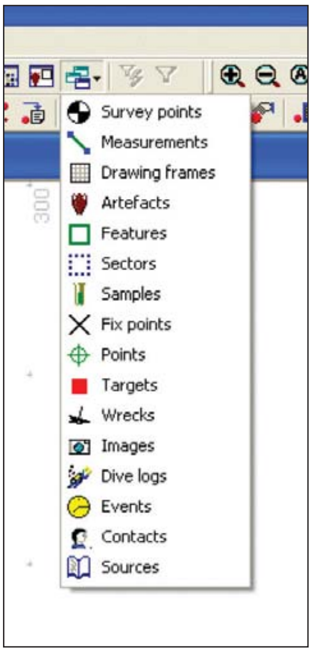
Target: Target objects are used to record positions and information about items found during a geophysical survey.

Wreck: information about known shipwrecks and reported wrecks can be recorded in a Wreck object.

Logbook: logbooks can used to record day to day events, ideas, interpretation and thoughts as text documents.

Drawing Object: Drawing objects include points, lines (polylines), rectangles, circles and text. Drawing objects can be used to draw such things as maps, trench outlines, contours and artefacts.

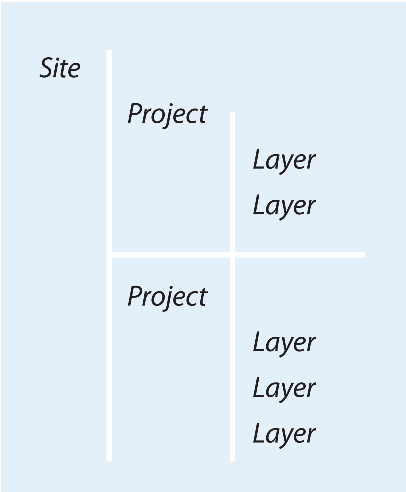
List of 'objects' supported by Site Recorder.
© Peter R. Holt



3 Object Hierarchy and Metadata

As well as recording information about objects encountered in a site archive, the schema also specifies ways of grouping objects into hierarchies and ways of defining relationships between objects. This allows the data to be ordered in a structured manner, making it easier to evaluate and navigate through the archive. Generally the grouping is ordered by object type. Stratigraphic grouping is made feasible with all georeferenced objects by the specification of position and orientation for each object.

The schema objects that define hierarchy include the Site, Project and Layer. A Site can contain a number of Projects and each Project can contain a number of Layers. The Layers are used to contain georeferenced objects, such as Artefacts and Survey Points.



The Site is the main object that represents the ship, monument or structure being recorded. The Site contains one or more Project objects which are usually used to group together data from individual seasons, or from self-contained sets of work, such as a geophysical survey. Each Project can contain one or more Layers. The Layers are used to collect together objects that are associated with each other, most usually by type.

The objects are brought together into collections or families which can be 'owned' by another object. This grouping is a useful way of collecting together similar objects or ones related to each other. The hierarchy of objects forms a 'tree' shape, with the Site at the root of the tree and all the many other objects branching out from it.

Information relating to the site as a whole is also contained within the site object. This includes archive version metadata based on the Dublin Core and geodetic information.

4 Data Management Using Site Recorder

It is necessary to identify the tasks that need to be completed at each phase of the project. From a data management perspective, the project phases include:

- *Project start-up*
- *Pre-fieldwork planning*
- *Fieldwork*
- *End of fieldwork*
- *Post-fieldwork*
- *End of project*

The planning of the project is done before the fieldwork season has started.

4.1 Project Name

The first step is to give the project a name. Try to avoid names that have been used before, those that are supposed to be humorous or are just too long.

4.2 Location

The next step is to decide on the coordinates of a central location for the work and the extents of the area to be investigated. When the project is centred on a known site this is relatively straightforward, as the position of the site will be known and an estimate of the size can be made. For a project that involves searching for a site, a planned search area has to be defined.

At this point it is important to decide on the coordinates to be used for mapping. Positions can be recorded using your own coordinates local to that site or in real-world coordinates taken from a Global Positioning System (GPS). In the short term it may seem easier to set up your own local grid coordinate system, but this becomes a problem if you want to integrate charts, aerial photographs or geophysical survey data.

Unless this has already been defined for you by the client, the next step is to decide which real world coordinate system to use. In general, it is better to utilize a commonly used coordinate system than something specific, defined for the local area. Often, mapping should be done using the WGS84 datum, as it is a common standard used by GPS receivers and the Universal Transverse Mercator (UTM) projection.

If the site to be recorded is a shipwreck, then it should be possible to add a Wreck object at the best estimate of position for the site. Information about the wreck can then be added to the Wreck object. For other site types a simple Point object can be used to mark its position.

4.3 Site Code

Although not essential at this stage, it is useful to define a code for the site; a unique identifier that is used to distinguish the site you are working on.

4.4 Sharing and Archiving

As soon as the Site file has been created for a project it is important to consider how and where the files will be archived, and the ownership of the information.

Archiving may not seem important in the early stages of a project, but as the information contained within the Site file grows, it becomes essential. Ensure that the archive is backed up on DVD or external hard drive and that copies are made after each significant addition to the archive.

Ownership of the information needs to be decided. Allocate who is to get a copy of the archive and ensure that they get an updated copy after each significant addition to the archive.

Also ensure that the metadata is set correctly before passing on any copies, as this will identify the version of the archive as well as ownership.

4.5 Pre-Fieldwork Planning

4.5.1 Introduction

With the Site file created, information about the site can be added and the fieldwork can be planned.

4.5.2 Importing Existing Information

If a position for the site is known, then charts and maps of the area can be added to the Site file. Charts and maps help to put the site into context and may give clues about how the site formed and where other parts of the same site may lie. Previous results from geophysical surveys can be included; this may establish a more accurate position for the site or may help define the site extents.

Typically coastline information in vector form can be imported and appears as a collection of Drawing objects on one or more Layers.

Charts can be scanned and added to the site plan as Image Basemap objects.

Targets or anomalies detected during geophysical surveys can be imported as Target objects or added by hand. Side scan sonar mosaics and multibeam (MBES) images can be added as Image Basemaps.

Previous site plans or sketches can be scanned and added to the plan. In some cases, the plans can be digitized and used as the starting point for the main site plan.

Documents relating to the project and site can be added as Sources.

Located or recorded shipwrecks can be added as Wreck objects.

A timeline of important events relating to the site can be created using Event objects.

In general, each dataset or image should be added to its own Layer, with image basemap Layers added to the last or lowest Project, so that they always appear under other objects on the chart.

Permission to use any images or chart data must be obtained before they are added to the dataset. Additional permissions may also need to be sought when publishing or archiving the dataset.

4.5.3 Setting up the Layers and Projects

At the beginning of any project it is advisable to create a set of Layers and Projects. The reason for this is that the lifetime of the project is often not known at the outset and small projects can turn into larger ones. If the Layers and Projects are correct from the start, then they will not have to be changed if the project evolves.

