1. FROM THE COORDINATOR

ICOM-CC Triennial Conference

As you should all have heard by now, the 19th ICOM-CC Triennial conference in Beijing has been postponed until May 17-21, 2021. The theme of the conference is Transcending Boundaries: Integrated approaches to Conservation. WOAM has a program of three papers and three posters as well as a fun-filled business meeting to delight all comers. The papers selected for the conference are:

- Evaluation of Silk Protein Reinforcement for Saturated Silk
- Non-destructive assessment of conserved archaeological wood with Computed tomography
- Experimental study of the Consolidation of decayed wooden planks from the Quanzhou Ship: discussion of the retreatment possibilities

The posters include:

- Bio-based treatment for Fe/S species extraction from waterlogged archaeological woods
- Mapping the State of the Art: the use of structured interview surveys in conservation research. The Trondheim Archaeological Leather Project (TALP)

In addition to our own program, the Triennial Conference will include the debut of the Archaeological Materials and Sites Working Group, which promises to be a wonderful addition to ICOM-CC. The organizers of the Triennial Conference have organized a raft of fascinating technical visits and optional add-ons which provide terrific opportunities to learn more about the museums and sites of China.
and the great preservation work that is done in them. The conference website is https://www.icom-cc2020.org/

ICOM-CC Elections

Usually, the elections for the ICOM-CC Directory Board and the new Coordinators take place in September at the Triennial Conference. This year however they will be uncoupled. The Elections will still take place in September although the Triennial Conference will occur in May 2021. This is because the term limits and the voting window are set by ICOM. The elections will be held the from Aug 31-Sept 15, 2020. Further information on how to vote will be sent out closer to the election.

Ida Hovmand is running for the position of WOAM coordinator. As many of you will know, she has been involved with WOAM for a long time over which time she has done significant research on the conservation of waterlogged leather objects. She has been an Assistant Coordinator for the last triennium and did a fabulous job in the role. I think that she will be a wonderful Coordinator and has a tremendous amount to offer to WOAM.

In addition to Ida’s candidacy other members of the group are running for positions within ICOM-CC. Emma Hocker is seeking reelection as Coordinator of the Archaeological Materials and Sites Working group and three individuals with current or past ties to WOAM are seeking election to the Directory Board. To read the biographies and statements of the candidates please visit http://www.icom-cc.org/351/about/candidates-for-directory-board-and-for-working-group-coordinators-2020-2023/#.XxqikJ5kJilU. If you are an ICOM-CC member, please keep an eye out for the election materials and take the time to vote in September.

Thank you

As I step away from the role of coordinator, I just wanted to take a moment to thank everyone in the group for all the enthusiasm and passion you bring to the topic. We are an active and energetic group and it is a real pleasure to get to learn about the diversity of projects that are undertaken and to represent the group. I would also like to thank the tremendous team of Assistant Coordinators who have dedicated a lot of time and effort to the work of the group this triennium: Ida Hovmand, Elsa Sangouard, Eleanor Schofield, Dilys Johns, Ingrid Stelzner and Jana Gelbrich. Working with them has been a great joy over the last three years.

2. NEWS FROM THE GROUP

AN INTRODUCTION TO THE BETSY PROJECT: A LARGE-SCALE RE-TREATMENT OF WATERLOGGED ORGANICS

Chelsea Blake, Conservator - Virginia Department of Historic Resources

In 2018, the Virginia Department of Historic Resources (VDHR), in Richmond, Virginia, received a National Park Service Maritime Heritage Grant for the re-treatment of the artifacts related to Betsy, a collier (coal transport) built in Whitehaven (Cumbria), England in 1772. Betsy was scuttled by the British in 1781, along with many other ships prior to the Battle of Yorktown, the final battle of the American Revolution. In the 1970s, the Yorktown Shipwreck Project began, after widespread looting of the sites raised awareness of the sites and compelled the Commonwealth of Virginia to act to preserve them. Nine wrecks were located and surveyed, of which Betsy was the most intact (Broadwater 2018).

