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Dendrochronological dating of two violins from private collections in Slovenia

Katarina ČUFAR¹, Micha BEUTING², Michael GRABNER³

Abstract

Dendrochronological analyses were made in two violins from private collections in Slovenia with an aim to date the wood of their resonance boards, to assess the time of their fabrication, to define the provenance of the wood, and to establish whether the labels of the instruments were original. The origin, the history and the exact age of the instruments had previously not been known. Tree-ring measurements were done on the surface of the bellies. In violin 1, it was made of one radial board, in violin 2 of two radial boards of Norway spruce (*Picea abies*). In violin 1, we measured 248 tree-rings and the year of the youngest ring was 1808. The dating was confirmed with more than 20 tree-ring chronologies from Austria, Germany, and Italy. The maximal value of the cross-dating parameter t -value after Hollstein (TH) was 12.4. In violin 2, we measured 141 and 137 tree-rings on each side of the belly, and the year of the youngest ring was 1640. The dating was also obtained by cross-dating with over 20 chronologies and confirmed with statistically significant TH up to 9.2. The year of the last ring in both cases corresponded with the terminus post quem, which indicated that the belly (instrument) was fabricated after the year of formation of the youngest ring. There is no evidence about the duration of seasoning and storage of the lumber, or how many tree-rings were removed when the instrument was manufactured. Our dendro-provenance study showed that the violin 1 most likely originated from Austria or southern Germany. The wood for the belly of the violin 2 possibly originated from Austria and the sequence significantly matched a chronology built from the instruments made by Jacob Stainer. In both instruments, the dendrochronological dating did not confirm the inscriptions on the labels on the inside of the instrument. The presented investigation was performed in 2008 and 2009 and is to our knowledge the first dendrochronological dating of music instruments in Slovenia.

Key words: violin, dendrochronology, tree-rings, dating, dendro-provenancing, Norway spruce=*Picea abies*

Dendrokronološko datiranje dveh violin iz zasebnih zbirk v Sloveniji

Izvleček

Opravili smo dendrokronološko analizo dveh violin iz zasebnih zbirk v Sloveniji. Cilj naloge je bil datirati branike na resonančnih deskah, ugotoviti, kdaj sta bili violini izdelani, od kod je izviral les in ugotoviti, ali so etikete na instrumentih originalne. Izvor, zgodovina in natančna starost instrumentov niso bili znani. Meritve širin branik so bile opravljene na pokrovih (resonančnih ploščah) obeh violin. Pokrov je bil pri violini 1 narejen iz ene in pri violini 2 iz dveh radialnih desk smreke (*Picea abies*). Na violini 1 smo izmerili 248 branik, najmlajša branika pa je nastala v letu 1808. Datiranje je bilo opravljeno z več kot 20 kronologijami širin branik smreke iz Avstrije, Nemčije in Italije. Najvišja t -vrednost po Hollsteinu (TH) je znašala 12,4. Pri violini 2 smo izmerili 141 oz. 137 branik, in to ločeno na vsaki strani pokrova. Datum najmlajše branike je bil 1640. Tudi ta datum smo ugotovili s sinhroniziranjem z več kot 20 kronologijami in ga potrdili s statistično značilnimi vrednostmi TH do 9,2. Leto zadnje branike v obeh primerih ponazarja terminus post quem, kar pomeni, da je bil pokrov (in najverjetneje tudi instrument) izdelan po danem letu. Ne vemo, kako dolgo so sušili in skladiščili les, preden so instrumenta izdelali, niti koliko zunanjih branik (gledano v drevesu) so odstranili pri obdelavi. Študija je pokazala, da les za pokrov violine 1 najverjetneje izvira iz Avstrije ali južne Nemčije, les violine 2 pa najverjetneje iz Avstrije, saj se je zaporedje širin branik najbolje ujemalo s kronologijo instrumentov, ki jih je izdelal Jacob Stainer. Pri nobenem od instrumentov datiranje ni potrdilo napisov na etiketah v notranjosti instrumenta. Raziskavi sta bili opravljena v letih 2008 in 2009 in sta po nam znanih podatkih prvi dendrokronološki datiranj glasbenih instrumentov v Sloveniji.

Ključne besede: violina, dendrokronologija, širine branik, datiranje, dendro-proveniencija, smreka=*Picea abies*

1 Introduction

1 Uvod

Dendrochronology is a widely accepted method for determining the age of the wood of music instruments. The bibliography of dendrochronology lists over 30 articles in different languages reporting on application of dendrochronology for studying music instruments (e.g. CORONA 1980, KLEIN 1985, KLEIN /BAUCH / MEHRINGER 1986, KLEIN 1996, POLLENS 2001,

TOPHAM / MC CORMICK 1998, 2000, GRISSINO-MAYER / SHEPPARD / CLEAVELAND 2004, BEUTING 2009a). These works confirmed that dendrochronological dating of instruments is possible and that it often solves the question of authenticity of the instrument.

When interpreting the results of dendrochronological dating, we must take into account that dendrochronology defines the date, i.e. the calendar year, in which the youngest measured tree-ring was formed. The dendrochronological date corresponds to the terminus post quem and indicates that the instrument was fabricated after the given year.

