
International conference on
Urban Tree Diversity
16-18 June 2014
Alnarp, Sweden
Programme & abstract book

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Urban Tree Diversity

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Department of Landscape Architecture, Planning and Management
Faculty of Landscape Architecture, Horticulture and Crop Production Science
Swedish University of Agricultural Sciences

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Session 6 - Strategies and planning for urban tree diversity

Session 7 - Ecosystem services provided by diverse urban tree populations

Session 8 - Urban tree diversity and urban people diversity

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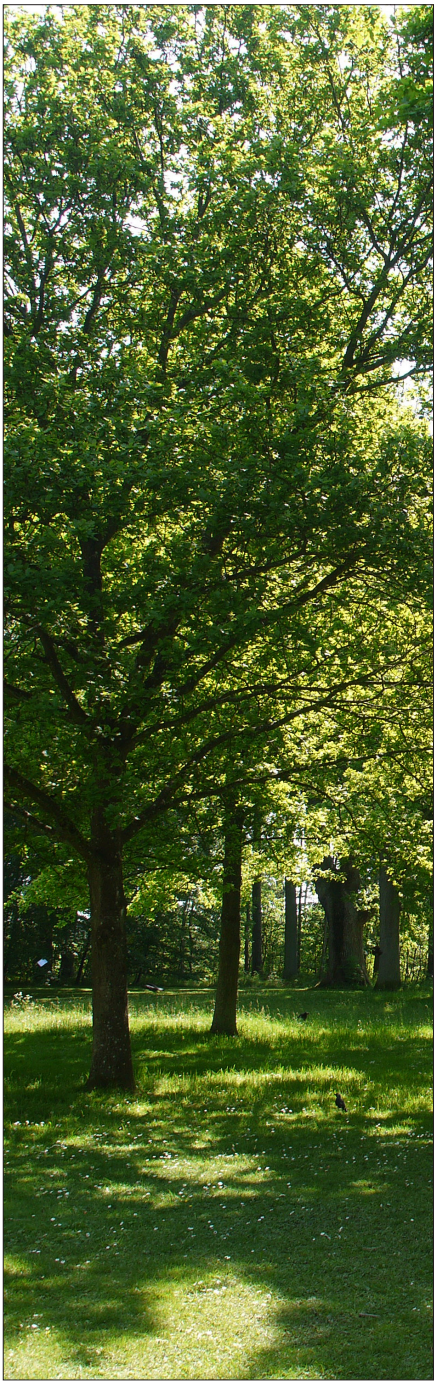


Dear colleagues!

I warmly welcome you all to the Alnarp campus of the Swedish University of Agricultural Sciences and to the first international conference on Urban Tree Diversity.

The need for diverse, resilient and multifunctional urban tree resources has been known for a while. In 1990, for example, the often-cited 10-20-30 rule was first put on paper by Frank Santamour. According to this rule-of-thumb, a single species should not comprise more than 10% of a city's tree population, while a single tree genus and tree family should not represent more than 20 respective 30% of the urban forest. During times of increasing climate change, urbanization and other pressures, a more comprehensive take on urban tree diversity will be needed.

This conference in Alnarp has urban tree diversity – in all its aspects – in focus. The event is organised in collaboration with the International Society of Arboriculture (ISA), the International Union of Forest Research Organizations (IUFRO) and the Nordic-Baltic Centre of Advanced Research on Forestry Serving Urbanised Societies (CARe-FORUS). Local hosts are the Swedish University of Agricultural Sciences (SLU) and the City of Malmö. The event's venue, SLU's campus at Alnarp near Malmö, hosts some of Sweden's best tree and shrub collections, as well as the university's unique Landscape Laboratory.

The event will consist of two days of plenary and parallel sessions, followed by a

day of excursions to either Malmö and surroundings or Greater Copenhagen (just across the Öresund bridge). Themes to be addressed at the congress include:

- Selection of urban trees
- Urban tree diversity in design and establishment
- Assessing diverse urban tree populations
- Ecosystem services provided by diverse urban tree populations
- Strategies and planning for urban tree diversity
- Urban tree management and maintenance
- Managing threats such as pest, diseases, climate change, invasiveness
- Urban tree diversity and urban people diversity