Excavations began in the early 1980s with plans and funding in place for the treatment of the artifacts. The surviving contents of the ship, estimated to be around 50%, were retrieved and treated as a part of the project. The finds consisted of a variety of artifacts, including domestic and personal effects and military items. These artifacts were treated at a time when the field of conservation of waterlogged organics was in its infancy and the people working on the project had few proven techniques upon which to draw for this type of work (Clarke and Grattan, 2014). No wet organic
treatment method had been determined to be the most beneficial and it was a time in the discipline of conservation when there was a lot of experimentation in the treatment of these materials. This is reflected in the wide variety of treatment methods used on the organics including: low molecular weight polyethylene glycol, acetone/ rosin, sucrose, and in some cases glycerol, ethulose, and Butvar treatments.

The project ended with little warning when the funding was cut partway through treatment. Treatments were stopped at whatever phase they were in at the time (pers. comm. Broadwater, 2018). Many artifacts were pulled directly out of treatment solutions and packaged straight away without being rinsed, other objects were packed away in their treatment solutions. Some fared well, having reached the end point of a successful treatment, and others were irreparably damaged due to incomplete treatment or because a treatment method’s effects were unknown at the time.

When the re-treatment project began, the goal was to increase the number of displayable and/or researchable artifacts, specifically those made of organic materials such as wood, leather, and textile. The wood and other organics, which were initially treated with PEG or sucrose, now have large, disfiguring blooms on the surface. Many are adhered to their packing materials. Some artifacts were packaged without going through treatment of any kind. Of the treatments that were completed, there is a wide range of success and failure in the long-term condition of the artifacts.

At the beginning of the project, there was no inventory of artifacts available and the records needed organization and clarification. For example, a small collection of material had been loaned to a museum in Whitehaven, UK and had been lost to institutional memory until the project began. Therefore, the first step for this project was to inventory and condition assess all of the artifacts in order to get a sense of the state of the collection and to identify items that needed immediate attention. Many of the packing materials had degraded and the identifying information was partially or completely lost in some instances. Further digging into the records revealed that all objects in treatment when funding was cut were transferred to another facility while still in treatment. This new facility introduced a new numbering and identification system which was not thoroughly documented in our records. For many objects, this led to the loss of the original context numbers and the introduction of a numbering system that overlapped with the previous numbering system.

As previously mentioned, some artifacts were found to be untreated and unwashed. Textiles were found still in river mud and there were concretions that had not been desalinated. Figure 1 illustrates the range of different conditions encountered just within the textiles from the wreck.

Among those objects that had been stored in their treatment solution thirty years ago, some containers had a sufficiently good seal that the solvent had not completely evaporated (Figure 2). Other containers had allowed the solution to dry out creating a chemical cake around an unidentified object(s) (Figure 3).

Step two of the project was to begin re-associating original documents and treatment records with the artifacts whenever possible. The state of the records made this especially difficult. Some records had been burnt, possibly due to heated solutions in the lab which had already caused fires during the treatment of Betsy artifacts (ECU Report 1990, YSAP Report 1984). Many “before treatment” photographs were overcrowded, overexposed, or did not include the entire object, and very few photographs were taken after treatment (Figure 4). Occasionally it was possible to re-associate the object with the original record where the original drawing or photograph was of a sufficiently high quality, but unfortunately, it has not been possible for all artifacts. In some
cases, a very thorough description existed and has helped with identification.

The two goals of this phase of the project were to identify which methods had been successful and determine a methodology to better predict the treatments used for objects with no records (drying methods, treatment materials, solution concentration, etc.). This idea was quickly discarded as it became apparent that there had
been no consistency in the application of treatments. While many of the treatment materials could be easily identified visually or by smell, methods differed even between the same types of object. This is demonstrated by the treatment approaches to the only two artifacts identified at the time as pitch buckets from the site (Figure 5). One was treated with sucrose and the other was treated with PEG, with no records explaining the choice to treat the two buckets using different methods.