¹ prof. dr. K. Č., UL, BF, Oddelek za lesarstvo, Rožna dolina, Cesta VIII/34, SI-1000 Ljubljana; katarina.cufar@bf.uni-lj.si

² dr. M. B., Dendrochronological investigations on musical instruments and art objects, Contastrasse 14, 20253 Hamburg, Germany, DE

³ dr. M. G., University of Natural Resources and Applied Life Sciences (BOKU) Vienna, Peter Jordan Strasse 82, A1100 Vienna, AUS

The instrument usually does not contain the tree-ring that was formed immediately before the tree was felled. During the fabrication of the instrument, the entire sapwood or sometimes at least some tree-rings from the periphery of the board (stem) are usually removed. Furthermore, the seasoning of the wood for instruments often lasts several years. Due to this, it is often impossible to tell exactly how many years should be added to the dendrochronological date. For some instrument makers, e.g. Guarneri del Gesù, it has been shown that the time between the youngest tree ring and the dates on the labels were very close (KLEIN / POLLENS 1998, BEUTING 2009b). This indicates that they removed only few rings from the periphery. In other cases, the makers removed a great number of the rings from the periphery or even the entire sapwood. In the case of Stainer there was, as a rule, a greater difference between the dendrochronologically obtained dates and the dates on the label (BEUTING / KLEIN 2003).

At the Institute of Wood Biology of the University of Hamburg, over 600 music instruments had been dated until 2004 (e.g. BEUTING 2004). Currently, the laboratory for dendrochronological investigations on musical instruments and art objects of Micha Beuting works on approximately 4000 tree-ring sequences mainly derived from measurements on instruments. Based on this database, reference chronologies have been built for different geographical areas and producers. Such chronologies provide an important source of information for determining the origin of the wood. Establishing the origin of the wood by tree-ring analysis is called dendroprovenancing.

Beuting (2004) showed that it was possible to define the area from which the famous violin makers obtained most of the wood for their instruments. The wood was, as a rule, not transported over long distances, although such long-distance transport cannot be entirely excluded.

In case of string instruments, the dendrochronological analysis is made by measuring tree-ring widths on the upper part of the instrument (belly), which is usually made of two or rarely one radial board of Norway spruce (*Picea abies* Karst.). In terms of quality, such wood usually corresponds to resonance wood. The properties of resonance wood are not exactly standardized. Statistical analysis of wood in different instruments helped to classify the tree-ring widths in resonance wood (BEUTING 2004, BEUTING 2009). According to these studies, spruce wood used for violin bellies had a mean tree-ring width of 1.07 mm. Such wood is classified as "fine grained" wood.

Tree-ring measurements must be done in a non-destructive way on the surface of the belly. It is normally varnished, therefore it is often difficult to recognize the tree-rings. Dendrochronology determines the calendar year of tree-ring formation and helps us to estimate the time of fabrication of the instrument. Besides this, it is also very important to define the authenticity of the instrument, particularly when expensive exemplars of producers like Stradivari, Guarneri or Amati are in question. Each

instrument usually has a label on the inside of the resonance body, where the producer and the year of fabrication are indicated. Several studies report that such labels are often altered or faked (e.g. BEUTING 2004, GRISSINO-MAYER / SHEPPARD / CLEVELAND 2004).

We present dendrochronological analysis of two violins from private collections in Slovenia. The objective of the work was to date the wood of the belly, to evaluate the time of violins' fabrication, to estimate the provenance of the wood, and to test whether the label on the instrument is authentic.

2 Materials and methods

2 Material in metode

We inspected two violins from private collections in Slovenia. The violin 1 was investigated in 2008. The belly was made of one radial board of spruce (*Picea abies*). The instrument contained the label, which indicated that it was made by Francisco Stradivari from Cremona in 1742.

The violin 2, whose belly was made of two radial boards of spruce, was investigated in 2009. It contained two labels; one of them indicated that the instrument was made by Andrea Guarneri from Cremona in 1747, whereas the second label contained the number 1867. Both labels were handwritten.

In both cases we measured the dimensions of the instrument (Figure 1) and identified the wood species used to manufacture different parts of the instruments. Then we inspected the belly and selected the locations for tree-ring measurements. Measurements were done where the number and resolution of tree-rings were optimal. In the violin 2, we measured tree-rings separately on the bass and treble sides. We measured tree-ring widths to the nearest 0.01 mm using LINTAB measuring table, TSAP-Win programme, and Olympus SZ 11 stereo-microscope (Figure 2). The measurements were repeated independently by two persons.

The results were plotted as tree-ring width series versus time. The tree-ring series of the same object were cross-dated visually and statistically in order to identify and correct possible measuring errors due to poor resolution of the rings. During the next steps, tree-ring series of the instrument were joined into the average, i.e. the chronology of the instrument. Afterwards, they were cross-dated with several reference chronologies of the laboratories at the University of Hamburg, University of Ljubljana, University of Natural Resources and Applied Life Sciences in Vienna, and Laboratory for Dendrochronological Investigations on Musical Instruments and Art Objects in Hamburg. We also used the chronologies publicly available at the International Tree-Ring Data Base (ITRDB). We used more than 110 chronologies and about 4000 sequences derived from

musical instruments covering the time span between 1137 and 2009.

TSAP-Win Scientific 4.64 programme (RINN 1988, 1989) was used to calculate the standard cross-dating parameters: Gleichläufigkeit (GLK%) (ECKSTEIN /

BAUCH 1969), t-value after Baillie and Pilcher (TBP) (BAILLIE / PILCHER 1973), t-value after Hollstein (TH) (HOLLSTEIN 1980). Both t-values are standard in dendrochronology, but TH is more frequently used for dating musical instruments.