In general, there should be a separate project for each season's work. The name of the Project should include the year and a description, such as '2012 Season'. Within each Project, Layers can be added for each object type as required.

For example, the Layers needed on a typical project in 2012 include:

- *2012 General (for drawings)*
- *2012 Control Points (for survey control)*
- *2012 Detail Points (for survey detail points)*
- *2012 Artefacts*
- *2012 Features*
- *2012 Samples*

Setting up the project layers. © Peter R. Holt

A separate Layer should also be used for each set of geophysical targets or raw data. In practice, a Site file will contain many Layers within each season's project, each containing a separate type or category of object.

4.5.4 Survey Methodology

It is necessary to agree the survey methodology before any fieldwork starts, so the correct equipment and tools can be sourced and the team trained in the methods to be used.

The task of survey processing can often become the responsibility of the project's data manager, not because of any inherent skill in surveying, but simply because it's a job to be done on the computer. Site Recorder contains the tools needed to process all type of survey measurements underwater, making this task relatively straightforward.

4.5.5 Object Names

The object naming policy to be used on the project should be agreed in advance and documented. Anyone who will be adding data to the system should be trained in its use.

4.5.6 Wordlists

Wordlists and thesauri are used to help maintain consistency within the recording system so need to be set up in advance of fieldwork. The standard wordlists used in Site Recorder can be adapted to suit a particular project.

4.5.7 Adding Contacts

At this stage an interim list of people involved in the project can be added as a list of Contacts.

Suggested Reading

Holt, P. 2007a. *Development of an Object-Oriented GIS for Maritime Archaeology - Motivation, Implementation and Results.* CAA2007. Southampton

Holt, P. 2007b. *The Site Recorder Database Schema.* http://www.3hConsulting.com/Research/research_schema.htm (Accessed October 2011.)

Lledo B. 2004, Field Example of a Database System Applied to Underwater Archaeology, the FileMaker Pro Approach. *TARAUDSTUA Conference.* Bodrum.

Madsen T. 1998. *Design Considerations for an Excavation Recording System, Design and use of Field Information Systems.* CAA-NL98.

Nickerson, S. 1994. A Site Information System (SIS): CADD/Database Integration for Field Use. *APT Bulletin.* 24(1), pp. 56-62

Quinn, R. 2001. The Assimilation of Marine Geophysical Data into the Maritime Sites and Monuments Record, Northern Ireland. *Historical Archaeology.*

5 Fieldwork

5.1 Introduction

Before the fieldwork starts, the Site file for the project should contain all of the information known about the site at that time. In the field, the recording system is used as the repository for all of the information gathered during each dive, but it is also used for day to day planning and decision support.

5.2 Adding Artefacts, Features, Sectors and Samples

Each Artefact is added to the site plan in a position derived from the survey work as it occurs. *In situ* or registration photographs can be imported into SR then digitized to scale, so a 2-dimensional drawing of each find can be added to the site plan. Other photographs and video clips can also be linked to each Artefact.

5.3 Adding Dive Logs

Dive logs should be added on the same day that the dive was completed and any backlog should be avoided.

5.4 Survey Processing

A backlog in survey processing should also be avoided, as the positioning of Artefacts will be dependent on the timely processing of detail survey point positions.

5.4 Data Security

With large quantities of information being added to the recording system as fieldwork progresses, the importance of backing up cannot be stressed enough. Version control is also of paramount importance, especially if the main site file is being copied and shared regularly.

It is essential that the archive is kept free from viruses and other malware. All copies of the archive should be separately checked for viruses when they are created. Copies of the entire Site archive should be copied to an external hard drive or CD at the end of each day. Ensure all copies are clearly marked with their contents, version and date of creation using permanent ink.

Where possible, a separate external hard drive should be used for the online backup so if the main computer hard drive fails, the online backup should survive. The data recovery procedure (to be used after data loss) should be tested periodically to ensure that it works in practice.

File archiving should be used for all important projects. The Site file version should be updated each time the file is backed up. All computers being used to add to the archive must have up-to-date antivirus software installed.

5.5 Large Project Operation

When working on large projects, it may become necessary for more than one person to add information to the recording system at the same time. Fortunately, this can be done by using the merge tool available within Site Recorder.

6 End of Fieldwork

At the end of a season or project, the information should be verified, published and archived. All metadata should be checked and updated. Copies of the dataset should be given to the recipients agreed at the start of the project. A copy of the archive should be placed in long term secure storage and a separate copy kept by the project team.

Suggested Reading

Holt, P. 2010. *Site Recorder Exercise Book*. http://www.3hconsulting.com/Downloads/SiteRecorder4ExerciseBook.pdf (Accessed February 2012.)

Appendix Summary

Site Recorder was chosen to support the dive teams in their work underwater. The working of the system is explained in early units of the course and additional help from the trainers is given during the practical dive session. Like most applications, it is important get ‘hands on’ experience to begin to understand how to use them. Site Recorder is no different. Experience during the field schools has shown that some of those students with a good level of computing knowledge progress quickly, others more slowly. This appendix on Side Recorder has, therefore, been written to support trainers and students while working with it.

Suggested Timetables

90 mins	Review of 2-Dimensional Survey Techniques and Introduction to 3-Dimensional Survey Techniques (NAS)
	Break
30 mins	Introduction to Site Recorder (3H) – Theory
60 mins	Site Recorder Practical Exercises (Using the SR Workbook)
	Break
90 mins	3-Dimensional Site Survey Practical Exercise
	Break
30 mins	Continue 3-Dimensional Site Survey Practical Excercise
60 mins	Process the Results of the 3-Dimensional Site Survey
	Break
90 mins	Continue Processing the Results of the 3-D Site Survey
	Break
60 mins	Student Group Presentations of the Results and Discussion
20 mins	Concluding Remarks and Closure

Teaching suggestions

This appendix introduces students to using Site Recorder in preparation for the practical dive session in Unit 12. Trainers should use a series of lectures and training exercises, before asking the students to apply their knowledge in a practical task. It is expected that trainers will use the generic presentations found on the NAS Teaching Pack Tutor CD. Included below are the file source codes for each of the teaching units that can be found on the NAS Teaching Pack Tutor CD.

Additional information on Site Recorder can be found at 3H's website. From here, trainers can download a variety of resources including a demonstration version of the software, presentations, work books and training exercises.

Introduction to 3-Dimensional Site Survey Techniques (NAS): What to Use

- *PowerPoint presentation: P1 Session 5 3D Survey*
- *Trainer's notes file: F:/part1_powerpoints.html*
- *PowerPoint presentation: P1 Session 7 Creating a 3D Plan - Starting to Plan a Site*
- *Trainer's notes file: F:/Part_1/PISession_7.pdf*

Introduction to Site Recorder: What to use

- *PowerPoint presentation: P1 Session 7 Creating a 3D Plan - Starting to Plan a Site*
- *Trainer's notes file: F:/Part_1/PISession_7.pdf*
- *Technical notes about survey principles can be found at: http://www.3hconsulting.com/techniques.html (Accessed February 2012).*

Preparing for Practical Sessions

Site Recorder (demo mode) can be downloaded from: http://www.3hconsulting.com/index.htm (Accessed March 2012.)