Of the treatment methods used, PEG has proved to be the most successful long-term treatment. Artifacts treated with acetone/rosin have “bubbles” of rosin on the surface causing yellowing, and the rosin is difficult to remove from the surface. Although initially PEG 4000 was identified as “perhaps the best” method for treating large wooden objects, acetone/rosin was used because of its ease and a belief that the result was as successful as PEG treatments (Klingelhofer, 1979). Later the treatment of large wooden objects was switched to the use of low or mixed molecular weight PEG without any documentation to explain the change. Due to incomplete records, it is unclear whether this change was because of a change in conservators or a product of another decision process. As a result of this change, we have several acetone/rosin treated wood objects in the collection that are now withered and fragile with re-treatment complicated or impossible due the irreversibility of the acetone/rosin treatment.

Artifacts treated with the sucrose method show both successes and failures. Long-term, the biggest issue has been the migration of the sucrose to the surface and a loss of structural stability that is afforded by bulking agents. Every object that was treated with sucrose shows crystallization on the surface leaving a hazy or sparkly appearance. While the sucrose on the surface can be reduced, this only solves the issue temporarily until the next minor fluctuation in the humidity results in more surface crystallization.

The PEG treated artifacts exhibit a sticky surface due to excess solution not being removed at the time of treatment, as well as migration of the PEG to the surface. Low molecular weight PEG is not a solid at room temperature, and therefore causes more issues with stickiness than its higher molecular weight counterparts. The PEG did provide the support needed during drying, which has meant that structurally the PEG treated wood is in better condition than those treated with sucrose or acetone/rosin. The added benefit of the PEG treatments has certainly been their reversibility and the relative ease by which the original treatments can be supplemented with higher molecular weights for better results.

To reduce surface cracks and bring artifacts closer to their original form, a few wooden artifacts are being treated in a humidity chamber. With limited space and budget, there has been a need to be very conscious in choosing methods for treatment and the equipment purchased for this project. For this reason, a temporary humidity chamber that can be disassembled and the parts reused has been built (Figure 6). Any objects in the humidity chamber must be monitored for mold activity, which to date has not been an issue, and will be addressed if it develops. By using a humidor humidifier for our chamber, we could maintain a very consistent high relative humidity in an economic way.

There have been several surprises during the retreatment project. One of the most unexpected surprises was the discovery of dangerous materials that were not documented in the surviving records. Black powder, which was identified as still live during a flash test, was recovered from a concretion, and misidentified during the original treatment. It was determined that the black powder spheres were the cores of grenades from the American Revolution and were all that remained after the rest of the grenade had corroded away. This was problematic as many grenade cores were recovered and stored with the rest of the Betsy artifacts. Some showed a surface coating of wax while others were not coated and clearly had a
Since many of the concretions were originally treated with acids and other chemicals, we were very concerned about the chemical stability of the material. Another surprise was a fibrous material resembling asbestos that was found on multiple objects. It was feared that a material, perhaps a support used during the original treatment, may have contained asbestos. The original treatment facility was noted as having asbestos during an inspection and could be another source of the fibers (Broadwater, 2018). This has since been identified as fiberglass, which is less hazardous, but still not optimal when considering the possible health implications. There are no records that suggest a source for this material and the remaining members of the original team have no recollection of any such material being used. It is therefore disconcerting that so much fragmentary fiberglass has been found on artifacts in the collection.

The problems of aging treatments are not unique to the VDHR and we are hoping that the information gained during this retreatment project will be useful to other labs with similar issues. We hope to test the feasibility of retreating artifacts with more modern and stable products and the success of sucrose removal followed by PEG impregnation. Another goal of the project is to gain information on the long-term interactions between sucrose and other treatment materials such as adhesives. There has not been much research on this to date, but with the need to build upon previous treatments with this collection; more research needs to be done. There are still a lot of questions to be answered and testing to be done and we plan to continue to share our work with the goal of adding to the profession’s understanding of these kinds of materials.

