

# **Conservation of Finds from Underwater Sites**

**Concluding Report for the 2013 HFF Grant**

**Department of Antiquities, Cyprus**

## **Introduction**

The fields of Underwater Archaeology and Conservation have been developing gradually in Cyprus in recent years. The discovery in 2007 of the Mazotos shipwreck which dates to the Classical Period and is located approximately 2.5km off the south coast of the island, has created a new dynamic in a field that up until recently was underdeveloped due to an influx in land development, growing number of visitors and a need to preserve the existing archaeological heritage on the mainland.

The Department of Antiquities (the body responsible for excavating, conserving, presenting and promoting archaeological remains and ancient monuments whether those are found terrestrially or underwater) has taken great steps in developing the field of underwater archaeology and conservation. As part of this commitment it has invested in the establishment of Conservation Facilities for the treatment of underwater finds and takes full responsibility for the conservation of all such finds found either through systematic excavations or surveys.

The Conservation Laboratory was set up in Larnaca, a coastal town, in 2010 and has been developing according to the needs generated, primarily, by the Mazotos shipwreck, the, until recently, only systematic annual underwater excavation.

Crucial to the development of the field has been the financial support given by the HFF in 2013 for the part-time employment of an Assistant Conservator to carry out daily activities in the Conservation Laboratory, to carry out a literature review of specific conservation issues and for a trip abroad to visit Conservation Facilities where finds from underwater sites are being treated. The latter received further financial support in 2014 in order to enable two members of staff to participate in the trip.

## **Work at the Laboratory for the Conservation of Underwater Finds**

Ms Antigoni Christofi, Conservator, began her part-time employment for one year on 1<sup>st</sup> March 2013. Her employment enabled the smooth running of the day to day activities in the Conservation Laboratory and the completion of the treatment of all (with few exceptions) ceramics excavated from the Mazotos wreck (2010, 2011, 2012 excavation periods). This included a gradual desalination process in more than 14 tanks, drying, consolidation and assembly (where necessary), photographic documentation and storage for approximately 180 objects including intact amphorae, parts of amphorae and groups of fragments.

All processes were documented and the finds stored, with their locations registered and the storage cabinets labelled with their contents.

Ms Christophi input has been critical in the progress of the conservation work in the lab as, through the collaboration with existing Department of Antiquities staff, it has been possible to refine the protocol for the treatment of ceramics and progress to addressing new types of material (mostly wood and metal) for treatment.



Small one-handed vessel before and after adhesion

### **Literature review on the Conservation of Waterlogged Wood and Marine Metal**

A literature review was conducted by Ms Christofi with the aim of recording methods of conserving waterlogged wood and marine metals. The report included a summary of deterioration mechanisms and treatment options employed in the conservation

- a) of waterlogged wood, such as impregnation, bulking, replacement of water with a non-aqueous solvent, slow and freeze drying and
- b) of marine metals and more specifically iron, lead and copper and their alloys, such as electrolytic reduction, chemical and mechanical cleaning.

It has provided basic knowledge of techniques and materials used over the decades, around the world, in the conservation of objects from underwater sites. Moreover, it enabled preliminary decisions on what methods of treatment for waterlogged wood and marine metals can be employed, at least for the early attempts, without the need for specialized and very expensive equipment, in order to treat material retrieved from previous and future underwater excavations.

### **Excavation at the Nissia Wreck**

In September 2014 the excavation of a shipwreck at Nissia in Protaras (Green Bay), Cyprus, was undertaken for twelve days by the University of Cyprus in collaboration with the Department of

Antiquities. A cast iron cannon, a number of wooden objects (a dead-eye, wooden 'logs' with pointed ends, a part of a wooden beam believed to be from the hull of the wreck, etc.), some ceramic objects and fragments and various metal encrustations were lifted from the seabed from what is currently considered to be an 18<sup>th</sup> century shipwreck.

Ms Eleni Loizides and Ms Antigoni Christofi, who has been able to continue her employment through a special HFF grant awarded in 2014, were on board assisting with the excavation, providing first aid to finds, taking conductivity measurements, and preparing objects for transportation to the conservation facilities in Larnaka.