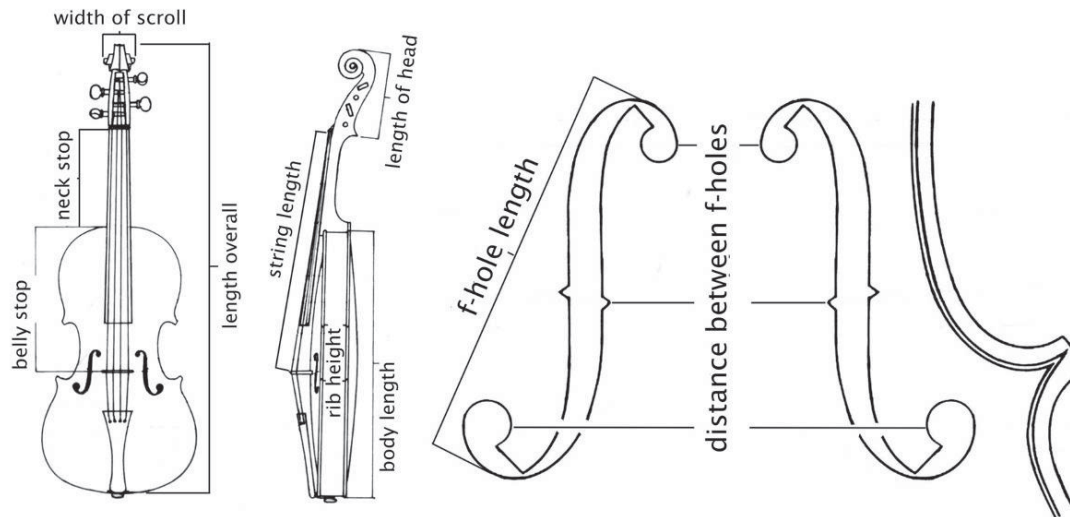


Figure 1. Organological measurements on a violin: the dimensions of the instrument, which are included in the report on dating (drawing Beuting)

Slika 1. Organološke meritve violine: dimenzije inštrumenta, ki so vključene v poročilo od datiranja (risba Beuting)



Figure 2. Measuring tree-ring widths on the resonance board of the violin: (a) with LINTAB measuring table and Olympus stereo microscope (magnification 10 – 100x) at the Department of Wood Science and Technology in Ljubljana, and (b) with the measuring device used at the laboratory of Micha Beuting in Hamburg consisting of lens (magnification 10 – 30x) produced by Krüss, and electronic gauge produced by Mitutoyo. Measuring accuracy of both instruments is 1/100 mm.

Slika 2. Merjenje širin branik na resonančni plošči na pokrovu violine: (a) LINTAB merilna miza in Olympus stereo mikroskop (povečava 10 - 100x), v laboratoriju na Oddelku za lesarstvo v Ljubljani in (b) merilna naprava, uporabljena v laboratoriju Miche Beutinga v Hamburgu, sestavljena iz sistema leč (povečava 10-30x) proizvajalca Krüssa, in elektronska naprava za merjenje, ki jo proizvaja Mitutoyo. Merilna natančnost obeh instrumentov je 1 / 100 mm.

3 Results and discussion

3 Rezultati in diskusija

3.1. Violin 1

For violin 1 (Figure 3), whose belly was made of a single resonance board, we constructed a chronology of the instrument containing 248 tree-rings (Figure 4). The tree-rings were on average 0.80 mm wide (minimum



0.2, maximum 2.95). The chronology of the instrument was dated with a number of local chronologies (of trees from known locations and instruments of known origin) and chronologies of instruments. We present statistical parameters (GLK; TH and TBP) for best matches with seven local chronologies and seven chronologies of instruments (Tables 1, 2). The youngest ring was dated to the year 1808. This date should be considered as *terminus post quem*; it indicates that the instrument (the resonance board) was made after 1808.

The fact that cross-dating with different reference chronologies gave the same date-end with different statistical values was used for dendroprovenancing. We attempted to define the origin (provenance) of wood for the instrument assuming that high agreement with a chronology from the known area indicates the origin of the wood. Similarly, high agreement with chronologies of different instruments allowed us to suppose that they might have been produced by the same shop or even the same instrument maker.

Figure 3. Violin 1 with belly made of a single spruce (*Picea abies*) radial board, with back and scroll made of maple (*Acer sp.*) wood

Slika 3: Violina 1 s pokrovom iz ene radialne smrekove (*Picea abies*) deske; spodnji del in polž sta izdelana iz lesa javorja rebraša (*Acer sp.*)

Table 1. List of the chronologies used for dating: (a) local chronologies of spruce (*Picea abies*) and (b) chronologies of instruments