References

Broadwater, J., Yorktown Shipwreck Project Lead Archaeologist, personal correspondence, 5 November, 2018.


Yorktown Shipwreck Project Conservation Record 230, 5 April, 1984.

Figure 4: An example of a record that had been burnt (left). A typical before treatment photograph (right).
**Abstract**

In 2013, The Restoration Center of the Institute for the Protection of Cultural Heritage in Slovenia established a department for the conservation of waterlogged organic archaeological objects. It is the first of its kind in Slovenia, although there had been some previous attempts to conserve waterlogged organic objects. To learn more about different methods and processes, their specific requirements, and the properties of consolidated objects, different consolidants or bulking agents were applied to a pole from the prehistoric pile dwellings on Ljubljana Moors. Three different materials were applied: melamine resin, PEG 2000 and saccharose. A difference was observed in the time consumption and amount of material used, as well as the uptake of the different treatment
and the final appearance of pieces conserved by different methods. FTIR spectroscopy and scanning electron microscopy (SEM) were applied to investigate the distribution of the treatment materials in different depths of the tested samples. Compression tests were used to observe mechanical properties of consolidated samples.

**Keywords:** waterlogged wood, Kauramin, PEG, saccharose, SEM, FTIR.

**Introduction**

In 2013, The Restoration Center of the Institute for the Protection of Cultural Heritage in Slovenia established a department for the conservation of waterlogged organic archaeological objects. It is the first of its kind in Slovenia, although there had been some previous attempts to conserve waterlogged organic objects (Erič 1997). Ljubljana Moors and several other waterlogged sites are rich with archaeological finds, which had mainly been subject to passive conservation in the past, with a few attempts to conserve wood with saccharose or PEG (Erič 1997).

To learn more about different methods and processes, their specific requirements and properties of consolidated objects, different treatment methods were applied to a pole from the prehistoric pile dwellings on Ljubljana Moors. The project initially designed to give the conservators an opportunity to study different treatment materials as well as to create samples for public presentations. For the purposes of public outreach, a piece of wood was also left untreated. Later we saw the opportunity to learn more, not just about the conservation processes, but also about the properties of the treatment materials and conserved objects by applying infrared spectroscopy (FTIR) as well as scanning electron microscopy (SEM).

**Experimental**

**a) Consolidation methods**

A pole from prehistoric pile dwellings on Ljubljana Moors ($U_{\text{max}}$ over 600), which had previously been cut into 2.5 cm thick slices and cleaned thoroughly in demineralized water, was used. Three different treatment materials were applied: melamine resin (Kauramin 800, BASF), PEG 2000 (Sigma-Aldrich) and saccharose (table sugar). Standard processes were used (Wittköpper 2010; Mühlethaler 1973; Dumkow and Fendel 1992). The final concentration of melamine resin was 25 %, of PEG 2000 two final concentrations were applied: 40% and 100 % and of saccharose 70 %. Because we do not have a vacuum freeze-dryer we were forced to look for other possibilities to simulate the process of freeze-drying, and we decided to try the process using silica gel in a normal household freezer (Pokupčić and Wiinblad 2013). Due to health and safety concerns and the costs associated with treating large objects, no methods based on organic solvents were selected.

Our aim was to learn more about the processes and the materials, therefore we documented the impregnation and drying for each piece to observe not only the final result but also the time taken.

**b) Microscopic and spectroscopic analysis**

Fourier transform infrared spectroscopy with attenuated total reflectance (FTIR ATR) was used on the samples. Small pieces were taken from different areas of the analyzed objects – surface, middle part and core, as seen in figure 1. FTIR ATR was used to chemically define the depth of the penetration of treatment materials. Analyses were performed using a PerkinElmer Spectrum 100 spectrometer with attached germanium ATR crystal. For each analysis 16 scans were averaged in the range between 4000 cm$^{-1}$ and 600 cm$^{-1}$ at the spectral resolution of 4 cm$^{-1}$.