The *Site Recorder Exercise Book* is located in the file C:\Program Files (x86)\3H Consulting\Site Recorder\Documents created during the installation of the software application or can be downloaded from: http://www.3hconsulting.com/downloads.html (Accessed March 2012.)

For the Using Site Recorder practical sessions it is preferable to use hard copies of the *Site Recorder Exercise Book*. Ideally two students will share one computer, so one copy per pair of students is required.

NB. Although it is possible that every student will have a personal computer and perhaps prefer to work alone, an already challenging session is likely to get even more complicated with everyone working at slightly different speeds.

Practical Sessions

There are two options for trainers to teach students how to use Site Recorder. Which they choose will depend on an assessment of the average level of computing skills of the students and the availability of sufficient notebook PC's to enable students to follow the exercises.

Option 1

The most straightforward way to teach the use of Site Recorder (particularly with a group of twelve or more students), is to demonstrate each of the selected exercises from the 3H Site Recorder Exercise Book and verbally explain each step of the process, projecting the steps onto the screen. Trainers can use either the UNESCO licensed copy of Site Recorder or Site Recorder (demo mode), which does not require a USB key.

Suggested exercises:

1. Add an object (pp. 9)

2. Projects and layers (pp. 11)
   - *a. Modify the layers*
   - *b. Showing and hiding layers on the chart*
   - *c. Setting the layer for an object*
   - *d. Locking layers*

3. Setting up the site (pp. 14)
   - *a. Modify the site*

4. Using the find tool (pp. 15)

5. Adding survey points and measurements (pp. 28)
   - *a. Create a new site*
   - *b. Add four survey points*
   - *c. Add six distance measurements*

6 Basic adjustment (pp. 30)

7. Finding mistakes (pp. 31)

8. Radial measurements (pp. 32)

9. Offsets and ties (pp. 33)

Additional exercises if time is available:

10. Adding a drawing frame (pp. 38)

11. Adding a preliminary sketch (pp.17)

12. More about drawing (pp. 21)

13. Adding a base map (pp. 25)

APPENDIX D

Option 2

An alternative option is to demonstrate each of the selected exercises, with the students following each step on their own computer. Although this is more challenging for the trainer, there is the significant benefit that everyone has the opportunity to begin to get practical experience.

Some students will be competent enough to proceed through the exercises at their own speed with little or no assistance from the trainer, the average will cope quite well with help from the trainer or the most skilled students, but some will find the exercises difficult. The trainer should be ready to assist those who are unable to follow the instructions.

Each of the students wanting to use their own computer will need to download the software application from 3H's website. This download is actually the full version of the software, but without the key supplied with each license it will only work in demonstration mode, which reduces its functionality, but allows all of the exercises to be completed. Trainers should note that once the software has been installed, copies of the Manual and *Site Recorder Exercise Book* are located in the computer folder: C:\Program Files (x86)\3H Consulting\Site Recorder\Documents.

To avoid delays during the allotted teaching time, trainers should remind students a day or two before that they need to download the software and check that it is installed and will open.

This is the preferred option, but the trainer needs to be flexible in terms of what can be achieved and to expect periodic interruptions, as students will inevitably not follow the exercises at the same speed or will inadvertently use the wrong computer keyboard command.

Students practice using Site Recorder. © Christopher J. Underwood

Dry 3-Dimensional Survey Practical Exercise

Once the students have mastered the use of Site Recorder it is important to put their skills to use in a survey practical exercise. The objectives of this exercise are for students to plan and carry out a 3-dimensional survey and process the results using Site Recorder.

The students are divided into teams with each team working on an artificial 3-dimensional site. Six students in each team is an ideal number, as it allows three pairs to work simultaneously.

For each site the following is required:

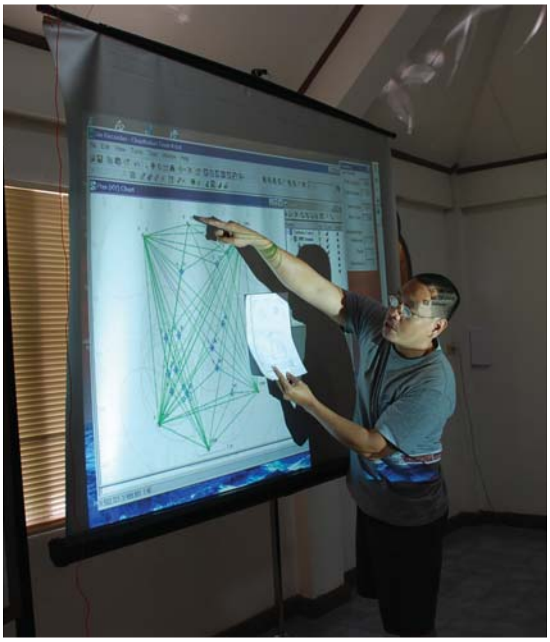
- *Objects such as tables and chairs can be used to represent large 3-dimensional artefacts or structures*
- *A minimum of twelve additional artefacts*

ABOVE: 3-dimensional survey practical set up. © Christopher J. Underwood

LEFT: Control points should be placed above and around the site to provide a better 'line of sight' for measurements. © Christopher J. Underwood

LEFT: Taking a direct survey measurement from a control point to a detail point on an artefact. © Christopher J. Underwood

BELOW: Each team present the results of their 3-dimensional survey. © Christopher J. Underwood



Alternatively a real site can be used, but the logistics are likely to be more complicated and it will not necessarily improve the teaching environment or the results of the exercise.

Equipment required for each team

- *3 x 10 metre tape measures (allowing 3 pairs to take measurements)*
- *6 x control points (to be fixed in position around and higher than the objects to be surveyed. Tape, cable ties or light rope can be used)*
- *3 x A4 boards*
- *3 x pencils and erasers*
- *Drawing grid/planning frame*
- *Recording forms for the survey*

Site Recorder recording forms are located in:

C:\Program Files (x86)\3H Consulting\Site Recorder\Documents. They can also be downloaded from http://www.3hconsulting.com/forms.html (Accessed March 2012.)

Alternatively NAS recording forms are located on the NAS Teaching Pack Tutor CD.

Trainer's notes file F:/introduction_course/Proforma_planning%20frame.pdf

Plotting the Results of 3-Dimensional Survey: What to use

Trainers should use Site Recorder (demo mode) to facilitate this practical session.

Student objectives:

- *Transfer the survey results to Site Recorder*
- *Understand the reasons for and characteristics of typical errors*
- *Understand the need to plan a survey*
- *Present each of the team's results to the class*

Trainers should expect varying levels of achievement. It is also possible that the teams may not complete the processing within the available time.