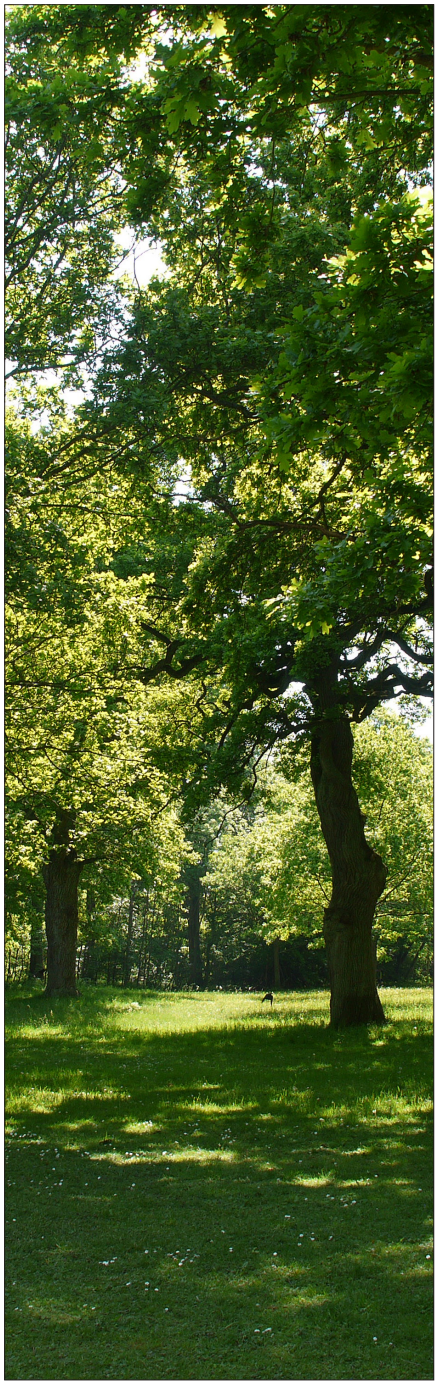
The hosting Department of Landscape Architecture, Planning and Management at SLU has a range of research, teaching and partnership activities on the theme of urban tree diversity. We are looking forward to hearing about your work, sharing knowledge and mutual inspiration.

I wish you all a fruitful conference and a nice stay in the Öresund region!

Kind regards, on behalf of the organising committee,

Cecil Konijnendijk van den Bosch

Head, Department of Landscape Architecture, Planning and Management, SLU



Barcham

The Tree Specialists

OUR TREES:

There are many ways of producing trees and each of them has advantages and disadvantages. At Barcham we containerise field grown trees into white containers. The method was pioneered at Barcham and we have been despatching young trees grown this way for over twenty years and are proud of the quality of young trees we are able to produce.

We believe this method, developed at Barcham, produces a resilient young tree which will transplant successfully into even the most hostile of environments. This has been repeatedly proven with over 60,000 trees, in all sizes, supplied to customers annually throughout the UK and Europe. This makes Barcham the largest tree nursery of its kind in Europe.

The nursery is over 300 acres and has over 125,000 trees in the characteristic white pot. Over 300 species and or cultivars in sizes from 10-12cm girth through to 35-40 cm girth are represented.

The white container we use ensures that trees are despatched with a vibrant and healthy root system with the risk of root girdling virtually eliminated. It is true that any tree left in a container for too long will suffer root damage but we have introduced a concept known as 'shelf life' to ensure that our trees are always delivered with their root systems in the optimum condition. The containerisation date of all trees is recorded and each, according to species, is allocated an optimum time in the container. Beyond this time damage is likely to have occurred to the root system and trees are systematically culled. We believe we are the only nursery to manage its containerised trees this way.

The white container, used to finish the trees, is also the container used to despatch and transport the trees to their final planting site. This means that the carefully nurtured root system is never exposed to desiccation or damage from the moment it is containerised to the moment it is planted.

The physiological health of young trees is critical to the survival of young trees but is rarely questioned or published assessments produced by tree nurseries. In fact it is largely ignored. Any assessment of the quality of young nursery trees has, up until now, been largely made by assessing morphological characteristics. Size, shape, form and girth size are all often specified and are of course important but rarely, if ever does anyone assess the actual physiological health of the tree they are specifying. At Barcham we have long felt that this is inadequate and that there should be a way of assessing and guaranteeing whole plant health.