Scanning electron microscopy (SEM) was used to observe wood microstructure and distribution of treatment materials within the cells and pores. Similar areas to those analyzed with FTIR were looked at. Analyses were performed on a JEOL 5500 LV SEM in low vacuum mode at different magnifications without any sample preparation.
c) Mechanical tests

Compression tests were performed on samples in both the fiber direction and transverse to fibers to observe the strength of the samples treated by different methods. Analyses were carried out by researchers at Faculty of Civil and Geodetic Engineering. Blocks were cut the test samples in radial direction with 1 cm² surface and height of the samples (2.5 cm, Figure 1).

Results

a) Observation of treatment times

Differences were observed in the treatment times and amount of material used, as well as the uptake dynamics of the different treatment materials and the final appearance of the pieces. Figure 2 shows the uptake in the weight of the samples over the length of the treatments. As observed from the results, melamine resin and PEG 2000 (40 %) need similar time to be incorporated into the wood structure. Samples treated with either material took approximately six months to treat. If we had stopped treating the melamine samples after their mass stabilized, the treatment time could have been halved for objects of this size. Saccharose took longer, about one year, for the final mass to stabilize. The longest treatment time based on mass uptake was for 100 % PEG 2000, approximately two years (not shown in diagram).

b) Properties of consolidated samples

In Table 1 organoleptic observations are listed. Samples varied in weight, in color as well as feel. The heaviest are the 100% PEG 2000 and saccharose treated samples and the lightest the 40% PEG treated samples and the freeze-dried samples.

Samples that were freeze-dried only, were considered as a standard or reference to compare with the other treated samples. The freeze-dried samples were very light, with a visible wooden structure. They would distort if not handled gently and, when cutting samples, the cell structure distorted to some extent. Cells were clearly visible under SEM; however, cell walls were rather thin, sometimes only fibrils of cell walls are visible. FTIR spectra of wood from the surface resembled the interior of the sample, with stronger carbonyl bands on the surface. These would suggest oxidation on surface of the wooden pole, which probably occurred during burial. FTIR spectra show cellulose features, however the lignin spectra are clearly visible as well suggesting partial cellulose degradation.
In the melamine treated samples, resin was observed with the SEM, mainly sticking to the surface of the cell walls, and sometimes filling the cell walls. The melamine covered the surface of the pole but was only visible with the SEM and not with the naked eye. This may account for the matte, powdery surface of the treated objects. The brightness of the samples was a bit surprising; however, we were pleased to see the wood structure. FTIR spectra showed the presence of both melamine and wood throughout whole samples and confirmed that there was a larger proportion of melamine resin on the surface of the wooden pole.

Figure 3: FTIR spectra of freeze-dried sample (solid line), melamine treated (dashed line) and 40% PEG 2000 treated samples (dotted line). Treatment materials prevail however, wood vibrations can be visible as well.

The 100% PEG 2000 samples were also filled with the treatment material. Samples appeared dark after consolidation and had a waxy feeling. PEG 2000 was observed in the pores and cells, as well as on the surface, whereas the wood remained lighter and could be clearly distinguished, when the samples were cut. Under SEM the resin in cells could be clearly distinguished. FTIR spectroscopy predominantly revealed PEG 2000 bands, as well, whereas bands belonging to wood constituents were barely visible. No differences were observed between surface and core of the samples.

The 40% PEG 2000 combined with freeze-drying samples were lighter and brighter than the 100% PEG 2000 treated samples, and the wooden structure was visible. The surface was still slightly waxy to the touch. Smaller pores were filled with consolidants, whereas larger pores were open but consolidant was visible. PEG 2000 vibrations prevailed in the FTIR spectra, however more wood bands could be observed. No differences could be seen between the surface and the interior of the sample.