Preglednica 1. Seznam kronologij za datiranje: (a) lokalne kronologije smreke (*Picea abies*) in (b) kronologije različnih instrumentov

| (a) LOCAL CHRONOLOGIES / LOKALNE KRONOLOGIJE | |
|---|---|
| Code / Koda | Description, span (length), and author / Opis, razpon (dolžina) in avtor |
| tw03_001 | Instruments-MK ¹ N Alps, 1491-1795 (305), BEUTING (2004) |
| tw02_001 | Instruments-MK, 1443-1804 (362), BEUTING (2004) |
| tw01_001 | Instruments-MK, 1382-1759 (378), BEUTING (2004) |
| 9999903M | Mittenwald Instruments, 1492-1857 (366), KLEIN et. al. (1984) |
| italchrn | Instruments-MK S Alps, 1418-1777 (360), BEUTING (2004) |
| 9999912M | Obergurgl, 1302-1974 (673), SIEBENLIST-KERNER (1984) |
| SwsPA | Dachstein Schwarzensee, 960 BC – 2003 (2964), GRABNER et al. (2001) |
| (b) CHRONOLOGIES OF INSTRUMENTS / KRONOLOGIJE INŠTRUMENTOV | |
| Code / Koda | Instrument, producer, ownership, inventory number², time span, length (years), instrument side³ / Inštrument, izdelovalec, lastnik, inventarna številka², razpon, dolžina (leta), stran inštrumenta³ |
| 2745701m | Violin, A. Posch, KHM SAM 564, 1580 – 1744 (165), MK |
| 2920102a | Cello, L. Widhalm, BM 4264, 1567 – 1736 (170), Tr |
| 2109913b | Violin, M. Klotz, private, 1554- 1702 (149), B |
| 2519924a | Violin, Stainer-copy, private, 1573 – 1746 (174), Tr |
| 1260101a | Trumpet marine, M. Hornstiener BM, 158, 1575 – 1780 (206), I |
| 2911506A | Bassettl, M.L. Widhalm, GMN, MIR 844, 1623 – 1784 (162), B |
| 2609904a | Violin, M. Hummel, GMN, MI 419, 1524 – 1624 (101), B |

Legend / Legenda

¹MK-mean chronology / lokalna kronologija

²KHM - Kunsthistorisches Museum Wien, Collection of musical instruments, BM - Musikinstrumentenmuseum Berlin, Stiftung Preußischer Kulturbesitz, GMN = Germanisches Nationalmuseum Nürnberg / kratice muzejev in zbirki ki hranijo inštrumente

³B = Bass/bas stran, Tr = Treble/sopranska stran, I = One piece/en del, MK = average sequence/povprečje več meritev, RB = Resonance board/ resonančna plošča

From the best seven matches with local chronologies, six were obtained with chronologies from the north of the Alps. Seven best matches with instruments were obtained for violins fabricated by Posch, Klotz, and Hummel, with a copy of Stainer's violin, and with two other string instruments of Hornsteiner and Widhalm. They all were Austrian or German instrument makers.

The best match of all was the one with the violin 2745701m of Anton Posch (Kunsthistorisches Museum Wien, Sammlung alter Musikinstrumente, Inv. Nr.: SAM 564)(GLK 74***, TH 12.4) (Table 2). The tree-ring sequences of our violin 1 and violin 2745701m also have

surprisingly good visual agreement (Figure 4), indicating that the wood might originate from the same forest. Unfortunately, the wood for our violin was felled more than 66 years after the death of Anton Posch (1677- 1742) who lived and worked in Vienna and was a good and highly esteemed instrument maker for the Austrian court especially between 1721 and 1739 (LÜTGENDORFF, 1975).

Our dating could not confirm that the producer was Francesco Stradivari in 1742. Francesco Stradivari (1671-1743) (LÜTGENDORFF, 1975) died before the last dated ring on the instrument was formed.

Table 2. Dating of the chronology of the violin 1 (248 rings) with (a) different local chronologies of spruce (*Picea abies*) and (b) chronologies of instruments. The end date is 1808.

GLK - Gleichläufigkeit, TBP - t-value after Baillie and Pilcher, TH - t-value after Hollstein

Preglednica 2. Datiranje kronologije violine 1 (248 branik) (a) z lokalnimi kronologijami smreke (*Picea abies*) in (b) s kronologijami instrumentov. Datum najmlajše branike na instrumentu je 1808.

GLK - Gleichläufigkeit / koeficient istosmernosti, TBP - t-vrednost po Baillieju in Pilcherju, TH - t-vrednost po Hollsteinu

(a) Local chronologies / Lokalne kronologije

| Code / Koda | Overlap / Prekrivanje | GLK | TBP | TH |
|-------------|-----------------------|-------|------|------|
| tw03_001 | 235 | 71*** | 11.0 | 11.7 |
| tw02_001 | 244 | 66*** | 9.2 | 10.0 |
| tw01_001 | 199 | 67*** | 9.1 | 9.5 |
| 9999903M | 248 | 66*** | 8.7 | 8.4 |
| italchrn | 217 | 68*** | 7.9 | 9.0 |
| 9999912M | 248 | 68*** | 7.1 | 7.9 |
| SwsPA | 248 | 63** | 6.9 | 7.8 |

(b) Tree-ring series of instruments / Kronologije inštrumentov

| Code / Koda | Overlap / Prekrivanje | GLK | TBP | TH |
|-------------|-----------------------|-------|------|------|
| 2745701m | 165 | 74*** | 10.8 | 12.4 |
| 2920102a | 170 | 74*** | 10.3 | 10.9 |
| 2109913b | 142 | 71*** | 10.1 | 10.6 |
| 2519924a | 174 | 72*** | 10.1 | 9.9 |
| 1260101a | 202 | 75*** | 8.9 | 9.3 |
| 2911506A | 162 | 68*** | 9.8 | 9.9 |
| 2609904a | 140 | 73*** | 8.7 | 9.3 |