We have now test using leaf fluorescence, electrolyte leakage and leaf chlorophyll content over 15,000 of our trees each season for four consecutive seasons. This number is statistically significant. Each of these tests, individually , is an indicator of whole plant health and with the combined data from all three tests we are able to state with confidence that our trees are in the optimum physiological condition and ready for successful transplanting. We believe that we are the only nursery to publish data on plant health. We now have data accumulated from over 600,000 individual leaf samples across over 350 species and cultivars which we have now incorporated in a new nursery benchmark system called Arborcheck.

About the organisers

International Society of Arboriculture (ISA) – www.isa-arbor.com

The International Society of Arboriculture (ISA) has served the tree care industry for more than 80 years as a scientific and educational organization. Through research, technology, and education, the International Society of Arboriculture promotes the professional practice of arboriculture and fosters greater worldwide awareness of the benefits of trees. ISA continues to be a dynamic medium through which arborists around the world share their experience and knowledge for the benefit of society. ISA is aligned on many fronts with other green organizations and is working hard to foster a better understanding of trees and tree care through research and the education of professionals as well as global efforts to inform tree care consumers. Today, there are than 20,000 International Society of Arboriculture members across the globe.

International Union of Forest Research Organizations (IUFRO) – www.iufro.org

IUFRO is a non-profit, non-governmental international network of forest scientists, which promotes global cooperation in forest-related research and to enhance the understanding of the ecological, economic and social aspects of forests and trees; as well as to disseminate scientific knowledge to stakeholders and decision-makers and to contribute to forest policy and on-the-ground

Nature is the focal point of all our work

HedeDenmark is the largest green service company in Scandinavia. Väla Mark & Trädgård is our subsidiary in Sweden. We develop and care for nature to the benefit of people, trade and industry, society and the environment

HedeDanmark creates natural elements in open spaces in the cities, develops recreational areas, creates, cares for- and maintains green and grey areas and provides winter services for public and private companies in Denmark and abroad.

Väla Mark & Trädgård
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Väla Mark & Trädgård
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www.hededanmark.com

HedeDanmark
nature is our business

Professionalism, value creation and innovation are core values for HedeDanmarks more than 1,000 employees who provide services to the forest, rural as well as urban areas, including gardens, parks and squares.

Arboricultural Research
and Education Academy

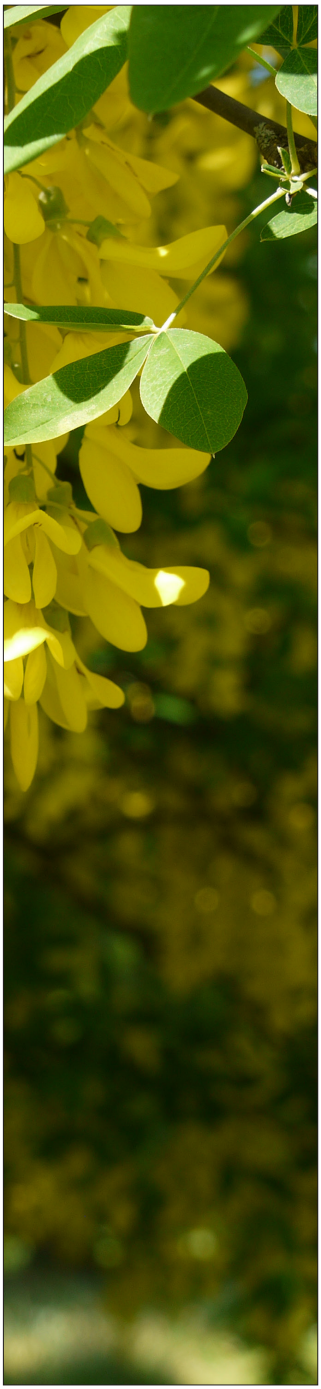
URBAN
& FORESTRY
URBAN
GREENING

forest management. IUFRO is open to all individuals and organizations dedicated to forest and forest products research and related disciplines. It is a non-profit, non-governmental and non-discriminatory organization with a long tradition dating back to 1892. The organisation is structured in a several Divisions under which Research Groups are placed. One of these Research Groups (6.07.00) focuses on Urban Forestry and it is this group that acts as co-sponsor of the conference.