Temporary storage of cannon on seabed following excavation



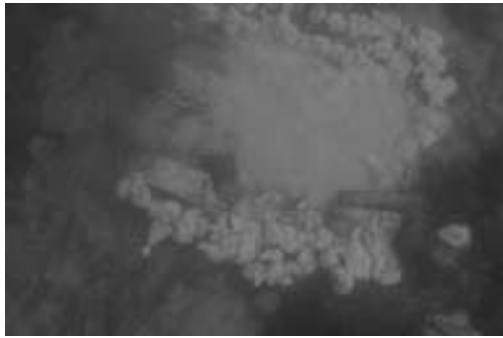
Lifting the cannon



Transporting the cannon in its tank in the conservation lab

At the completion of the excavation the excavated trench was reburied using fine-grained sand and geotextile to protect the newly exposed wood that was not lifted. Additionally, in-situ

experiments aiming to assess the burial environment, its effects on wood and the effectiveness of re-burial methodologies were carried out. Firstly, following excavation of one of the wooden logs and its detailed documentation, it was cut in half. One half was reburied at its original position within the trench whilst the other was kept for in lab conservation. Both fragments will be assessed and compared during future visits to the site.

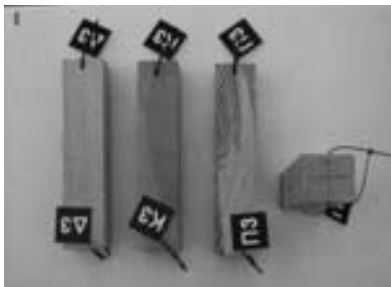


Covering the trench with sand and geotextile



The half wooden log before reburial

The second experiment aims to look into the rates of decay of samples of new wood (cedar, pine and oak) when exposed or protected underwater and the third experiment will monitor sediment movement.



Group 3 of the rate of decay experiment



Covering Group 3 with sand and geotextile



The rod for recording sediment movement

## Visit to Conservation Facilities in Denmark and Sweden

From the 3<sup>rd</sup> until the 7<sup>th</sup> of November 2014, conservation facilities, where objects from underwater sites are being treated, in Copenhagen, Goteborg and Stockholm, were visited by Ms Eleni Loizides and Ms Antigoni Christofi. The National Museums of Denmark's conservation facilities in Brede, Studio Västsvensk Konservering(SVK)and the Vasa Museum were visited. The decision for visiting these two countries was taken following the assistance of Dr. Ulrike Guerin of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001) and was based on the extensive experience that both of these countries have in this domain and the similarities between the work carried out there and the work expected to be carried out in Cyprus in the future.

Ms Kristiane Sraetkvern gave a tour in the waterlogged wood conservation laboratories of the **National Museums of Denmark in Brede** as well as an invaluable description of their current procedures for treating waterlogged wood using pre-treatment impregnation with PEG 2000 followed by freeze drying. The tanks used for the PEG impregnation vary from state of the art stainless steel ones to plastic ones and wooden constructions lined with a heavy duty plastic material to metallic ones coated with an epoxy resin and wooden ones lined with fibre glass. They have three freeze driers the largest one of which can hold wood up to 8meters long!



The Conservation Labs in Brede

Moreover, she described experimental procedures they carry out using a type of sugar, mannitol, in concentrations of 5% or 10%, followed by freeze drying as a cheaper and quicker alternative to the PEG treatment. In addition, she suggested the cellosolve/petroleum treatment for composite lead/wood objects from the Mazotos wreck provided proper health and safety measures are employed.

The metals conservator of the National Museums of Denmark also gave an interesting presentation of the treatment currently under way for two cast iron cannons using electrolytic reduction.

In **Goteborg**, Ms Sara Gainsford creditably replaced the waterlogged wood conservator Ms Ebba Phillips, who was away on the day, in giving a tour of the conservation laboratories for

waterlogged wood and marine metals but also a quick tour of the laboratories for the conservation of archaeological metals, textiles, paintings/frames and furniture of the **Studio Västsvensk Konservering (SVK)**.

