COST Action FP1302 STSM-report

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STSM Topic: "Methods for wood identification and dendrochronological dating of musical instruments"

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Period: 2016-05-04 to 2016-07-31

1. Introduction & Purpose of the STSM

The proposed STSM project was aimed to acquire methodological and technical expertise in wood-anatomy and dendrochronological dating of musical instruments. In particular the interest was to acquire the proper methods and techniques to perform wood identification and to analyse tree ring series with dendrochronological approach applied to musical instruments.

2. Description of the work carried out during the STSM

The main work carried out in at the University of Ljubljana was done in the laboratory under the supervision of Prof. Dr. Katarina Čufar and her collaborators Dr. Maks Merela, and Luka Krže.

The work was divided into two phases: the first phase to acquire the method of identification of different wood species used in general and those used in musical instruments construction, the second phase was used to acquire the dendrochronological dating technique of musical instruments.

In order to learn the methods, I started to work on wood identification. I practiced on widely used species (e.g., *Picea abies* and *Fagus sylvatica*) then on the identification of other selected species. I practiced collection and preparation of samples for microscopy (e.g. embedding, cutting) and microscopy analysis of sections. Once acquired the expertise to identify wood species, I learned how to perform dendrochronological analyses for tree ring dating in general and when applied to musical instruments. I learned: a) Core sampling, b) Tree-ring width measurement with two methods 1) using the measurement system Lintab and 2) using the image processing program ImageJ both in combination with the program TSAP-Win for the cross-dating of tree ring sequences. I learned cross-dating and dating of tree ring series. The question of constructing reference chronologies for dating was addressed as well.

Finally I applied the acquired techniques to perform wood identification and dendrochronological dating of various objects and of music instruments.

All samples for macroscopic wood identification were initially examined under a stereo microscope Olympus (up to 100 x magnification). Due to often very small dimensions of the samples taken from an object microscopic slides for wood identification can be prepared after

embedding in a media like paraffin. For the purpose of producing anatomical slides I prepared the samples following the procedure: 1) Identification and marking of the transverse, radial and tangential plane on the samples; 2) Dehydration and infiltration with paraffin in tissue processor LEICA TP 1020© (2002, Leica Microsystem) (Fig. 1a); 3) Preparation of paraffin blocks with a paraffin dispenser LEICA EG 1120© (fig. 1b sx) and heated electric forceps LEICA EG F© (Fig. 1b); dx); 4) Reduction of paraffin blocks; 5) Trimming of the paraffin blocks and cutting of samples with a semi-automatic rotary microtome LEICA RM 2245© (fig. 1c) obtaining sections about 9 µm thick; 6) Staining with a water solution of safranin and astra blue (Werf van der et al., 2007); 7) Preparation of permanent slides mounted in Euparal (Prislan et al. 2014) (fig. 1d).

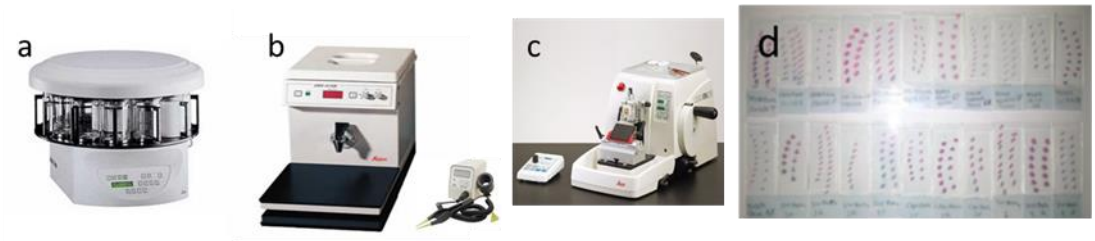

Fig.1. a LEICA TP 1020©, b LEICA EG 1120© and LEICA EG F©, c LEICA RM 2245©,d permanent slides mounted.

