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<thead>
<tr>
<th><strong>Title</strong></th>
<th>Dendrochronological analysis of oak from a shipwreck, Skjernøysund 3, Mandal, Norway</th>
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</thead>
<tbody>
<tr>
<td><strong>Authors(s)</strong></td>
<td>Daly, Aoife</td>
</tr>
<tr>
<td><strong>Publication date</strong></td>
<td>2011-09</td>
</tr>
<tr>
<td><strong>Series</strong></td>
<td>Chronology, Culture and Archaeology (CCA) reports; 2</td>
</tr>
<tr>
<td><strong>Publisher</strong></td>
<td>University College Dublin. School of Archaeology</td>
</tr>
<tr>
<td><strong>Item record/more information</strong></td>
<td><a href="http://hdl.handle.net/10197/3559">http://hdl.handle.net/10197/3559</a></td>
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</table>
Dendrochronological analysis of oak from a shipwreck, Skjernøysund 3, Mandal, Norway

September 2011
CCA report 2 (September 2011)
Dendrochronological analysis of oak from a shipwreck, Skjernøysund 3, Mandal, Norway

Aoife Daly, Ph.D.

Marie Curie funded project: Chronology, Culture and Archaeology, based at the School of Archaeology, University College Dublin. The main theme of the project is the analysis of short tree-ring sequences but other themes are also addressed, namely maritime timber, digital data sharing and non-destructive analysis. The analysis described in this report is within the maritime timber theme, and is in collaboration with Jørgen Johannessen, Norwegian Maritime Museum and Jens Auer, University of Southern Denmark.

In this report the dendrochronological analysis of 20 oak samples from a shipwreck named Skjernøysund 3, Norway, is described. In the interest of access to data and to enable researchers to utilise this material in the future, all measurements are submitted to the Digital Collaboratory for Cultural Dendrochronology (DCCD, www.dendrochronology.eu).

The 20 samples come from different constructional components of the ship, and from the ship’s cargo. All but one have been dated (see fig. 1).

**Ship’s frames**
Three samples are taken from the ship’s framing timbers. Sapwood is preserved on all three, and complete sapwood on two of these samples. The bark ring in each of these is fully formed, showing that the trees were felled in the winter or early spring. One sample (frame 207) is from a tree that was felled in winter AD 1387-88 while frame 224 is from a tree that was felled in winter AD 1389-90.

**Ship’s planks**
Seven of the dendrochronology samples are from planks, and two of these have sapwood preserved, of which one has complete sapwood to bark edge. Two outer planks have only heartwood preserved. Allowing for missing sapwood, the felling date for the trees that were used to make the ship’s outer planks is estimated at after AD1385. (A number of estimates for the average number of sapwood years in oaks in Northern Europe have been calculated, and in northern Poland, oaks have an average of 15 sapwood years (-6 +9) (Wazny 1990). It is this sapwood statistic that is used here.) Two loose planks likewise have only heartwood preserved. The trees for these planks were felled after AD1376.
One of the three ceiling planks (361) has, as mentioned above, complete sapwood to bark edge preserved. The tree used for this plank was felled in **winter AD1389-90**.

**Mast step chock**
The sample from a chock associated with the ship’s mast step has sapwood preserved. Allowing for missing sapwood, the tree, from which this piece was made, was felled in c. AD1388-96.

**Ship’s cargo**
Seven planks from the ship’s cargo were also analysed. Sapwood was preserved on six of these, and bark edge could be confidently identified on two. Again, the bark ring on these two are fully formed, so the trees these planks come from were felled in the winter. The felling date for both trees that the samples with bark edge come from is **winter AD 1393-94**.

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**Repair/Chock**
A wedge of timber from the ship is also analysed. This has complete sapwood to bark ring preserved and is from a tree that was felled in **winter AD 1393-94**. This timber thus probably should be seen as belonging not to the original ship’s structure, but rather to a repair, or from the packing of the cargo.
Table 1. The results of the calculation of correlation between the tree-ring curves from each sample from the site with each other. The grey tone highlights the high t-values.
Stray timber
One sample is taken from a loose timber and might not have any real association to the shipwreck. This sample contains 89 tree-rings, but could not be dated.