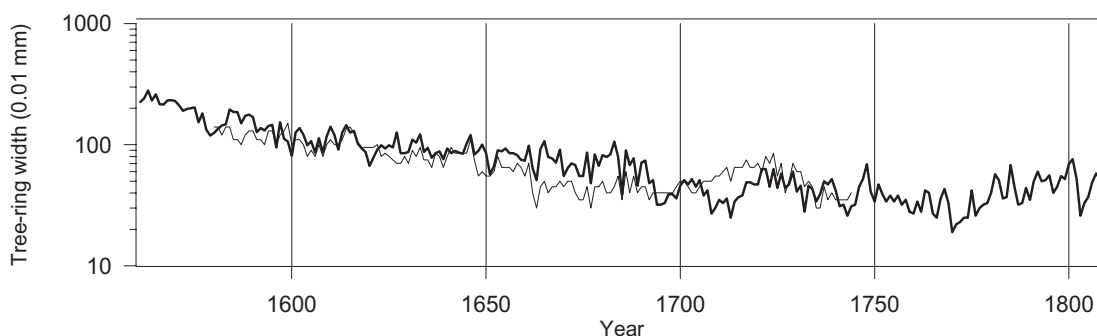


Figure 4. The tree-ring chronology of the violin 1 (bold curve) with the last ring dated to 1808, and the chronology 2745701m of a violin made by Anton Posch (thin curve), last ring 1742

Slika 4. Kronologija violine 1 (debela krivulja), datum zadnje branike 1808 in kronologija violine 2745701m, ki jo je izdelal Anton Posch (tanka krivulja), zadnja branika 1742

3.2. Violin 2

Violin 2 (Figure 5) had the belly made of two resonance boards. We performed measurements on each of them, i.e. on bass and treble sides. The good agreement of tree-ring sequences indicated that the two boards originated from the same stem, therefore we joined them into a chronology of the instrument containing 141 tree-rings. The tree-rings were on average 0.69 mm wide (0.28 to 1.25 mm). The cross-dating of the chronology with different local chronologies and tree-ring sequences of the instruments enabled us to date the youngest ring to 1640. In Tables 3 and 4, we present best matches with seven chronologies and seven instruments and the parameters of dating, which all confirmed the end date of 1640. The year 1640 should in this case also be considered as *terminus post quem*. It indicates that the resonance board and instrument were made after this date. Cross-dating parameters indicate that

the wood originated from Austria, possibly from the area around Innsbruck, where Jacob Stainer collected the wood for his instruments (Figure 6).

We could not confirm that the inscriptions »*Andreas Guarnerius fecit Cremonae, lab. Sial sancte the. 1747*«, and »1867« could tell the maker or the year when the violin was made. Our dating of the last ring to 1640 indicates that the instrument could have been produced during the lifetime of Andrea Guarneri (1626-1698) (LÜTGENDORFF 1975), but consistently good agreement with the chronologies from Austria as well as the design of the instrument indicated that it had been more likely produced by Jacob Stainer (1618/19-1683), who lived in the same period (HOPFNER, 2003). BEUTING (2004) specifically showed that the violin makers from Cremona used the wood from the Italian Alps. We cannot comment on the label containing the year 1867, because the date of the youngest tree-ring on the instrument's belly had been formed 227 years earlier.

Table 3. List of the chronologies used for dating: (a) local chronologies of spruce (*Picea abies*), and (b) chronologies of instruments

Preglednica 3. Seznam kronologij za datiranje: (a) lokalne kronologije smreke (*Picea abies*) in (b) kronologije različnih instrumentov

| (a) LOCAL CHRONOLOGIES / LOKALNE KRONOLOGIJE | |
|---|--|
| Chronology code / Koda kronologije | Description, span (length), and author / Opis, razpon (dolžina) in avtor |
| 250mk_01 | Stainer MK ¹ , 1336-1686 (351), BEUTING (unpubl.) |
| tw01_001 | Instruments-MK, 1382-1759 (378), BEUTING (2004) |
| 9999909M | Narrow ringed instruments, 1423-1789 (367), KLEIN et. al. (1984) |
| SwsPA | Dachstein Schwarzensee, 960 BC – 2003 (2964), GRABNER et al. (2001) |
| tw02_001 | Instruments-MK, 1443-1804 (362), BEUTING (2004) |
| tw03_006 | Instruments-MK, North Alps, 1443-1854 (412), BEUTING (2004) |
| 9999903M | Mittenwald Instruments, 1492-1857 (366), KLEIN et. al. (1984) |
| (b) CHRONOLOGIES OF INSTRUMENTS / KRONOLOGIJE INŠTRUMENTOV | |
| Code / Koda | Instrument, producer, ownership, inventory number², time span, length, instrument side³ / Inštrument, izdelovalec, lastnik, inventarna številka², razpon, dolžina, stran inštrumenta³ |
| 1401501m | Violin, M. Hummel, GMN, MI 419, 1524-1637 (114), MK |
| 2106901A | Cello, J. Klotz, MIT, 1491-1759 (269), B |
| 1011401B | Viola d'amore, P. Allettsee, MDM, 5412, 1515-1717 (193), Tr |
| 1401501B | Violin, M. Hummel, GMN, MI 419, 1532-1637 (116), Tr |
| 1991404e | Organ, South Germany, MDM, 13125, 1504-1619 (116), register r. |
| 1401501A | Violin, M. Hummel, GMN, MI 419, 1524-1624 (101), B |
| 2509928b | Violin, J. Stainer, private, 1565 – 1637 (73), B |