To follow up the teams can be encouraged to:

- *Complete the data entry from 3-dimensional survey*
- *Enter the results of the 2-dimensional surveys carried out earlier in the week*
- *Continue to work through the remaining exercises in the Site Recorder Exercise Book*

Suggested Reading: Full list

Bowens, A (ed.). 2009. Underwater Archaeology - *The NAS Guide to Principles and Practice,* Second Edition. Blackwell Publishing

Holt, P. 2007*a*. *Development of an Object-Oriented GIS for Maritime Archaeology - Motivation, Implementation and Results.* CAA2007. Southampton

Holt, P. 2007*b*. *The Site Recorder Database Schema.* http://www.3hConsulting.com/Research/research_schema.htm (Accessed March 2012.)

Holt, P. (2010). *Site Recorder Exercise Book.* .http://www.3hconsulting.com/Downloads/SiteRecorder4ExerciseBook.pdf (Accessed March 2012.)

Lledo, B. 2004. Field Example of a Database System Applied to Underwater Archaeology, the FileMaker Pro Approach. *TARAUDSTUA Conference.* Bodrum.

Madsen, T. 1998. *Design Considerations for an Excavation Recording System, Design and use of Field Information Systems.* CAA-NL98

Nickerson, S. 1994. A Site Information System (SIS): CADD/Database Integration for Field Use. *APT Bulletin.* 24(1), pp. 56-62.

Quinn, R. 2001. The Assimilation of Marine Geophysical Data into the Maritime Sites and Monuments Record, Northern Ireland. *Historical Archaeology.*

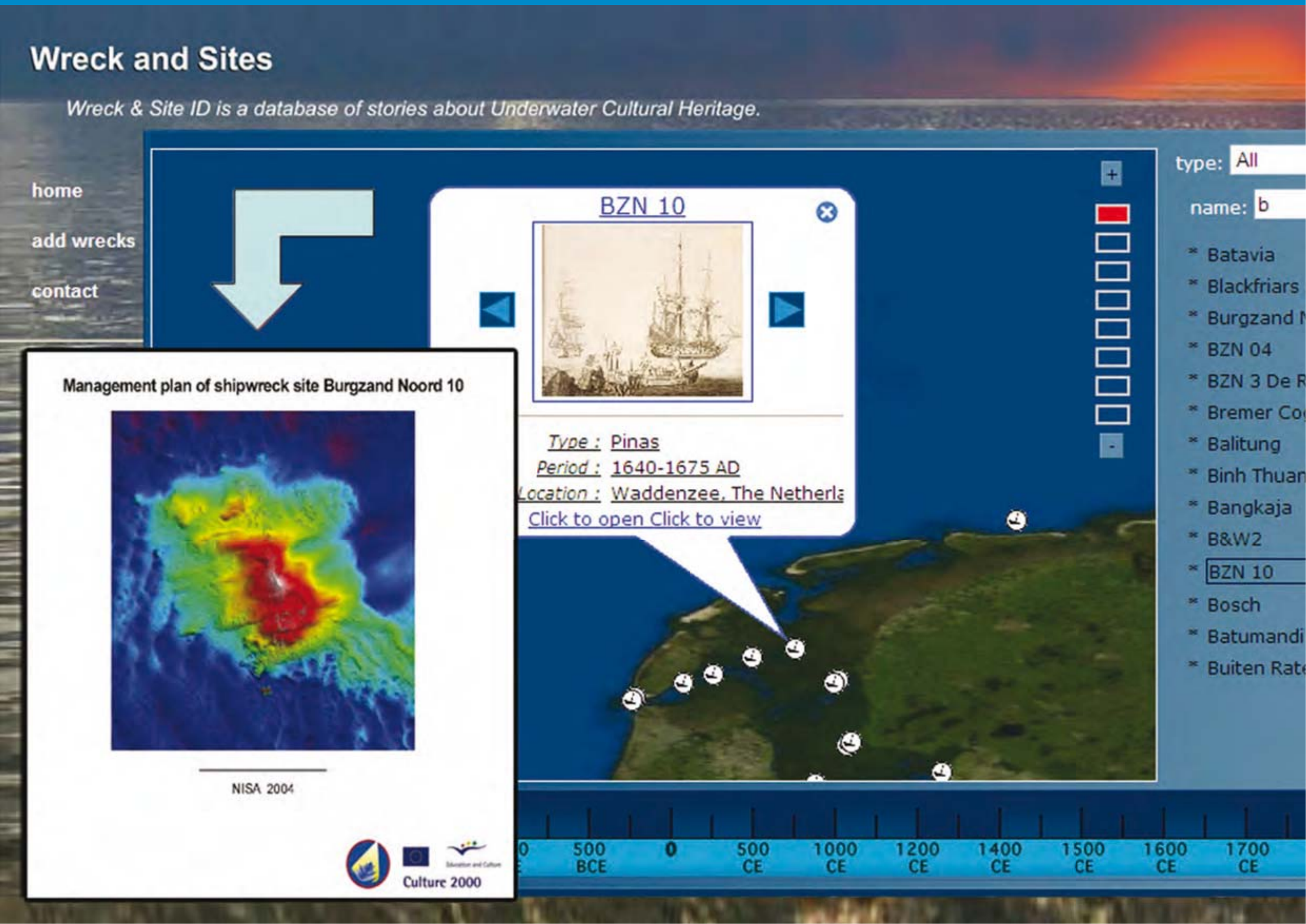
United Nations
Educational, Scientific and
Cultural Organization

The Protection of the
Underwater Cultural Heritage

APPENDIX E

Author Martijn. R. Manders

Management Plan



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APPENDIX E

Contents

APPENDIX E

Author Martijn R. Manders

Management Plan

Part I: Format of the Management Plan

Title

Management Plan of the [Name], Shipwreck site

0 Administrative details

0.1 Date

0.2 Client

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

0.3 Executed by (contractor)

(The name of the team facilitating the project)

0.4 Approved authorities

(The name of the authority responsible for the site)

0.5 Central registration number

(The registration number/database for the site)

0.6 Location research area

(Description of where it is, for example province, district, place, etc.)

0.7 Coordinates coordinated from Global Positioning System (GPS)

0.8 Environmental context

0.8.1 Coastal geology

0.8.2 Climate

0.8.3 Flora and fauna

0.8.4 Human impact

0.9 Size of research area

(Total area measurement in square metres)

0.10 Depth

(Depth in metres taking into account tidal differences)

0.11 Owner terrain

(The owner of the area the site is situated in, e.g. the State)

0.12 Reported by

(The name of the individual who first reported the site)

0.13 Periods of research

(Dates of fieldwork)

0.14 Site definition

(Short description of what the site is)

0.15 Deposition of archives

(Where are they deposited)

0.16 Legal status

(Protected or non-protected site)

0.17 Recognized threats

(Short summary of major threats)

0.18 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 with which the site can be associated)

2.3.4.1.2 Century

(The century from which the ship dates)

2.3.4.1.3 Exact dating

(The year and/or date that the ship set sail or sank, e.g. 1465, 15 December 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 in which the ship sailed)

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 in 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. Asian, Thai or European)

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, therefore, can 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 or 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 parts of the wreck are missing or still intact)

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

(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 Metal

3.2.2.1.2 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 Inorganic

3.2.2.2.3 Composite

(Note any parts of the wreck that comprise of different materials, such as iron and wood)

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, excavation, monitoring, etc.). Note the importance or significance of the site.