Provenance
The correlation (t-value) between the dated tree-ring curves from the ship and cargo timbers from Skjernøysund 3 is shown in table 1. It can be seen that a very high t-value is achieved between two of the ship’s planks (samples 212 and 233), but on inspection of the graph plot of the tree-ring widths from these two it is concluded that these are not from the same tree, and are therefore treated as two separate trees.

Even though the ship timbers and cargo timbers were felled circa four years apart, there is no very clear distinction between these timbers in terms of their internal correlation. Indeed, table 1 indicates a relatively diverse source of the ship’s timbers.

Three mean curves from the material have been made. Z076M001 is an average of the 14 tree-ring curves that match best together, as marked in table 1. Z076M002 is an average of the remaining five dated tree-ring curves, also indicated in table 1. Z076M003 then is an average of all dated samples.

The correlation between these three averages, representing the Skjernøysund 3 ship and its cargo, and diverse oak site and master chronologies for Northern Europe is shown in table 2. The timbers match best with a wide range of other timbers whose origin is the Southern Baltic region. Skjernøysund 3 matches best with objects and timbers (ship planks, panels etc.) that derive from the extensive medieval Baltic timber trade, and now found e.g. in England, and with chronologies built from timber found in archaeological sites and historic buildings from around the mouth of the Vistula River (Gdansk, Elblag etc.). The trees that were used to build the ship, and the trees that were felled to make the planks that were carried as cargo, probably grew in the Vistula hinterland.

Analysis
For measuring and for the analysis and the calculation of the t-value (“t-test”), ”DENDRO” (Tyers, 1997) and ”CROS” (Baillie & Pilcher, 1973) are used. In the analysis master and site chronologies for Northern Europe are employed.
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Table 2. The results of the calculation of correlation between the chronologies for the shipwreck and cargo and diverse site and master chronologies from Northern Europe. The source of the chronologies is given. The grey tone highlights the high t-values.
Literature


Daly, A. Bovet Læsø vrag. *Dendro.dk rapport nr. 8*, 2009, Brønshøj.


## Catalogue

**Catalogue format:**

<table>
<thead>
<tr>
<th>Filename</th>
<th>Title and sample number</th>
<th>Tree species (QUSP = <em>Quercus sp.</em>, oak, PISY = <em>Pinus sp.</em>, pine, PCAB = <em>Picea abies</em>, spruce) and number of years measured</th>
<th>Chronological position of the tree-ring curve</th>
<th>Number of sapwood years, presence of bark</th>
<th>Felling date</th>
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Skjernøysund 311 cargo plank
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Dated AD 1172 to AD 1391
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Average ring width 122.17 Sensitivity 0.16
Interpretation AD 1392-6

Z076008a
Skjernøysund 331 cargo plank
Raw Ring-width QUSP data of 141 years length
Dated AD 1253 to AD 1393
15 sapwood rings and winter bark surface
Average ring width 144.15 Sensitivity 0.17
Interpretation AD 1393-94 winter

Z076009a
Skjernøysund 349 repair/chock
Raw Ring-width QUSP data of 210 years length
Dated AD 1184 to AD 1393
14 sapwood rings and winter bark surface
Average ring width 127.22 Sensitivity 0.17
Interpretation AD 1393-94 winter

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Skjernøysund 252 mast step chock
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Dated AD 1208 to AD 1388
13 sapwood rings and no bark surface
Average ring width 91.67 Sensitivity 0.20
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Skjernøysund 227 ceiling plank
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Skjernøysund 293 loose plank
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Skjernøysund 266 cargo plank  
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Interpretation AD 1387-88 winter

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<td>19 timber mean</td>
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Conversion: R = radial split plank, T = tangential plank, W = whole timber, S = squared whole timber, H = half timber, Q = quarter timber, O = other conversion. Pith: C = centre, V = less than 5 rings, F = 5 – 10 rings, G = greater than 10 rings.

Aoife Daly, Ph.D.

4th September 2011
Chronology, Culture and Archaeology (CCA). Funded through a Marie Curie Intra-European Fellowship (IEF) and based at the School of Archaeology, University College Dublin, the project is concerned with the precise dating of timber and wood from archaeological or historical contexts. As dating results emerge these are disseminated to project collaborators through this CCA report series. Full publication of the extensive material and methodological advancements will be prepared during the course of the project and submitted to peer review journals.