Identification was made on the basis of an analysis of the cross (fig.2 a), radial (fig.2 b) and tangential section (fig.2 c) of each sample. For identification of European wood species we used various identification keys (Čufar and Zupančič, 2009). We also used the common wood anatomy literature like Microscopic Wood Anatomy (Schweingruber, 1978), European woods (Schweingruber, 1990), and the on-line wood anatomy book and identification keys (Schoch et al., 2004). Wood identification was also made with help of the computer added identification key INTKEY (Richter and Dallwitz, 2000) which contains a database of wood descriptions and an interactive identification system for wood identification of commercial wood species from all over the world. In addition we used the on-line source InsideWood (Inside Wood, 2004, Wheeler, 2011), which contains illustrations and descriptions of wood species in agreement with IAWA lists of features for hardwood and softwood identification (IAWA Committee, 1989, 2004). The identification was performed with a Nikon microscope 800. Digital microphotographs were captured with Nikon DS-Fi1 digital camera.

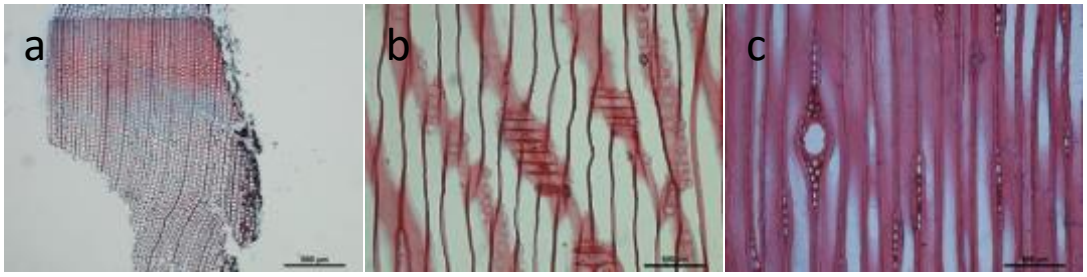

Fig.2. Cross a, radial b and tangential c section of *Picea Abies*.

Once acquired the method I started with identification of commercial and more exotic species, like those used for bows of stringed instruments (e.g. Čufar et al. 2007). Woods used for bows can be among others used in the genus *Manilkara* (Fig.3).

Fig.3. Cross, radial and tangential section of *Manilkara foilloyana* (from left to right)

In the second phase of the work I started to collect cores to practise with tree-ring dating. Cores of common hardwood and softwood species in Slovenia were collected. The cores were transported to the laboratory and air dried. The surface of the cores was polished using sanding paper. Afterwards tree-ring width measurements and cross-dating were performed using two different methods: 1) using LINTAB measuring table, stereoscope and TSAP Win software (Frank Rinn, Heidelberg, Germany) and 2) using scan image (1200 dpi) processed with the program ImaJ also combined with TSAP Win software (Čufar et al., 2015).

3. Description of the main results obtained

I applied the acquired techniques to perform wood identification and tree ring dating on a music instrument.
The aim was to date a violin from a Slovenian owner. The violin maker was not known. The only available part of the violin was the belly, were I performed the macroscopic identification with magnifying glass (10 x magnification) (Fig 4.). I identified a softwood with presence of resin ducts and without coloured heartwood. It was established that the belly was made of Norway spruce (*Picea abies*), in which is the most frequently used wood for violin bellies (e.g., Čufar et al., 2010).

Fig. 4: Macroscopic identification of wood of violin belly with magnifying glass (10x magnification).

The belly was formed by two parts of the same board wood section in fact the series of rings was repeated in the left and in the right part of the belly. The dating was carried out at the left part of the belly in the front side because it proved to be more suitable for the measurement respect to the back side. To perform the measurement of tree-ring width with the first method, using the image analysis software ImaJ, I positioned scotch tape in such a way as to obtain measures always perpendicular to ring boundary from the pith to the bark, counting the number of rings and added a scale bar for reference to take the scan image (1200 dpi) to process (Fig.5).