Legend / Legenda

¹MK-mean chronology / lokalna kronologija

²KHM - Kunsthistorisches Museum Wien, Collection of musical instruments, BM - Musikinstrumentenmuseum Berlin, Stiftung Preußischer Kulturbesitz, GMN = Germanisches Nationalmuseum Nürnberg / kratice muzejev in zbirk, ki hranijo inštrumente

³B = Bass/bas stran, Tr = Treble/sopranska stran, I = One piece/en del, MK = average sequence/povprečje več meritev, RB = Resonance board/ resonančna plošča

Table 4. Dating of the chronology of the violin 2 (141 rings) with (a) local chronologies, and (b) chronologies of instruments. The date end is 1640.

GLK - Gleichläufigkeit, TBP - t-value after Baillie and Pilcher, TH - t-value after Hollstein.

Preglednica 4. Datiranje kronologije violine 2 (141 branik) (a) z lokalnimi kronologijami in (b) s kronologijami instrumentov. Datum najmlajše branike na instrumentu je 1640.

GLK - Gleichläufigkeit / koeficient istosmernosti, TBP - t-vrednost po Baillieju in Pilcherju, TH - t-vrednost po Hollsteinu

(a) Local chronologies / Lokalne kronologije

| Code / Koda | Overlap / Prekrivanje | GLK ² | TBP ³ | TH ⁴ |
|-------------|-----------------------|------------------|------------------|-----------------|
| 250mk_01 | 141 | 66*** | 7.4 | 8.7 |
| tw01_001 | 141 | 65*** | 7.1 | 8.1 |
| 9999909M | 141 | 63** | 6.9 | 8.6 |
| SwsPA | 141 | 68*** | 6.8 | 7.5 |
| tw02_001 | 141 | 58* | 5.6 | 6.6 |
| tw03_006 | 141 | 63** | 5.5 | 6.8 |
| 9999903M | 141 | 63*** | 5.4 | 5.5 |

(b) Tree-ring series of instruments / Kronologije inštrumentov

| Code / Koda | Overlap / Prekrivanje | GLK ² | TBP ³ | TH ⁴ |
|-------------|-----------------------|------------------|------------------|-----------------|
| 1401501m | 114 | 63** | 8.0 | 9.2 |
| 2106901A | 141 | 67*** | 7.4 | 9.1 |
| 1011401B | 126 | 68*** | 8.2 | 9.0 |
| 1401501B | 106 | 67*** | 7.7 | 8.7 |
| 1991404e | 116 | 73*** | 7.9 | 8.4 |
| 1401501A | 101 | 65** | 6.6 | 8.0 |
| 2509928b | 73 | 67** | 5.2 | 7.9 |



Figure 5. Violin 2 with belly made of two spruce (*Picea abies*) boards; back and scroll are made of maple (*Acer sp.*) wood

Slika 5. Violina 2 s pokrovom iz dveh smrekovih (*Picea abies*) radialnih desk; spodnji del in polž sta izdelana iz lesa javorja rebraša (*Acer sp.*)

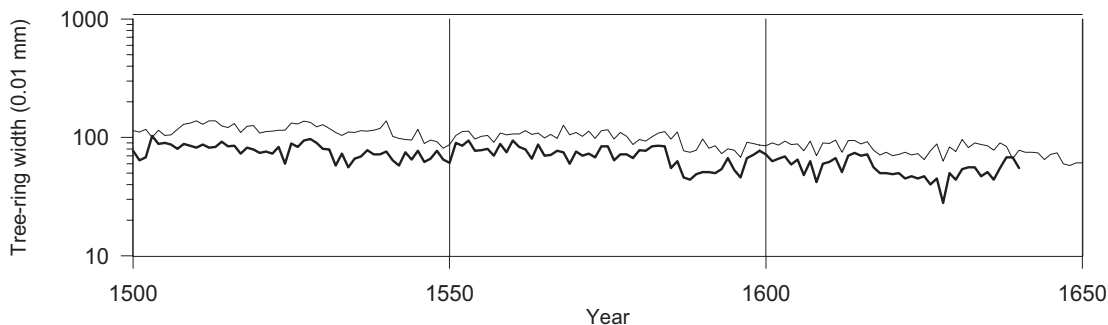


Figure 6. The tree-ring sequence of the violin 2 (bold curve) with the last ring dated to 1640, and the chronology 250mk_01 of Steiner's instruments (entire span 1336-1686) (thin curve)

Slika 6. Kronologija violine 2 (debela krivulja), datum zadnje branike 1640 in kronologija inštrumentov 250mk_01 (celoten časovni razpon 1336-1686), ki jih je izdelala Stainerjeva delavnica (tanka krivulja)

4 Conclusions

4 Sklepi

According to our knowledge, the presented investigation conducted in 2008 and 2009 is the first dendrochronological dating of musical instruments in Slovenia. The results confirm that the use of dendrochronology and co-operation of laboratories from the three countries is meaningful.

The results show that both instruments were made in workshops outside Slovenia and that the wood originates from the Northern Alps in Austria or Germany. The presented dating is very reliable. In both cases we have repeatedly confirmed the dating by using a list of chronologies and by obtaining high and statistically significant cross-dating parameters.