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

(Summary of panned 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 under 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.

APPENDIX E

Management Plan

Part II: Example Management Plan

Prepared by Team B *(alphabetically ordered by last names)*:
Sothea An (Cambodia), Sheldon Clyde B. Jago-on (Philippines),
Palitha Weerasingha Kalu Dewalage (Sri Lanka),
Nandadasa Samaraweera (Sri Lanka),
Cyril Santos (Philippines), Sam Ol Thoam (Cambodia)

Title

Management Plan of the Mannok Shipwreck Site, the Gulf of Thailand, Rayong Province, Thailand

0 Administrative details

0.1 Date

1st March 2011

0.2 Client

Underwater Archaeology Division, Fine Arts Department of Thailand

0.3 Executed by (contractor)

UNESCO regional trainees participating in the Third Foundation Course, Chanthaburi province, Thailand

0.4 Approved authorities

Underwater Archaeology Division, Fine Arts Department of Thailand

0.5 Central registration number

No registration number yet

0.6 Location research area

Province: Rayong, Thailand; District: Kram, Klaeng;
Place: Mannok Island; Site Name: Mannok Shipwreck

0.7 Coordinates

N12 30 20.2 E101 42 2X.X (WGS 84)

0.8 Environmental context

The Mannok shipwreck lies at a depth of approximately 20 metres on the seabed, surrounded by sand and silt. There is obvious evidence of environmental impacts, such as physical decay especially on the upper part of the ship's structure.

0.8.1 Coastal geology

The Mannok Island has a low promontory, with beaches along its coasts, some of which have resorts. The interior sediments maybe composed of clays rich with iron.

0.8.2 Climate

N/A

0.8.3 Flora and fauna

The Mannok shipwreck site is rich with flora and fauna. Various species of fish can be seen in the area, such as groupers, eels, crabs, urchin, barracuda, stone fish and sea worms.

0.8.4 Human impact

There is widespread commercial fishing activity in the area. As a result of these activities fishing paraphernalia, such as fishing nets, stone sinkers, hooks and fish traps can be seen on and around the site.

0.9 Size of research area

The designated research area is approximately 50 x 20 square metres and encompasses the shipwreck and its close vicinity.

0.10 Depth

19 to 20 metres

0.11 Owner terrain

Government of Thailand

0.12 Reported by

Mr Vichien Singmatorthone

0.13 Periods of research

14 day field work period from 28 February to 13 March 2011

0.14 Site definition

Medium size (42 m x 6.5 m) iron steam shipwreck, around 15 per cent of the wreck remains are preserved on the sea bed. Total length of the wreck is approximately 42 metres from bow to stern. The width of the amidships is approximately 6.5 metres. The shipwreck lies in a North South direction. The site is located 1 nautical mile southwest of Mannok Island and appoximately10 nautical miles from the port of Rayong.

0.15 Deposition of archives

No archival data of the Mannok shipwreck has yet been found. The Mannok shipwreck is situated in the territorial waters of Thailand and as such, is protected by the law of 'Ancient Monuments, Antiques Objects of Arts and National Museums, B.E. 2504 (1961)'

0.16 Legal status

N/A

0.17 Recognized threats

N/A

0.18 Date of re-assessment/re-evaluation

28 February to 13 March 2011. This research will determine when the next monitoring of the site will be.

1 Introduction

1.1 Previous studies

Previously used as the training site during the First and Second Foundation Courses on Underwater Cultural Heritage.

1.2 Historical context

Thai, South-East Asian, French Indo-China

2. Assessment of the site

2.1 Description of research assignment

To complete a non-intrusive survey and photo documentation as part of the Third Foundation Course on Underwater Cultural Heritage.

2.1.1 Reference to working standards

All research is carried out under the guidelines of the 2001 UNESCO Convention and Underwater Archaeological Division of the Fine Arts Department of Thailand.

2.1.2 Research objectives

The training serves as a practical application of techniques (offsets and other measurement methods, using Site Recorder, planning frames) for surveying an underwater archaeological site. The aim of the training is for students to produce a management plan for the Mannok shipwreck site, alongside identifying the threats and the possible mitigating measures required to conserve the site.

2.1.3 Expected results

A. A site survey and a management plan

B. A series of storyboards to be used for a public exhibition

2.1.4 Aims/wishes of the client

To enable South-East Asian underwater archaeologists to survey and make a management plan according to the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage.

2.1.5 Imposed research conditions

Non-intrusive survey techniques

2.1.6 Evaluations in between

During the two weeks diving on the site, each night the research group will come together to discuss and evaluate the work don

2.2 Working procedure

2.2.1 Research methods

Non-disturbing survey using ties (tri-lateration), offsets, and grids or frames.

2.2.2 Imposed work conditions

Safety is the priority. Safety measures are enforced by the UAD.

2.2.3 Modus operandi

N/A

2.2.4 Natural sciences, applied sciences and other research

Marine biologists can study marine animals and organisms that live on the wreck site. Geologists can assess the dynamics of sedimentation on the seabed and make predictions regarding possible future impacts to the site.

2.3 Research results

2.3.1 Environmental research

Attention was given to identifying the immediate environmental conditions and factors that could be directly affecting the site, as well as the threats from fishing communities and recreational divers.

2.3.2 Physical condition

Approximately 10 to 15 per cent of the shipwreck is visible. The ship is constructed from iron, has one boiler and some parts of the hull is missing. The hull was reinforced with concrete and some wood portions that form part of the deck construction were also documented.

2.3.2.1 Finds visible on surface

Large metal parts, ceramics, bricks, charcoal, pipes and glass bottles

2.3.2.2 Completeness

Approximately 10 to15 per cent of the shipwreck is visible. Stern and bow and some parts of the boiler in the amidships area is clearly intact.

2.3.2.2.1 Completeness of wreck parts

Upper structure, deck and other parts are missing.

2.3.2.2.2 Stratigraphy intact

Only one type of sediment was documented on the seabed: silty-sand.

2.3.2.2.3 Mobile artefacts in situ

Ceramics, bottles, charcoal and stonewares.

2.3.2.2.4 Relation between mobile artefacts and wreck parts

The ceramics, bottles and stoneware may have been part of the ship's cargo or among the things used by the crew and/or passengers. The charcoal may have been the fuel to the boiler.