The Saccharose treated samples were treated according to the literature (Wittköpper 2010). The solution was heated to reach higher concentration at the saturation point (70 %) and the objects were dried in sealed PE bags to slow down the water evaporation. However, the samples became deformed, which suggests that the final concentration of the consolidant was too low. Despite that fact, the cells appear to be filled with consolidant, which was observed on the surface of the sample as well. FTIR showed a distinctive polysaccharide spectrum, typical of saccharose, masking the spectra of the wood.

The results of the compression tests were indicative and expected. They showed the largest resistance to compression in the melamine treated samples, followed by the 40%

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Properties of conserved object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melamine resin</td>
<td>bright color, matt surface, visible wooden structure, light, formaldehyde smell</td>
</tr>
<tr>
<td>Melamine resin after freeze drying</td>
<td>hard, visible wooden structure, heavy, consolidant on surface, formaldehyde smell</td>
</tr>
<tr>
<td>PEG 2000 100%</td>
<td>almost black, heavy, waxy appearance and touch, no visible wooden structure</td>
</tr>
<tr>
<td>PEG 2000 40% and freeze drying</td>
<td>brown color, light, visible wooden structure</td>
</tr>
<tr>
<td>Freeze drying</td>
<td>brown, very light, darker than melamine, visible wooden structure, on touch resembles expanded polystyrene foam</td>
</tr>
<tr>
<td>Saccharose</td>
<td>dark brown, heavy, distorted appearance</td>
</tr>
</tbody>
</table>
PEG 2000 and freeze-dried samples. 100% PEG 2000 treated samples had lower compression strength than 40% samples. The least resistant were, as expected, the unconsolidated freeze-dried samples. Contrary to the case in contemporary woods, in the treated samples the transverse strength was higher than the longitudinal (Bokan Bosiljkov 2018).

Conclusions
The aim of our study was to get as much information as possible about the treatment techniques and properties of the treated samples. This study was not carried out to rate different methods as better or best; each method has its advantages and disadvantages. The results will help us when we need to decide in the future for the most appropriate method for conservation of waterlogged wooden archaeological objects.

Acknowledgement
The author would like to thank Nuša Saje for taking care of sampling during the treatments.

References


Objectively, this approach has certain limitations. There can be a real feeling of isolation when you are confronted with a specific problem. Publications and conferences disseminate results but may also impose constraints on accessibility and frequency. Some areas of our work are too specific or unusual to warrant publication. Consequently, we may not be able to access existing knowledge that would be helpful. Publications often focus on the scientific parameters of treatments and the practical side in the laboratory work is under-represented and information is difficult to access. Moreover, attendance at conferences requires an investment of time and money both for speakers and attendees. While the interest of conferences is undeniable, it is difficult to present work that results from a collaborative approach between different institutions. Therefore, it is likely that some opportunities for exchanges and learning are lost.

In view of this, we would like to propose a new, easy, protected and accessible tool to ensure regular exchanges and create an online community of people working in the field of archaeological restoration and conservation. This tool would aim to informally collect, share and disseminate not only research but also practical advice and feedback, based on the everyday experience of people working in our conservation labs. The site is reserved for conservation professionals. It is hosted by the Arc'Antique IT department, access is managed and secured by Arc'Antique. The limited access is not an inconvenience because the goal is to promote the exchange of knowledge between professionals.

To supplement - and not to replace - the means at our disposal to access knowledge, you are invited to participate in the co-construction of a collaborative website “Let’s ORG” (Figure 1). As part of a participatory project, this tool aims to present, on a permanently accessible basis, experiments, practices and knowledge that everyone would like to share with the community.

2. Tool

It is capable of hosting both data and exchanges. Therefore, participants will be able to complete a simple database for practices and case studies. Documentation may also be uploaded.

a. Data form
For the data part, uses will be asked to fill in a form dealing with a single case. The information will then be made available on the site using one or several keywords.