Malmö Stad – www.malmo.se

Malmö stad

Malmö is the commercial centre of southern Sweden and an international city. This is expressed, not least, by the fact that Malmö has 300 000 residents from approximately 170 different nationalities. Malmö is also undergoing a transition from being an industrial city to a city of knowledge. Older industries have been replaced by investments in new technology and training programmes of high calibre. The strongest sectors in Malmö are logistics, retail and wholesale trade, construction, and property. Malmö has an international harbour and the airports Kastrup and Sturup are only half an hour's journey from the centre of Malmö. Over the last years the City of Malmö has received many international awards for its focus on sustainable city development and pilot projects such as Augustenborg and the Western Harbour.



Nordic-Baltic Centre of Advanced Research on Forestry Serving Urbanised Societies (CARe-FOR-US II) - www.nordicforestresearch.org/care-for-us2/

CARe-FOR-US II is a 'centre without walls' funded by the Nordic Forest Research (SNS) under the Nordic Council of Ministers. Coordinated by the University of Copenhagen, it aims to enhance networking and knowledge exchange on forestry serving urbanised societies amongst leading researchers within the Nordic-Baltic region, with special emphasis on the involvement of PhD-students and other early-career researchers. The centre also compiles and disseminates up-to-date information on the state of art of research within the CAR's field, with particular emphasis on aspects of governance, nature and health relations, recreation and tourism, and qualitative woodland management. CARe-FOR-US places specific emphasis on research that is carried out in close collaboration with policy and practice.

Swedish University of Agricultural Sciences (SLU) – www.slu.se

SLU is a university with a clearly defined role in society: to take responsibility for the development of learning and expertise in areas concerning biological resources and biological production. This responsibility stretches over the wide-ranging fields of agriculture, forestry and food industry to environmental questions, veterinary medicine and biotechnology. SLU and its over 3000 employees offers a broad

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Milford is proud to be a sponsor of the 2014 Urban Tree Diversity Conference

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spectrum of educational programmes and single subject courses. Main campuses are located at Alnarp, Skara, Ultuna and Umeå. The Department of Landscape Architecture, Planning and Management (host of this conference) is dedicated to research, education and collaboration in all types of landscape, with a particular focus on multifunctional and dynamic landscapes and their importance to people. Its about 90 staff are organised in five thematic groups, one of which on the theme of urban vegetation. The department has the vision to become recognised as one of Europe's leading environments for research, development and education on landscape issues, developing and providing knowledge and expertise for sustainable development and management of urban and rural landscapes.

The Department of Landscape Architecture, Planning and Management is dedicated to research, education and collaboration in all types of landscape, with a particular focus on multifunctional and dynamic landscapes and their importance to people.

Conference venue

SLU Alnarp makes you feel welcome with its campus and a park with thousands of trees, bushes and flowers, as well as with its landscape and horticultural laboratories, its rehabilitation garden and a range of beautiful buildings. Alnarp castle, which was completed for the then agricultural institute in 1863, dominates the center of the park as a clear symbol of the campus. Today it is a modern workplace for about 100 staff of SLU Alnarp's staff.

Most of current Alnarpsparken has probably been wooded for 10,000 years, i.e. since the ice sheet retreated from Skåne. In the 1100s Alnarp or "Alnethorp" was a manor with large land holdings. In the mid-1300s the area belonged to a Danish knight.

Though the Treaty of Roskilde in 1658 Alnarp came into Swedish hands and later became a royal estate. By the mid-1700s the Alnarp forest was probably Sweden's only elm forest. Remnants of this forest can still be found today.

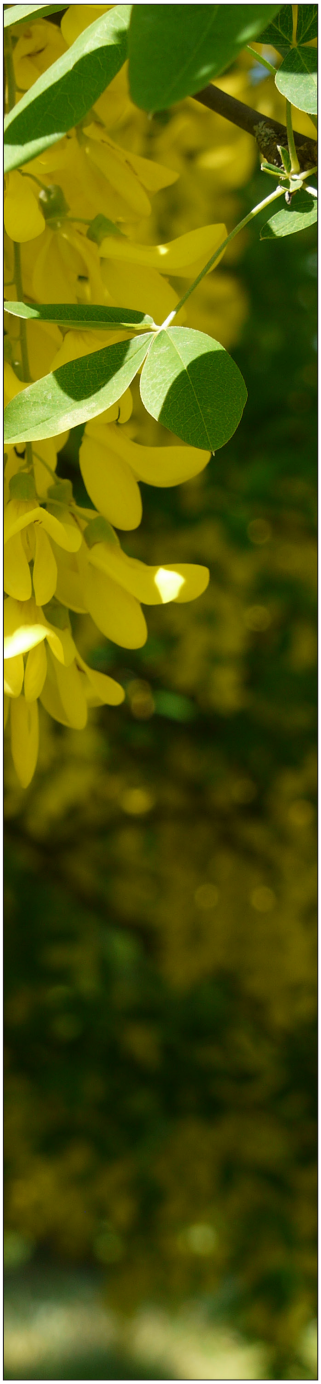
Design of the Alnarp Park began in 1859, the same year as the construction of the castle began. In 1862 the castle was finished and the "Agricultural Institute" was opened and its first course started. In the early 1880s, the park was completed. In accordance with romantic ideals landscape parks like the one in Alnarp were shaped with a system of winding pathways and a pleasant, smoothly rolling terrain.

