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Editorial

Monitoring seasonal dynamics of wood formation

Tree rings have proven to be a valuable source of environmental information. Relationships between annual tree growth and environmental factors have been identified and used to reconstruct the past and make inferences about the future. Tree rings have been successfully used to date anthropogenic activities, reconstruct past climates, study the dynamics of forest growth and succession, reconstruct natural disturbances such as forest fires and insect outbreaks, study geomorphic processes and even to quantify water and biochemical cycles. All this information is stored in the tree ring as a variety of characteristics, including ring width, density profile, chemical composition of the wooden matrix and cell morphology.

Depending on the tree species and the environmental setting, this ecological information can be strongly expressed or diffusely masked by other, concurrent information. A more detailed mechanistic understanding of the process of environmental registration in tree rings is therefore required to fully exploit this archive. Thanks to constant improvements in measuring techniques and tools, there is an increasing capacity to study tree rings at very high resolutions. These capabilities are opening new frontiers in environmental research thanks to the opportunity to distinguish between different intra-annual signals. An unavoidable and fundamental step towards a mechanistic understanding of the physiology of tree growth and of the signal registration process, however, depends on a detailed understanding of the rate and timing of ring formation. Questions such as “when during the season does this occur”

and “which environmental factor produced that feature” are fundamental for linking effects to causes.

Since observations of wood formation are hindered by the fact that growth occurs inside a tree, intra-annual ring development must be assessed via a variety of methods. Techniques such as stem-size monitoring (dendrometers), static and invasive marking (pinning) and micro-sampling can be repeated at regular intervals during the growing season to study wood formation. All these approaches have their strengths and weaknesses and the potential for further improving these techniques is high.

A first workshop on *Intra-annual analysis of wood formation* held in October 2005 in San Vito di Cadore (Italy) (see the 2007 special issue of *Dendrochronologia* 25(2)) represented an important milestone in this field. The workshop resulted in an increased use of wood monitoring techniques and major scientific outputs. During this workshop, experiences were shared and various methods were discussed in depth. A second workshop, *Monitoring seasonal dynamics of wood formation*, was held in Otočec (Slovenia) in April 2009. This workshop was organized to give scientists the opportunity to exchange new information and to present and discuss the latest developments and results. Thirty researchers from Europe and North America participated in discussions about sampling strategies, sample preparation, definitions, measurements and analysis. Results of studies on hard and softwood species from boreal to Mediterranean regions were presented (Table 1).

**Table 1**  
Workshop presentations.

Authors	Affiliations	Title
Jožica Gričar <sup>1</sup>	<sup>1</sup> Slovenian Forestry Institute, Ljubljana, Slovenia	Wood and phloem formation
Holger Gärtner <sup>1</sup>	<sup>1</sup> WSL Swiss Federal Research Institute, Dendro Sciences, Birmensdorf, Switzerland	Sample preparation and image analysis in quantitative wood anatomy: Further development of (new) tools
Tuula Jyske <sup>1</sup> , Harri Mäkinen <sup>1</sup> , Pekka Nöjd <sup>1</sup>	<sup>1</sup> Finnish Forest Research Institute (METLA), Finland	Where is the Finnish cambium hiding? Challenges related to sampling, sample preparation and measurements
Martín De Luis <sup>1</sup> , Klemen Novac <sup>1</sup> , José Raventós <sup>1</sup> , Jožica Gričar <sup>2</sup> , Katarina Čufar <sup>3</sup>	<sup>1</sup> Department of Geography, University of Zaragoza, Spain <sup>2</sup> Slovenian Forestry Institute, Ljubljana, Slovenia <sup>3</sup> Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Slovenia	Wood formation in <i>Pinus halepensis</i> from dry and semi-arid ecosystems in Spain
Peter Prislan <sup>1</sup> , Katarina Čufar <sup>1</sup> , Jožica Gričar <sup>2</sup>	<sup>1</sup> Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Slovenia <sup>2</sup> Slovenian Forestry Institute, Ljubljana, Slovenia	Wood formation in beech ( <i>Fagus sylvatica</i> L.)

Table 1 (Continued.)