2.3.2.2.5 Relation between mobile artefacts

It is possible that most of the artefacts found were part of the cargo.

2.3.2.2.6 Stability natural environment

Presently, the natural environment looks stable.

2.3.3 State of preservation

2.3.3.1 Organic wreck parts

Deteriorating

2.3.3.2 Metal wreck parts

Corroding

2.3.3.3 Organic mobilia

Deteriorating

2.3.3.4 Metal mobilia

N/A

2.3.4 Cultural-historic and archaeological data

2.3.4.1 Identification

2.3.4.1.1 Cultural context

Available evidence reveals that this shipwreck dates back to early twentieth century, during the time of France's attempt to dominate Thailand. As a result, there is much value in the shipwreck's cultural context.

2.3.4.1.2 Century

Coins found on the wreck site were minted in 1917, dating the ship to the early twentieth century.

2.3.4.1.3 Exact dating

Sinking date is estimated to be some time after 1917.

2.3.4.1.4 Function

Most likely the wreck was a trade or passenger transport ship.

2.3.4.1.5 Type

Steam ship.

2.3.4.1.6 Operating area

Within the Gulf of Thailand.

2.3.4.1.7 Propulsion

Steam

2.3.4.1.8 Size

41 metres long and 6.5 metres wide.)

2.3.4.1.9 Material

Metal hull, probably wooden deck.

2.3.4.1.10 Building tradition

Mixed European and South Asian traditions.

2.3.4.1.11 Inventory

Metal objects, ceramics, wood and charcoal.

2.3.4.1.12 Cargo

Ceramics, glass bottles and possibly wood.

2.3.4.1.13 Personal belongings

Coins, ceramics, and wearing as buttons pocket watch have been found.

2.3.4.2 Constructional features

Metal hull (probably reinforced later with concrete), rudder and boiler.

2.4 Risk assessment

2.4.1 Natural impact

Saturated warm sea water and strong currents cause harm to the metal parts of the ship.

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

As some prominent parts of the wreck are still visible on the seabed, the wreck could be attractive to recreational divers.

3.1.1.1 Visible

3.1.1.1.1 Visible as landscape element

Yes. The Mannok site lies at a depth of 20 metres with parts of the ship still clearly visible.

3.1.1.1.2 Visible as exhibition element

The site is situated far from the shore, at 20 m depth and is therefore barely visible. Only recreational divers may be able to enjoy the site, but the state of the site will probably not allow it to be raised and put on display in an exhibition. The finds, however, can be well presented and are a fine illustration of coastal trade and human transport in early twentieth century Indo-China.

3.1.2 Memory value

3.1.2.1 Historic value

Collective memory may be obtained through research and survey.

3.2 Physical quality

3.2.1 Structural integrity

3.2.1.1 Presence of ship construction

Approximately 10 to 20 per cent of the total structure of the shipwreck is intact.

3.2.1.2 Completeness of the wreck parts

Approximately round 10 per cent is visible but the rest may be buried under the sediments.

3.2.1.3 Stratigraphical conditions

N/A

3.2.1.4 In situ portable antiquities

In situ mobilia, such as ceramics, bolts, nuts, lantern and rope coil are scattered over the shipwreck. Some of them are in fairly good condition and would be attractive to antique collectors.

3.2.1.4.1 Relation between portable objects and ship parts

The mobilia has a relationship with the functions of a ship. Ceramics are abundantly distributed in galley area.

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

Part of the cargo or materials used in the ship by the crew or passengers.

3.2.1.5 Stability of the natural environment

Relatively stable at the moment.

3.2.2 State of preservation

3.2.2.1 Wreck parts

It is badly weathered; most of the strong hull parts are decayed.

3.2.2.1.1 Organic material

Some of the organic materials seen over the wreck, such as rope coil and wood planks charcoal, are in a highly fragile condition. Marine animals as marine bores and worms are actively damaging the materials.

3.2.2.1.2 Composite

Some parts of the structure of the ship are made of wood and connecting metal plates. Both wood and metal parts are in very fragile condition.

3.2.2.2 Artefacts

3.2.2.2.1 Organic material

There is little remaining of organic materials (wood and coil ropes) that made up rigging parts. Other organic materials that can be identified are in very bad condition.

3.2.2.2.2 Inorganic

Ceramics, bricks, and other inorganic artefacts seen on the wrecks site are in a fairly well preserved condition and some are still intact.

3.2.2.2.3 Composite

No composite objects were found during this research.

3.3 Quality of archaeological information

3.3.1 Representative value

The Mannok wreck site adds much value to the list of the shipwrecks in Thailand. As a steam ship with one boiler and a variety of artefacts, it provides an abundance of information regarding shipbuilding in the South Asia.

3.3.1.1 Chronological

Unique shipwreck for understanding technology of the constructed period.

3.3.1.2 Regional

The Mannok shipwreck is comparatively important among the other iron wrecks found in the region, belonging to the same period.

3.3.2 Significance of information

3.3.2.1 Geographical significance

The Mannok shipwreck has notable significance geographically, particularly for the information it provides regarding the shipbuilding technology of Thailand.

3.3.2.2 Historical or archaeological significance

The Mannok shipwreck is has high historical significance for Thailand. Given the historical backdrop, the sinking may have been caused by French forces who attempted to occupy Thailand. All these things if verified can add to its archaeological and historical significance.

3.4 Conclusion

The Mannok site is a fine example of coastal trade and human transport in early twentieth century Indo-China era. This early steamship is an interesting dive site that contains a lot of history. Objects may be raised for exhibition, but to raise the site itself will prove to be too difficult or expensive.

The site therefore has a high archaeological significance for its specific period of history in this area, which provides it with local, national and regional significance.

4 Site management

4.1 Cost-benefit analysis and general conclusion

Further research can provide additional information about the wreck which may contribute to its significance. Purposive excavation could be done to answer particular questions or alternatively the site can be protected *in situ*.

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

4.2.1 Safeguarding

4.2.1.1 Legal

The wreck is lying on the seabed within Thai territorial waters and is protected under the law of 'Ancient monuments, Antiques, Objects of Arts and National Museums B.E.2504 (1961)'.

4.2.1.2 Physical

The Mannok wrecksite is vulnerable to natural environmental forces and human impacts.

4.2.2 Monitoring

Once identified, the first site survey was conducted in 2008. Subsequently in 2009 and 2010 the shipwreck became used as a training ground for South Asian underwater archaeologists under the UNESCO 2001 Convention. The site has been monitored at least once every six month, since being identified. [actions planned]

4.2.3 Visualizing

A scale map layout was prepared that covered the bow, amidships and stern, illustrated by both photographs and video. [actions planned]

4.2.4 Finance

N/A

4.3 Date of re-assessments/re-evaluation

To be confirmed.