Concretely there would be two forms: the first would be used to enter information and would give rise to a final document. The second would be used to access all the information that had been contributed.

We would ensure the data-processing tool is easy, practical, and quick to fill in.

b. Exchanges / blogs
Two blogs will be included on the site. The first will be a FAQ on conservation-restoration issues. Everyone can answer and comment if the subject concerns them.

The second blog will focus on how the collaborative website works. The site will then be improved continuously based on participants’ input.

3. Development
At present, our tool is being built. Our aim is for the construction of the site to be participatory. We want each of you to help this project take shape. Today, we are presenting only a general framework of the site with a few finalized sections as examples: the characterization and extraction phases of ferrous compounds.

The site also includes a questionnaire that participants are asked to fill in, to produce a
conservation report. There will be the following headings: archaeological context, identity of the object, conservation state, conservation treatment (storage – analysis - iron and sulfur extractions – consolidation/drying – deacidification – display). The form is the same for each material. A summary description is guided by drop-down lists to increase ease and efficiency of use. To enable this, we need to agree on a common vocabulary of items like degradation terms.

4. The Arc’Antique commitment: This tool needs a huge human investment that we are ready to assume. At Arc’Antique, we have experience in using collaborative sites permitting technical and scientific exchanges between conservation professionals. We would be happy to share, freely, our experience on this type of cooperation. Arc’Antique will take care of the maintenance of the site and the life of the information shared through it. This site must provide permanent accessibility to the data-processing tool via Internet.

Access to this site will be secure and restricted. It will only be accessible after validation by the administrators. An identifier and password are then delivered to access the site. All information shared on the site will only be accessible by members of the site. All members are identified and visible on a web page.

There are several categories of access to the site:
1- administrator: to build - physically modify the site, accept - refuse or delete registrations.
2- collaborator: addition - deletion - modification of documents completed by third parties
3- contributor: addition - deletion - modification of their own documents. Contributors cannot modify other members’ documents.
4- reader: consultation of documents only.

Most users will have the status of contributor. This will enable them to be responsible for the documents they share. Only the administrators (Gwenaël Lemoine and Charlène Pelé-Meziani, at present) will be able to intervene on these documents, after validation of the interested parties.

This website aims to support existing tools and does not seek to replace exchanges between conservation professionals in any way.

5. Perspectives
This website will enable the collection of all studies that have been conducted - published or not- on the conservation-restoration of organic materials. The results of studies or practical treatments may vary according to the type of corpus. The wide variety of objects could make it difficult to apply in other labs. Ideally, all the contributions to the website could result in the production of a flowchart which would help us move towards improved treatment for each type of material in various environments. For example, as part of our involvement in the issue of waterlogged organic material impregnated with iron compounds, tests on chemicals have so far failed to define a specific chemical. This is because we have mainly worked on oak, due to the limited availability of archaeological samples, and have worked only on a single level of wood degradation. On the website, we could gather together experience from all around the world and assemble them like pieces of a puzzle. The missing information would be highlighted, and studies can be carried out to complete the flowchart. The website aims to be a co-creation and upgradeable tool for the conservation and restoration community.

To reach the website:
1/ send an email to the administrators (charlene.pele-meziani@loire-atlantique.fr or gwenael.lemoine@loire-atlantique.fr)
2/ you will receive a confirmation email with your identifier, your password, and a link to accept the invitation

Acknowledgements
In presenting this document, we would like to thank the information technology (IT) of the Department of Loire-Atlantique, including Angélique Desponts and Stéphanie Breger-Labarrère for supporting us in setting up the collaborative space.
Figure 1: Screenshot for Let’s Org
Thanks to the Foundation of the American Institute for Conservation/Tru Vue Professional Development Award, I was able to participate in the four-day course “Vacuum Freeze-drying of Waterlogged Archaeological Wood for Conservators.” The course was organized by the Organisationen Danske Museer and the National Museum of Denmark and held in the museum’s Artefacts Conservation Department in Brede from 4 – 7 September 2018. The Artefacts Conservation Department is in the beautifully converted Brede Works, a historic factory complex from the late 19th – early 20th century on the outskirts of Copenhagen. The workshop was expertly taught by Poul Jensen, Lars Brock Andersen, and Nanna Bjerregaard Pedersen and was well-attended, as there were 30 participants from all over the world.