One of the largest plant collections in Sweden

The collection of exotic plants began at the time of park establishment and continues in the present era. Alnarp Park's specialty are woody plants and with about 2,500 different species and varieties the Alnarp plant collection is one of the country's richest. Trees, shrubs and herbs from almost all continents are represented.

Between the years 1975 and 1978, a new range of species was added which included conifers. Tree care is done meticulously in the park to ensure a healthy and beautiful tree population also in the future. Obviously the Alnarp Park is of great value for education. Plants are therefore signed with both Swedish and Latin names.

Every year large amounts of annuals flowers and bedding plants are planted, while a large collection of perennials adds to the diversity of the park environment.



1. **Alnarpsgården**
   - Reception and service
   - Assembly Hall
   - Alnarp Library
   - Landscape Architecture, Planning and Management
2. Alnarp Rehabilitation Gardens
3. **Agricum**
   - Teaching premises
   - Assembly hall Terra Nova
4. **Articum**
5. **Faculty Administration Office**
   - Administration
   - Communications Office
   - Human Resources Department
   - Service/Infra
6. **Navet**, main entrance to
   - Crafoord lecture hall
   - Biosystems and Technology
   - Biotron
   - Plant Breeding
   - Plant Protection Biology
7. Park Unit Office
8. Programme for Diversity of Cultivated Plants (POM)
9. Printshop
10. **Slottet** (Alnarp castle), main entrance to
    - Work, Science, Business Economics and Environmental Psychology
    - Landscape Architecture, Planning and Management
    - MOVIUM
    - External Relations Alnarp
11. Student Unions
12. Southern Swedish Forest Research Centre
13. **Teknicum**
    - SLU Holding
    - Service/Cleaning
14. **Tornhuset**
    - Student Service Centre
    - Exchange Student Affairs
    - IT Division
15. Alnarp Horticultural Laboratory
16. Receiving goods
17. WC

Museums

18. Museum of Horseshoeing
19. Museum of Agriculture
20. Museum of Coaches

Other

21. Akademiska Hus
22. Alnarp Restaurant

Studentboende

23. Gamlegård
24. Hovbeslagsskolan
25. Hönshuset
26. Kasernen
27. Lantan
28. Mejeristigen
29. Radhusvägen
30. Västra Elev
31. Östra Elev

32. Guest housing
33. Laundry room

Information

Bus stop

Monday June 16th, 2014			
Time			
8:30AM - 9:00AM	Welcome to Alnarp - The organisers *Assembly Hall (in Alnarpsgården)*		
9:00AM - 9:45AM	Dr Leong Chee Chiew - Singapore, a green and biodiversity-rich city-state, against the odds *Assembly Hall (in Alnarpsgården)*		
9:45AM - 10:30AM	Prof. Dr Nina Bassuk and Prof. Dr Jason Grabosky - Urban sites are made for plant diversity *Assembly Hall (in Alnarpsgården)*		
10:30AM - 11:00AM	Coffee break and poster session *Outside Assembly Hall (in Alnarpsgården)*		
	Session 1 - Selection of urban trees. (Moderator: Rich Hauer) *Assembly hall Terra Nova (in Agricum)*		**Session 2 - Urban tree diversity in design and establishment. (Moderator Alan Simson)** *Assembly Hall (in Alnarpsgården)*
11:00AM - 11:10AM	Introduction	11:00AM - 11:10AM	Introduction
11:10AM - 11:30AM	Bert Cregg - Urban tree selection in a changing climate	11:10AM - 11:30AM	Sara Barron, Dr. Stephen Sheppard - The role of trees in enriching dense suburban environments: incorporating residents' values into suburban forest design and care
11:30AM - 11:50AM	April Jackson - Examination of Sugar Maple provenance responses to increasing temperature and drought	11:30AM - 11:50AM	Johanna Deak Sjöman - Regulating ecosystem services and sustainable planning - the role of tree species and strategic planting
11:50AM - 12:10PM	Per Anker Pedersen - Testing of ornamental trees in harsh winter conditions at Ås, Norway.		**Session 3 - Exotic and native urban tree species, invasiveness etc. (Moderator: Henrik Sjöman)** *Assembly Hall (in Alnarpsgården)*
12:10PM - 12:30PM	Jelle A. Hiemstra - Evaluation of street tree varieties in the Netherlands	11:50AM - 12:00PM	Introduction
12:30PM - 12:50PM	Glynn Percival - Identifying physiological characteristics associated with stress tolerance in ornamental trees	12:00PM - 12:20PM	Mark J. Ambrose; Frank H. Koch; Denys Yemshanov; and P. Eric Wiseman - Modelling urban distributions key host trees for invasive forest pests
		12:20PM - 12:40PM	Hans Martin Hanslin and Arne Sæbø - Seed vitality of exotic species in their northern introduced range