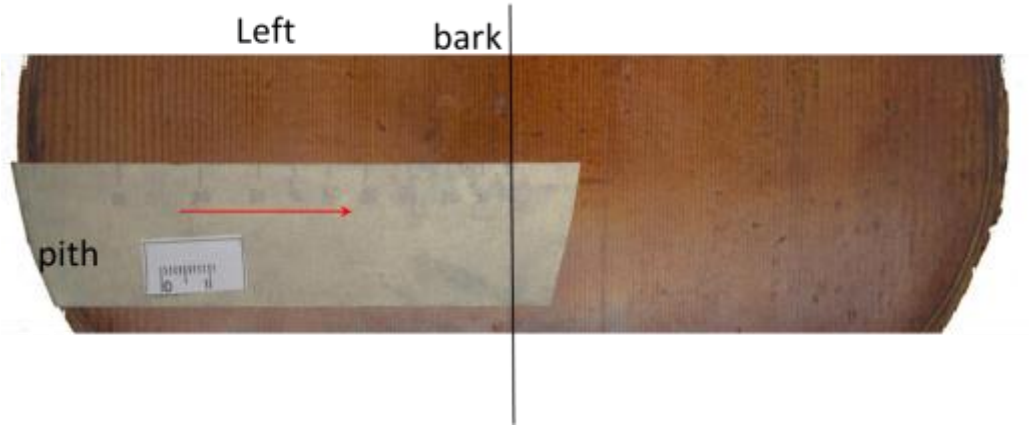

Fig.5. Left side of violin belly with direction of measurement (red arrow) from the pith to the bark.

I measured the tree-ring width with ImageJ and exported the values to Excel file.

Subsequently I also measured the tree-ring width with the second method measuring tree-ring directly from the belly with LINTAB and TSAP Win system (Fig. 6).

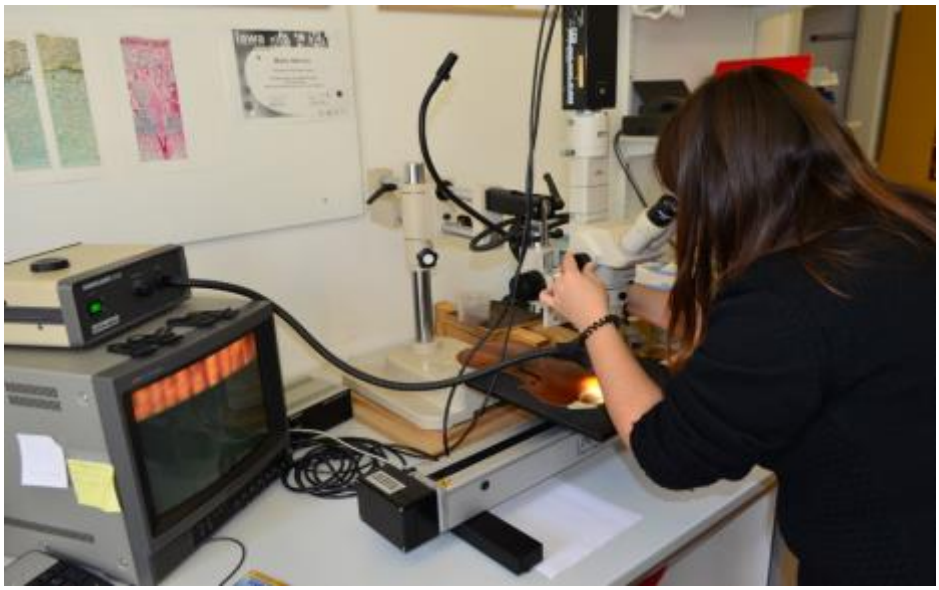

Fig.6. Measuring tree-ring width on the violin belly with LINTAB measuring table and TSAP Win software

Cross-dating was performed with TSAP Win software, using the obtained tree-ring series using the two methods, with different reference chronologies (Čufar et al., 2015).