Conservators and scientists at the National Museum of Denmark have been engaged in the research and use of PEG 2000 (and other impregnation agents) and vacuum freeze-drying to conserve waterlogged archaeological wood for over two decades. They have several years of data and many examples of treated artifacts to demonstrate that the combination of PEG 2000 and vacuum freeze-drying produce the most stable, optimal results. As conservators, we always strive for the best possible treatment outcomes for artefacts in our care and remain up to date in our knowledge of conservation materials and techniques. The course presented a rare opportunity to delve intensively into treatment methods for wet archaeological wood. For these reasons, I was keen to attend the workshop.

The workshop began with the fundamentals, or basic concepts, of freeze drying, the properties of wood, and assessment of the PEG, Mannitol, and Sucrose impregnation agents. These lectures were thorough, well-organized, and a useful review of the content, which established a foundation that subsequent lectures steadily built on. Once the basic concepts were established, the presenters delved into the specifics of planning the conservation process, such as selecting the optimal working parameters of the freeze dryer and determining the end point of the freeze-drying process. Lectures were intermingled with hands-on exercises. The practical exercises complemented the lectures and covered techniques for determining the degree of degradation of waterlogged wood, methods for analyzing the PEG impregnation solutions, and planning the conservation process/treatment. In one
exercise, I particularly liked the use of a handheld sugar refractometer for monitoring PEG solutions. The refractometer is a quick and accurate way to monitor the PEG impregnation solution and determine when the percentage of PEG needs to be increased and, ultimately, when to remove artifacts from the solution. An important take-away or realization from the course is that the interaction between the impregnation agent and the wood is not entirely understood. PEG 2000 works but there is still research to be done to answer why it works. Mr. Brock-Andersen suggested more research could be done looking at the material when it is at the freezing point.

Course participants were also treated to a guided tour of the wet wood conservation laboratory by conservators Anette Hjelm Petersen, Anne Moesgaard, and Jan Brunn Jensen. They discussed how their laboratory was set up, the various artifacts they were working on, and some of the challenges they have experienced. Most of the projects in the lab were wood timbers from different ship hulls but there was also a wood bucket from the Viking period and leather shoes and gloves that dated to the 17th-18th centuries. The laboratory and freeze-drying equipment were impressive. There were many features to admire: such as the extensive track system built into the ceiling that provided the means to move the crane/hoist around the lab to lift and transfer heavy artifacts; long steel tables, with tops that sloped gently to the center, that were used for washing/cleaning wood timbers; and the immense size of their large freeze dryer, with a chamber that was 8 m long and 2 m in diameter! Throughout the tour, we also had the opportunity to share, compare, and discuss tips in lab design and treatment methodology of wet organic artefacts; this presented another enjoyable opportunity to connect with our new colleagues.

Touring the wet wood conservation laboratory. The museum conservators discuss how these planks from a ship hull are being supported and reshaped.

The material covered over the four days is very relevant to the work I undertake at the Maryland Archaeological Conservation (MAC) Laboratory. The content the instructors presented exemplified decades of teaching and invaluable research in the use of polyethylene glycol (PEG) impregnation and vacuum freeze-drying to conserve waterlogged archaeological wood artefacts. By the end of the course, I and other participants from North America were converts of PEG 2000. The course provided the research data and justification to reexamine, adjust, and improve the treatment protocols we currently use at the MAC Lab to conserve waterlogged archaeological wood artefacts. I wish to express my gratitude to the course organizers and presenters for sharing their tremendous wealth of knowledge and expertise.