		12:40PM - 1:00PM	Wakana Azuma, Iwasaki, A., Ohsugi, Y., Ishii, H. - Does adjacent late-successional forest prevent plagiosere of fragmented and abandoned secondary forest in sub-urban Japan?
1:00PM - 2:00PM	Lunch and poster session *2nd floor Alnarpsgården*		
	Session 4 - Assessing diverse urban tree populations. **(Moderator: Anders B. Nielsen)** *Assembly hall Terra Nova (in Agricum)*		**Session 5A - Urban tree management and maintenance – managing diversity, including pest and disease management.** **(Moderator: Justin Morgenroth)** *Assembly Hall (in Alnarpsgården)*
2:00PM - 2:10PM	Introduction	2:00PM - 2:10PM	Introduction
2:10PM - 2:30PM	Topi Tanhuanpää - Defining canopy metrics of urban trees with high density ALS data	2:10PM - 2:30PM	Märit Jansson; Allan Gunnarsson; Fredrika Mårtensson; Sarah Andersson - Creating tree diversity in school grounds with focus on children's perspectives on vegetation establishment
2:30PM - 2:50PM	Eldar Kurbanov, Oleg Vorobiev - Change analyses of urban forests in republic Mari El of Russia with the use of remote sensing	2:30PM - 2:50PM	Adrina Bardekjian - Shaping Diverse Identities in Urban Forestry: Influences of Metaphor, Language and Agency
2:50PM - 3:00PM	Mark J. Ambrose - Analysis of urban and natural forest composition across North America	2:50PM - 3:00PM	Igor Lacan - The good, the bad, and the abiotic: a survey of urban tree composition and tree problems in the San Francisco Bay Area (USA)
3:00PM - 3:30PM	Coffee break and poster session *Outside Assembly Hall (in Alnarpsgården)*		
	Session 4 continues *Assembly hall Terra Nova (in Agricum)*		**Session 5A continues** *Assembly Hall (in Alnarpsgården)*
3:30PM - 3:50PM	Raffaele Lafortezza - Urban forestry plantations assessment in a global change perspective	3:30PM - 3:50PM	Dr. Justin Morgenroth - Where have all the mature trees gone? - A meta-analysis
3:50PM - 4:10PM	Paolo Semenzato, Dina Cattaneo, Tommaso Sitzia, Matteo Dainese - Assessing and comparing composition and diversity in urban trees populations in Northern Italy	3:50PM - 4:10PM	Kevin L Frediani - The Importance of Urban Tree Diversity

4:10PM - 4:30PM	Anders Busse Nielsen, Marcus Hedblom, Anton Stahl Olafsson, and Björn Wiström - Spatial configurations of urban forest in Denmark and Sweden – patterns for green infrastructure planning	4:10PM - 4:30PM	Aki Männistö - Urban Tree Diversity in Finland
5:00PM	Busses depart from Alnarpsgården		
7:00PM - 11:00PM	Joint dinner in Malmö at Malmö City Hall		