Authors	Affiliations	Title
<b>Manuela Romagnoli</b> <sup>1</sup> , Martina Cherubini <sup>1</sup> , Stefano Spina <sup>1</sup> , Angela Bistoni <sup>1</sup> , Jožica Gričar <sup>2</sup> , Peter Prislan <sup>3</sup> , Katarina Čufar <sup>3</sup>	<sup>1</sup> Facoltà di agraria, Università degli studi della Tuscia di Viterbo, Italy <sup>2</sup> Slovenian Forestry Institute, Ljubljana, Slovenia <sup>3</sup> Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Slovenia	Wood formation in Chestnut ( <i>Castanea sativa</i> Mill.) from central Italy
<b>Annie Deslauriers</b> <sup>1</sup> , Sergio Rossi <sup>1</sup> , Audrey Turcotte <sup>1</sup> , Hubert Morin <sup>1</sup> , Cornélia Krause <sup>1</sup>	<sup>1</sup> Université du Québec à Chicoutimi, Canada	SAS routines for analyzing the time series from dendrometers
Jörg Fromm <sup>1</sup> , Uwe Schmitt <sup>1</sup> , <b>Jeong-Wook Seo</b> <sup>1</sup> , Risto Jalkanen <sup>2</sup> , Harri Mäkinen <sup>2</sup>	<sup>1</sup> Department of Wood Science, University of Hamburg, Germany <sup>2</sup> Finnish Forest Research Institute (METLA), Finland	High-resolution cambium dynamics in boreal pine trees at various distances from their northern tree line in view of the anticipated climate warming: Introduction into our DFG-Project, March 2009 to March 2011
<b>Hanuš Vavrčík</b> <sup>1</sup> , Vladimír Gryc <sup>1</sup>	<sup>1</sup> Mendel University of Agriculture and Forestry Brno, Czech Republic	Software for calculation of times of tracheids differentiation
<b>Patrick Fonti</b> <sup>1</sup>	<sup>1</sup> WSL Swiss Federal Research Institute, Dendro Sciences, Birmensdorf, Switzerland	Making data comparable
<b>Sergio Rossi</b> <sup>1</sup> , Annie Deslauriers <sup>1</sup> , Hubert Morin <sup>1</sup> , Cornelia Krause <sup>1</sup>	<sup>1</sup> Université du Québec à Chicoutimi, Canada	Data analysis and representation of xylem growth
<b>Risto Jalkanen</b> <sup>1</sup> , Tarmo Aalto <sup>1</sup> , Harri Mäkinen <sup>1</sup> , Primož Oven <sup>2</sup> , Jeong-Wook Seo <sup>3</sup>	<sup>1</sup> Finnish Forest Research Institute (METLA), Finland <sup>2</sup> Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Slovenia <sup>3</sup> Department of Wood Science, University of Hamburg, Germany	Variation of tracheid number in radial files of xylem growth ring in pinned and micro-cored Scots pine in northern Finland
<b>Jelena Trajković</b> <sup>1</sup> , Bogoslav Šefer <sup>1</sup>	<sup>1</sup> Sveučilište u Zagrebu, Šumarski fakultet, Croatia	Application of pinning techniques in Croatia
<b>Alessio Giovannelli</b> <sup>1</sup> , Maria Laura Traversi <sup>1</sup> , Annie Deslauriers <sup>2</sup> , Sergio Rossi <sup>2</sup>	<sup>1</sup> Laboratorio xilogenesi, IVaLSA-CNR, Sesto Fiorentino, Italy <sup>2</sup> Université du Québec à Chicoutimi, Canada	Analysis of non-structural carbohydrates in woody ring and cambial zone of poplar
<b>Ute Sass-Klaassen</b> <sup>1</sup> , Jan den Ouden <sup>1</sup> , Clifton Sabajo <sup>1</sup> , Evelijn Belien <sup>1</sup>	<sup>1</sup> Forest Ecology and Forest Management Group, Wageningen University, The Netherlands	Combining cambial analysis and vessel-size analysis to study the effect of flooding on earlywood formation of oak and ash
<b>Cyrille Rathgeber</b> <sup>1</sup> , Sergio Rossi <sup>2</sup> , Annie Deslauriers <sup>2</sup> , Jožica Gričar <sup>3</sup> , Jeong-Wook Seo <sup>4</sup> , Jean-Daniel Bontemps <sup>1</sup> , Patrick Fonti <sup>5</sup>	<sup>1</sup> Centre INRA de Nancy, France <sup>2</sup> Université du Québec à Chicoutimi, Canada <sup>3</sup> Slovenian Forestry Institute, Ljubljana, Slovenia <sup>4</sup> Department of Wood Science, University of Hamburg, Germany <sup>5</sup> WSL Swiss Federal Research Institute, Dendro Sciences Unit, Birmensdorf, Switzerland	Cambium phenology, tree-ring formation and dendroecology

This special issue of *Dendrochronologia* collects several studies presented during the 2009 workshop. The first contribution describes intra-annual observations of wood formation for a novel species (Čufar et al., 2011). Following contributions present new tools for the analysis of data from micro-sampling observations (Vavrčík and Gryc, 2011; Rathgeber et al., 2011) and dendrometer data (Deslauriers et al., 2011). Finally, innovative examples of how detailed timing of ring formation can be successfully applied to tree-ring based anatomical (De Luis et al., 2011), ecological (Sass-Klaassen et al., 2011) and physiological (Giovannelli et al., 2011) studies are presented.

As guest editors we would like to thank *Dendrochronologia*, the authors and participants of the workshop, as well as the reviewers for their valuable contributions to the preparation of this special issue.

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