The most significant match, for both tree-ring series was obtained with the reference chronology of spruce from Austria (table1).

Table1. Results of cross-dating showing the dating of the last ring (DateR) to calendar year 1928 with 4 chronologies (CRO1, CRO2, CRO3, CRO4). The most significant match was obtained for CRO2 with GLK=63**, TVBP=4,6 and TVH=5,2 (red bold); GLK-Gleichläufigkeit, TVBP-t-value after Baillie and Pilcher and TVH-t-value after Hollstein.

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*** TSAP CROSS-DATING     ***  DATE:  2016.07.20  TIME: 08.03. ***

Sample     (=Single): Vio07DLM                 PCAB
Reference  (=Single): CRO1 (BAW, Ger)       PCAB     0      330  1622  1951
Dating
Sample    Ref.      PosL  PosR   OVL Glk GSL     TV  TVBP  TVH    CDI  DateL  DateR
Vio07DLM CRO1       212   307    96  57      11,4   4,6   4,0    24   1833   1928

Sample     (=Single): Vio07DLM                 PCAB
Reference  (=Single): CRO2 (KLE, Ger)                0      170  1755  1924
Dating
  Sample     Ref.  PosL  PosR   OVL Glk GSL     TV  TVBP  TVH    CDI  DateL  DateR
Vio07DLM CRO2        79   174    92  63 **     7,3   4,6   5,2    31   1833   1928

Sample     (=Single): Vio07DLM                 PCAB
Reference  (=Chrono): CRO3 (Kalk, A)            PCAB     0      576  1421  1996
Dating
  Sample     Ref.  PosL  PosR   OVL Glk GSL     TV  TVBP  TVH    CDI  DateL  DateR
Vio07DLM CRO3       413   508    96  64 **     0,8   3,7   3,5    23   1833   1928

Sample     (=Single): Vio07DLM                 PCAB
Reference  (=Chrono): CRO4 (Ost, A)            ABAL     0     1021   977  1997
Dating
  Sample     Ref.  PosL  PosR   OVL Glk GSL     TV  TVBP  TVH    CDI  DateL  DateR
Vio07DLM     CRO4   857   952    96  66 ***    0,4   3,1   2,6    21   1833   1928

*** DATE:  2014.11.04  TIME: 08.03.  End of cross-date job.    **
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The dating according with the given chronologies shows that the outermost ring of the violin was dated to the year 1928 (Fig.7).

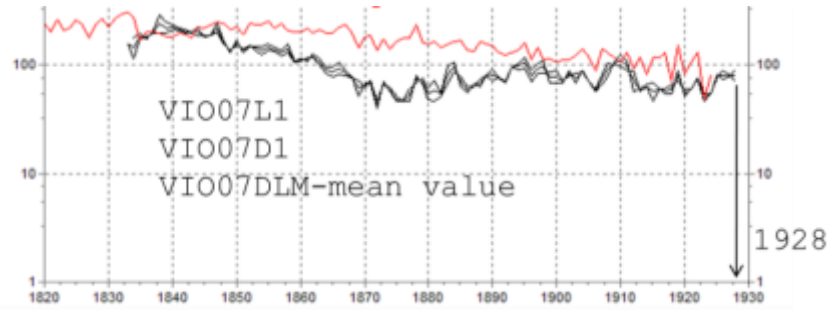

Fig.7. Tree-ring series of the violin (black) with the last ring dated to 1928, the reference chronology (red) and the end year 1928.

4. Future collaboration with the host institution

One of the main purposes of this STMS was to exchange the knowledge between the University of Naples Federico II, Dept. Agricultural and Food Sciences in Italy where I work as a doctoral student and the host University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology in the topic of wood related to the musical instruments. This offers great potential for future work and research in our historical areas.

5. Confirmation by the host institutions of the successful execution of the STSM

The confirmation letter of the host institution of successful execution of the STSM is attached in the file.

6. Authorization to post the report at the Action website

I agree that this report is posted at the Action website.

7. References

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