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

United Nations
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The Protection of the
Underwater Cultural Heritage

APPENDIX F

Author Christopher J. Underwood

Suggested Timetable for the Foundation Course

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APPENDIX F

Contents

APPENDIX F

Author Christopher J. Underwood

Suggested Timetable for the Foundation Course

Introduction to the Appendix

This appendix provides a suggested timetable for the six-week Foundation Course. The timetable is structured in such a way that each topic builds upon the knowledge learnt from previous units. This enables the students to expand their knowledge and skills on underwater archaeology in a progressive manner, within the limited duration of the training course. Changes to the sequence of the units may disrupt the logical flow of learning and be disadvantageous to the students.

Considering that the students may come from different academic backgrounds and have varying levels of experience, the first two weeks are devoted to the basics of maritime archaeology. The lectures and practical sessions are intended to prepare the students for the field diving exercises that take place during the third and fourth weeks of the training period. During the field diving exercises on an actual shipwreck, students are taught how to assess and survey the site and plan how the archaeological site can be sustainably managed and safeguarded. The final two weeks are focused on the preparation of a management plan for the shipwreck and how to present findings to both professionals and the general public.

Considering that the timetable may change according to the availability of the selected trainers, the organizers should inform the trainers as early as possible, so that they have adequate time to plan and ensure their availability during the dates of the units assigned to them.

WEEK 1	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
Arrival of students and trainers and transfer to Chanthaburi before Monday	90 mins	Introduction of Students, Trainers and Support Team and Tour of National Maritime Museum or Office of the Host Organization	**UNIT 2** Back To Basics (The Scope of Underwater and Foreshore Archaeology)	**UNIT 2** Back to Basics (2-D Survey Wet Practical Session)	**UNIT 2** Back to Basics (Project Planning and Safety)	**UNIT 7** Data Management in Maritime and Underwater Archaeology (3-D Survey Dry Practical	**APPENDIX D** How to Use Site Recorder (Presentations of the Results of the 3-D Survey Practical)	*Free Day and Report Writing*	**WEEK 1** UNITS 1, 2, 7 and Appendix D
	30 mins	Break	Break	Break	Break	Break	Break		
	90 mins	Opening Ceremony	**UNIT 2** Back to Basics (Underwater and on the Foreshore Site Types, Introduction to Dating Archaeological Material)	**UNIT 2** Back to Basics (2-D Survey Wet Practical Session)	**UNIT 7** Data Management in Maritime and Underwater Archaeology (Introduction)	**UNIT 7** Data Management in Maritime and Underwater Archaeology (3-D Survey Dry Practical Session)	**APPENDIX D** How to Use Site Recorder (More Advanced Practical Exercises)		
	60 mins	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
	90 mins	**UNIT 1** Introduction to the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage and its Annex	**UNIT 2** Back to Basics (Introduction to 2-D Survey Techniques)	**UNIT 2** Back to Basics (Project Designs)	**UNIT 7** Data Management in Maritime and Underwater Archaeology (Review of 2-D Survey Techniques & Introduction	**APPENDIX D** How to Use Site Recorder (Continue 3-D Survey Practical and Start Processing the Results of 3-D Survey Exercise)	Informal Review and Discussions of the Units Covered in Week 1		
	30 mins	Break	Break	Break	Break	Break	Break		
	90 mins	**UNIT 1** Introduction to the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage and its Annex	**UNIT 2** Back to Basics (2-D Survey Dry Practical and Analysis of Results)	**UNIT 2** Back to Basics (Diver and Remote Sensing Area Search, Survey and Position Fixing)	**APPENDIX D** How to Use Site Recorder (Practical Exercises)	**APPENDIX D** How to Use Site Recorder (Continuing Processing the Results of the 3-D Survey Exercise)	Informal Review and Discussions of the Units Covered in Week 1		
	30 mins	Discussion	Discussion	Discussion	Discussion	Discussion			

Total hours per day = 8 hours 30 minutes

WEEK 2	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
	90 mins	**UNIT 3** Management of Underwater Cultural Heritage	**UNIT 4** Underwater Archaeological Resources	**UNIT 5** Desk-based Assessment	**UNIT 6** Significance Assessment	**UNIT 11** Finds Handling and Conservation	**APPENDIX C** Introduction to Metal Shipbuilding Technology	*Free Day or the First Practical Dive Session* OR UNIT 12 Practical Dive Session, Mannok Shipwreck Site (Project Briefing, Dive Equipment and Site Familiarization and Debrief)	↓ **WEEK 2** UNITS 3, 4, 5, 6, 10, 11, 12 and Appendix C
	30 mins	Break	Break	Break	Break	Break	Break		
	90 mins	**UNIT 3** Management of Underwater Cultural Heritage	**UNIT 4** Underwater Archaeological Resources	**UNIT 5** Desk-based Assessment	**UNIT 6** Significance Assessment	**UNIT 11** Finds Handling and Conservation	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Introduction to the Management Plan, Storyboards, Site Assessment and Management of the Project Archive)		
	60 mins	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
	90 mins	**UNIT 3** Management of Underwater Cultural Heritage	**UNIT 4** Underwater Archaeological Resources	**UNIT 6** Significance Assessment	**UNIT 10** Intrusive Techniques in Underwater Archaeology	**UNIT 11** Finds Handling and Conservation	*Relocation to Rayong Province for the Practical Dive Session*		
	30 mins	Break	Break	Break	Break	Break			
	90 mins	**UNIT 3** Management of Underwater Cultural Heritage	**UNIT 4** Underwater Archaeological Resources	**UNIT 6** Significance Assessment	**UNIT 10** Intrusive Techniques in Underwater Archaeology	**UNIT 11** Finds Handling and Conservation (Visit the Archaeology Unit's Finds Storage and Conservation			
	30 mins	Discussion	Discussion	Discussion	Discussion	Discussion			

Total hours per day = 8 hours 30 minutes

WEEK 3	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
	30 mins	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	*Free Day and Report Writing*	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	↓ **WEEK 3** UNIT 12 and Appendix E (Management Plan) as well as Storyboards, Wreck Assessment and Country Presentations
	All day	Dive Equipment and Site Familiarization	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards		Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	
	30 mins	Debrief	Debrief	Debrief		Debrief	Debrief	Debrief	
	Evening	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)		**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	

WEEK 4	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
	30 mins	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	*Free Day and Report Writing*	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	**UNIT 12** Practical Dive Session, Mannok Shipwreck Site (Project Briefing)	*Relocation to Chanthaburi*	↓ **WEEK 4** UNIT 12 and Appendix E (Management Plan) as well as Storyboards, Wreck Assessment and Country Presentations
	All day	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards		Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards	Site Tasks, Site Assessment, Survey Skills, Management Plan and Storyboards		
	30 mins	Debrief	Debrief		Debrief	Debrief	Debrief		
	Evening	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)		**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)	**UNIT 12** and **APPENDIX E** (Complete Dive Logs, Task Planning, Management Plans and Country Presentations)		