If we used only the reference chronologies of the laboratory in Ljubljana and those publicly available from the international database ITRDB, the dating would not have been possible, or would have been less reliable. Neither could we use dendroprovenancing to presume the area of the origin of the wood.

Many Slovenian foresters and wood technologists believe that many famous European violin producers made their instruments of resonance spruce wood from Pokljuka, Slovenia. Our results do not suggest that the wood of the two violins might originate from Slovenia (Pokljuka), so this question remains open for future research.

5 Summary

5 Povzetek

Dendrokronologija je splošno sprejeta metoda tudi za ugotavljanje starosti glasbenih inštrumentov, posebej godal. Pri datiranju ugotovimo, v katerem letu je nastala najmlajša branika na inštrumentu, zato ugotovljeno leto obravnavamo kot terminus post quem, kar pomeni, da je bil inštrument izdelan po njem. Inštrument ponavadi ne vsebuje branike, ki je nastala tik pred posekom drevesa, saj pri obdelavi lesa pogosto delno ali v celoti odstranijo beljavo oz. les iz zunanjega dela debla. Na Inštitutu za biologijo lesa Univerze v Hamburgu so do leta 2004 raziskali in datirali več kot 600 glasbenih inštrumentov, predvsem godal (prim. BEUTING 2004). Trenutno zasebni Dendrokronološki laboratorij Miche Beutinga hrani že nad 4000 zaporedij širin branik, ki v glavnem izhajajo iz meritev na inštrumentih. Na osnovi teh zaporedij so izdelali referenčne kronologije za različna geografska območja in proizvajalce inštrumentov. Uporabljajo jih za določitev dendroprovenience, to je izvora lesa. Beuting (2004) je s to metodo opredelil območja, od koder je prihajal les za znamenite mojstre, kot so Stradivari, Guarneri, Stainer, in njihove delavnice. Večinoma so uporabljali les z rastišč

v relativni bližini krajev svojih delavnic (radij okoli 100 km), redko pa so les uvozili iz bolj oddaljenih območij.

Največ raziskav je bilo opravljenih na resonančnih ploščah godal, ki so v večini primerov sestavljene iz dveh ali redkeje iz ene radialne deske iz resonančnega lesa smreke (*Picea abies*) (LEDINEK, 2002). Lastnosti resonančnega lesa niso povsem standardizirane. Beuting (2004, 2009) je v svojih študijah ugotovil, da se za resonančne plošče violin večinoma uporablja les s srednjo širino branik 1,07 mm (trgovska kategorija "fine grain").

Poleg datiranja s pomočjo dendrokronologije lahko ugotovimo tudi, ali je inštrument original ali ponaredek. Vsak inštrument ima običajno etiketo z navedbo proizvajalca in leta izdelave. Etikete so pogosto ponarejene, napis na njih pa pogosto »obljublja«, da ga je izdelal znameniti proizvajalec, kot je npr. Stradivari. Številne dendrokronološke študije so pokazale, da so bile etikete ponarejene (npr. BEUTING 2004, GRISSINO-MAYER / SHEPPARD / CLEVELAND 2004). To je najbolj očitno takrat, kadar je datum na etiketi starejši od dendrokronološko ugotovljenega datuma.

V članku predstavljamo dendrokronološke analize dveh violin iz zasebnih zbirk v Sloveniji, za kateri niso poznali izvora, zgodovine in natančne starosti. V obeh primerih je šlo za violino z lepim zvokom in obetavnim napisom na etiketi (Stradivari oz. Guarneri). Cilj naše raziskave je bil datirati branike na resonančnih deskah, oceniti, kdaj sta bili violini izdelani, od kod je izviral les in preveriti, ali so bile etikete na instrumentih originalne.

Violina 1 je bila raziskana v letu 2008, glede na etiketo naj bi jo izdelal Francisco Stradivari iz Cremona leta 1742. Pokrov je bil v enem kosu izdelan iz radialne deske smreke (*Picea abies*). Violina 2 je bila raziskana v letu 2009 in je vsebovala dve etiketi. Na eni je bilo napisano, da je inštrument izdelal Andrea Guarneri iz Cremona leta 1747, na drugi pa je bilo navedeno leto 1867. Pokrov violine je bil narejen iz dveh smrekovih radialnih plošč.

V obeh primerih smo izmerili dimenzije inštrumenta (slika 1) in določili, iz katere vrste lesa so bili izdelani različni deli. Potem smo pregledali pokrov in določili mesto za merjenje širin branik. Pri violini 2 smo širine branik merili ločeno na levi in desni plošči. Širine branik smo izmerili z merilno mizico LINTAB, z natančnostjo 0,01 mm. Les smo opazovali pod Olympus SZ 11 stereo-mikroskopom (slika 2), meritve pa smo beležili s programom TSAP-Win. Ker so bile branike ozke in so bile zaradi laka manj razločne, smo meritve večkrat ponovili. Zaporedja širin branik različnih meritev smo vizualno in statistično sinhronizirali in odpravili morebitne napake, nastale pri merjenju. V nadaljevanju smo sestavili kronologijo inštrumenta in jo primerjali z referenčnimi kronologijami smreke iz dendrokronoloških laboratorijev na Univerzi v Hamburgu, Univerzi v Ljubljani, Univerzi BOKU na Dunaju ter laboratorija za Dendrokronološke analize glasbenih instrumentov in umetniških predmetov v Hamburgu ter s kronologijami baze Tree-Ring International

Data Base (ITRDB). Uporabili smo nad 110 kronologij in okoli 4000 zaporedij širin branik glasbenih instrumentov, ki pokrivajo časovno obdobje od 1137 do 2009. Ob datiranju smo s pomočjo programa TSAP-Win (Rinn 1988, 1989) izračunali standardne statistične kazalnike: koeficient istosmernosti (nem. Gleichläufigkeit, GLK%), t-vrednost po Baillieuju in Pilcherju (TBP) in t-vrednost po Hollsteinu (TH).