Because of the unavailability of PEG 2000 in Goteborg they usually impregnate waterlogged wood with 10% PEG 1500 and 30% PEG 4000 followed by freeze drying. They have a 5meter freeze drier. The percentages of PEG used are adjusted according to the degree of degradation of the objects. Prior to PEG impregnation the wooden objects are usually treated in baths with 3% DTPA (diethylenetriaminepentaacetic acid) to remove the iron which, if left in the object, will act as a catalyst and degrade the wood further.



The Freeze drier at SVK

Ms Gainsford provided details from the conservation of a forged iron cannon and presented how this was separated from its wooden carriage, desalinated to the point where the metal would allow (before its surface became too brittle) and how it is preserved until it will be displayed in an oxygen free atmosphere, in nitrogen, to ensure its stability.

Leather artefacts are usually treated with 10-15% PEG 400, ropes with CMC (carboxymethyl cellulose) and PEG whereas textiles are either dried under controlled conditions or freeze dried.

In the exceptional **Vasa Museum** in **Stockholm** the conservator Malin Sahlstedt was very welcoming and enthusiastic in giving a tour around the Vasa ship and explaining the treatment following its excavation in 1961, more than four decades ago. It was sprayed as a whole for 17 years with PEG, initially 4000 but then also with 1500 and 600 in order to ensure better penetration. The outside of the ship was then given a final coat by brushing with PEG 4000 and was dried under controlled conditions of 65-80% RH for 9 years.

Smaller finds were impregnated with PEG 4000 in two 20meter tanks heated at 60°C for 12-18 months and were then brushed with a final layer of PEG 4000 before being slowly air-dried.

Problems associated with organic acids, sulphate reducing bacteria, soluble salts emerging to the surface of the timbers and corroding iron that altered the mechanical properties of the wood were observed around the year 2000. In 2004 a climate control system was installed in the museum which keeps the relative humidity at 52% ± 2% and the temperature at 18°C ± 1°C thus inhibiting new salt outbreaks. It should be noted that the museum currently accepts around 1,2 million visitors per year, twice as many as estimated when built.

A project of recording the movements of the ship's timbers is well on its way (showing that the hull is settling downwards about 1mm/year and the stern is twisting at a very slow rate) and a new cradle to support the ship is currently being considered that will not concentrate the load at specific points. A large scale project of replacing the 5000 iron rods coated with epoxy (that were placed underwater before the lifting of the ship) are currently being replaced with new stainless steel ones.

Vasa Conservators have been experimenting with techniques to remove iron salts from already treated finds. They have concluded that extraction using DTPA at neutral pH and re-impregnation with 15-30% PEG 1500 followed by freeze drying produces very good results.

Lars-Erik Barkman, Head of Research and Collections at the National Museums of World Culture, kindly joined the tour around the Vasa and gave very interesting inside information on the original conservation treatment of the ship as his father was one of the first conservators involved in the treatment of the ship. He was also kind enough to offer a drive outside the original storage area, purposely built for the Vasa conservation.

During this educational trip the opportunity arose to visit several museums including the Sjöhistoriskamuseet (the Maritime Museum), the Medelhavsmuseet (Museum of Mediterranean and Near Eastern Antiquities) and the Medeltidsmuseet (Medieval Museum) in Stockholm.

The visit to the above Conservation Facilities has provided a unique opportunity to become familiar with the current thought and approach in Denmark and Sweden in relation to the Conservation of Underwater Finds. Exchange of ideas and experiences as well as seeing close up the equipment and infrastructure required to implement the treatments has provided a good basis for forming strategies for the future development of the Conservation of Underwater Finds in Cyprus. The Department of Antiquities is very grateful for all the colleagues who were welcoming and more than willing to answer questions and clarify details with enthusiasm and professionalism.

## **Conclusion**

The work conducted by the Department of Antiquities in Cyprus in the field of Underwater Conservation has been and continues to be enhanced by the support of the HFF. The funding from the HFF contributes greatly in the progress of works by enabling the Conservation Team to not only deal with the daily conservation requirements but also to advance knowledge and experiences as it continues to set the foundations of Underwater Archaeology and Conservation on the island.