WEEK 5	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
	90 mins	**UNIT 14** Asian Shipbuilding Technology and **APPENDIX B** Basic Termi-nology of Shipbuilding	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**UNIT 16** Museology (Introduction to the Storyboards)	**UNIT 16** Museology (Final Preparation of the Storyboards)	**UNIT 17** Public Archae-ology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology		↓ **WEEK 5** UNIT 13, 14, 16, 17, 18, Appendix A and Appendix B
	30 mins	Break	Break	Break	Break	Break	Break		
	90 mins	**UNIT 14** Asian Shipbuilding Technology and **APPENDIX B** Basic Termi-nology of Shipbuilding	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**UNIT 16** Museology (Introduction to the Storyboards)	**UNIT 16** Museology (Final Preparation of the Storyboards)	**UNIT 17** Public Archae-ology, Raising Awareness and Public Participation Projects in Underwater and Maritime		
	60 mins	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch		
	90 mins	**UNIT 14** Asian Shipbuilding Technology and **APPENDIX B** Basic Terminology of Shipbuilding	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**UNIT 13** Asian Ceramics	**UNIT 16** Museology (Introduction to the Storyboards)	**UNIT 18** Archaeological Publication	**UNIT 17** Public Archaeology, Raising Awareness and Public Partici-pation Projects in Underwater and Maritime Archaeology	*Free Day and Report Writing*	
	30 mins	Break	Break	Break	Break	Break	Break		
	90 mins	**UNIT 14** Asian Shipbuilding Technology and **APPENDIX B** Basic Termi-nology of Shipbuilding	**APPENDIX A** (Appendix to Unit 14) Ethnographic Boat Recording Practicum	**UNIT 13** Asian Ceramics (Visit to the National Maritime Museum's Ceramics Collection)	**UNIT 16** Museology (Introduction to the Storyboards)	**UNIT 18** Archaeological Publication	**UNIT 17** Public Archae-ology, Raising Awareness and Public Participation Projects in Underwater and Maritime Archaeology		
	30 mins	Discussion	Discussion	Discussion	Discussion	Discussion	Discussion		

Total hours per day = 8 hours 30 minutes

WEEK 6	Duration	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Summary of units covered
	90 mins	**UNIT 8** Geographic Information Systems (GIS) in Underwater Archaeology	**UNIT 9** *In Situ* Preservation	**UNIT 15** Material Cultural Analysis	*Preparation of Student Presentations*	**Conference:** Student Presentations and Exhibition of the Storyboards for Visitors	*Free Day*	*Departure of Students and Trainers*	**WEEK 6** UNITS 8, 9, 15 and Appendix E
	30 mins	Break	Break	Break	Break	Break			
	90 mins	**UNIT 8** Geographic Information Systems (GIS) in Underwater Archaeology	**UNIT 9** *In Situ* Preservation	**UNIT 15** Material Cultural Analysis	*Relocation to Bangkok*	**Conference:** Student Presentations and Exhibition of the Storyboards for Visitors			
	60 mins	Lunch	Lunch	Lunch	Lunch	Lunch			
	90 mins	**UNIT 8** Geographic Information Systems (GIS) in Underwater Archaeology	**UNIT 9** *In Situ* Preservation	**APPENDIX E** Management Plan for Mannok Shipwreck Site	*Installation of Storyboards at the Venue and Final Preparation of Presentations and Closing Ceremony*	*Closing Ceremony at UNESCO Field Office in Bangkok*			
	30 mins	Break	Break	Break					
	90 mins	**UNIT 8** Geographic Information Systems (GIS) in Underwater Archaeology	**UNIT 9** *In Situ* Preservation	Preparation of Student Presentations					
	30 mins	Discussion	Discussion	Discussion					
Total hours per day = 8 hours 30 minutes									

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Training Manual

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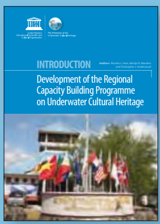

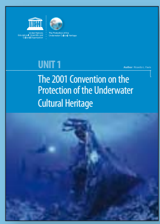

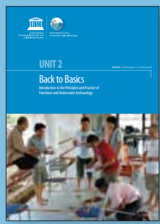

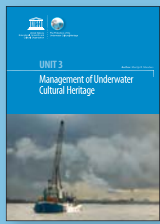

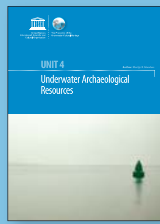

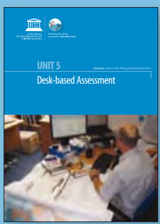

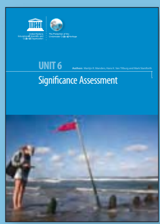

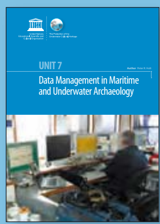

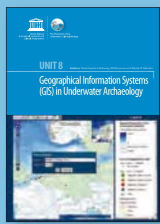

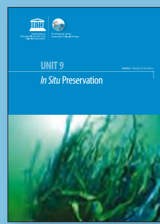

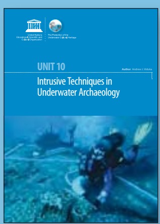

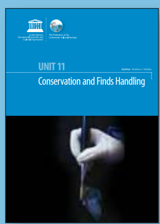

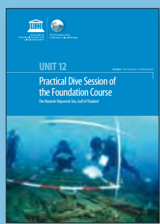

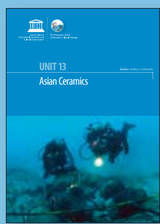

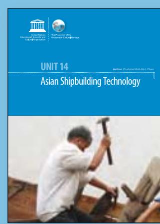

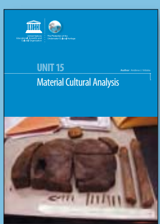

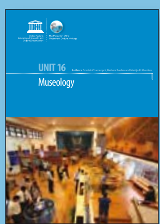

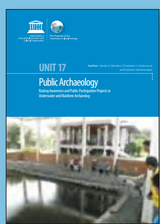

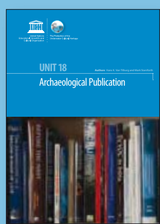

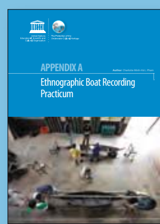

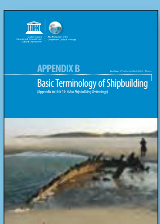

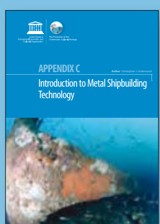

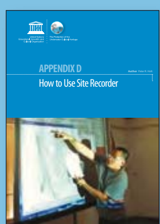

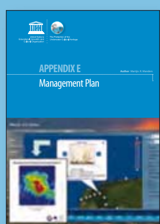

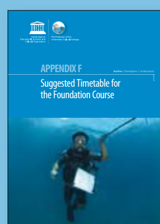

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