Za violino 1 (slika 3) smo sestavili kronologijo širin branik, dolgo 248 let. Povprečna širina branik je bila 0,80 mm (0,2 do 2,95 mm). Kronologijo instrumenta smo datirali z več lokalnimi kronologijami (dreves z znanih lokacij in/ali inštrumentov znanega proizvajalca) in kronologij posameznih inštrumentov (preglednica 1). V preglednici 2 predstavljamo po 7 najboljših rezultatov. Najmlajšo braniko violine 1 smo datirali v leto 1808. Ta datum ponazarja *terminus post quem*. Kazalniki ujemanja so bili najvišji pri primerjavi s kronologijami smreke z rastišč v Avstriji in Nemčiji in s kronologijami instrumentov iz delavnic Posch, Klotz, in Hummel, s kopijo Stainerjeve violine in z inštrumentoma iz delavnic Hornsteiner in Widhalm, ki so delovali v Avstriji in Nemčiji. Najboljše je bilo ujemanje s kronologijo violine 2745701m Antona Poscha (GLK 74 ***, TH 12,4) (pregl. 1, 2). Ujemanje krivulj naše violine 1 in violine 2745701m je tako dobro (slika 4), kot da bi bil les izviral iz istega gozda, žal pa je bil les za violino 1 posekan že po smrti Antona Poscha (1677- 1742). Dendrokronološka datacija violine 1 nikakor ne potrjuje napisa na etiketi, ki navaja, da naj bi jo bil izdelal Francesco Stradivari iz Cremona leta 1742. Les za violino je bil namreč posekan šele po letu 1808, in to ne na rastiščih v italijanskih Alpah, od koder je navadno prihajal les za inštrumente Stradivarjev.

Pri violini 2 (slika 5) je bil pokrov narejen iz dveh resonančnih plošč, zato smo opravili meritve na obeh. Dendrokronološka primerjava je pokazala, da sta obe deski izviral iz istega debla, zato smo izračunali kronologijo inštrumenta, dolgo 141 let. Povprečna širina branik je bila 0,69 mm (0,28 do 1,25 mm). Primerjava z različnimi lokalnimi kronologijami in kronologijami inštrumentov (pregl. 3, 4) je omogočila datiranje najmlajše branike v leto 1640, ki ga tudi v tem primeru moramo obravnavati kot *terminus post quem*. Statistični parametri kažejo, da les izvira iz Avstrije, po možnosti iz območja okoli Innsbrucka, kjer je Jacob Stainer (1618/19-1683) pridobival les za svoje inštrumente (slika 6). Inštrument je imel dve etiketi. Prva navaja, da je inštrument izdelal Andrea Guarneri iz Cremona leta 1747, na drugi pa je bila napisana številka 1867. Ker je bil inštrument narejen po letu 1640, je v resnici veliko starejši kot nakazujeta napisa na etiketah. Tudi v tem primeru les ni izviral z italijanskih rastišč. Navedeno torej kaže, da violine ni izdelal znameniti Andrea Guarneri (1626-1698), čeprav je violina bila narejena v času njegovega življenja. Najverjetneje jo je izdelal njegov sodobnik Jacob Stainer.

Raziskavi, opravljeni v letih 2008 in 2009, sta po nam znanih podatkih prvi dendrokronološki datiranja glasbenih

inštrumentov v Sloveniji. Rezultati potrjujejo, da sta bila uporaba dendrokronologije in sodelovanje laboratorijev iz treh dežel smiselna. Oba inštrumenta sta bila narejena v delavnicah zunaj Slovenije in les zanju izvira iz območij severnih Alp, iz Avstrije ali Nemčije. Datiranje je bilo zelo zanesljivo, saj smo ga v obeh primerih večkrat potrdili z različnimi kronologijami. Če bi uporabili le referenčne kronologije laboratorija iz Ljubljane in iz mednarodne baze kronologij ITRDB, datiranje ne bi bilo možno, ali pa bi bilo manj zanesljivo in tudi ne bi mogli sklepati, od kod les izvira.

Mnogi slovenski gozdarji in lesarji verjamejo, da so znameniti evropski izdelovalci violin za svoje inštrumente uporabljali resonančno smrekovino s Pokljuke. Naši rezultati ne kažejo, da bi bil les raziskanih violin lahko izviral iz Slovenije (Pokljuke), zato to vprašanje še naprej ostaja odprto.

Zahvaljujemo se lastnikom violin, da so se odločili za dendrokronološko raziskavo svojih inštrumentov. Posebna zahvala gre Martinu Zupančiču in Luki Kržetu za veliko pomoč pri identifikaciji lesa, meritvah in pri interpretaciji rezultatov.

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