Tuesday June 17th, 2014			
Time			
9:00AM - 9:45AM	Prof. Dr. Ingo Kowarik - Aliens in the city!? Considering context dependence helps calming down heated alien-native debates *Assembly Hall (in Alnarpsgården)*		
9:45AM - 10:30AM	Dr Nina-Marie Lister - Landscape as Infrastructure: Towards an Ecological Urbanism *Assembly Hall (in Alnarpsgården)*		
10:30AM - 11:00AM	Coffee break and poster session *Outside Assembly Hall (in Alnarpsgården)*		
	Session 6 - Strategies and planning for urban tree diversity. (Moderator: Stephan Pauleit) *Assembly hall Terra Nova (in Agricum)*		**Session 5B - Continues from day 1. (Moderator: Justin Morgenroth)** *Assembly Hall (in Alnarpsgården)*
11:00AM - 11:10AM	Introduction	11:00AM - 11:10AM	Introduction
11:10AM - 11:30AM	Dr Charles A. Wade and Dr. J. James Kielbaso - Diversity, Now and Then, and what is still being over-planted	11:10AM - 11:30AM	Keith Sacre, Jon Banks - Young Tree Vitality: A Tree Nursery Benchmark System.
11:30AM - 11:50AM	Peter Duinker - Making the Halifax Treescape More Native: Initiatives in Planting Native Tree Species in Parks, Streets, and Institutional Lands	11:30AM - 11:50AM	Jon Banks - Mulching as a means of controlling root rot pathogens
11:50AM - 12:10PM	Henrik Sjöman - A tree is not a tree is not a tree – the importance to talked about details in the urban tree planning	11:50AM - 12:10PM	Anand B. Persad - Restoration of Urban Forests after Emerald Ash Borer (EAB) and Relevance of an Urban Fit Matrix in Replant Selection in North America

12:10PM - 12:30PM	Alan Simson - The developing profile of urban forestry in the UK.	12:10PM - 12:30PM	Alessio Fini - Root severance and urban trees: a four years study evaluating growth, physiology and stability
12:30PM - 12:50PM	Dr. Richard Hauer - Managing Urban Trees in Through a Life Cycle of Exotic Insect and Disease Pressures	12:30PM - 12:50PM	Frida Andreasson, Björn Embrén, Ann-Mari Fransson - Growth of Prunus avium street trees is increased by addition of biocharcole to a structural soil
12:50PM - 1:10PM	Nanamhla Gwedla - Municipal parks managers' development visions and attitudes towards urban forestry in South African towns	12:50PM - 1:10PM	Stephen J. Livesley - Redirecting rainfall runoff into nature strips to improve the performance of urban street trees in residential suburbs
1:10PM - 2:00PM	Lunch and poster session *2nd floor Alnarpsgården*		
	Session 7 - Ecosystem services provided by diverse urban tree populations **(Moderator: Wendy Chen)** *Assembly hall Terra Nova (in Agricum)*		**Session 8 - Urban tree diversity and urban people diversity.** **(Moderator: Märit Jansson)** *Assembly Hall (in Alnarpsgården)*
2:00PM - 2:10PM	Introduction	2:00PM - 2:10PM	Introduction
2:10PM - 2:30PM	Jago Keen - The support of biodiversity by street trees in the City of London	2:10PM - 2:30PM	Russell Horsey - The Trees and Design Action Group (TDAG): an innovative and successful approach for building tree diversity into urban design
2:30PM - 2:50PM	Ruzana Sanusi - Urban street trees before, during and after a heat wave and pedestrian thermal comfort	2:30PM - 2:50PM	Jonathan Stoltz et al - Green cover may be a good indicator for Serenity as a restorative factor
2:50PM - 3:10PM	Yuk Hiruta, Mikiko Ishikawa, - Research on Indicators for Evaluating the Temperature-Moderating Function of Ecological Components	2:50PM - 3:10PM	Charlie Shackleton - A diversity of species, perceptions and settings: patterns of tree species richness, abundance and uses in small towns in South Africa
3:10PM - 3:40PM	Coffee break and poster session *Outside Assembly Hall (in Alnarpsgården)*		

	Session 7 continues *Assembly hall Terra Nova (in Agricum)*		**Session 8 continues** *Assembly Hall (in Alnarpsgården)*
3:40PM - 4:00PM	Scott Maco - Assessing the value of urban trees with i-Tree: its applicability to international audiences and overcoming limitations	3:40PM - 4:00PM	Patrick T. Hurley et al. - Forest foodways and existing edible urban landscapes: The case of urban forests in New York City and Philadelphia, USA
4:00PM - 4:20PM	Kyle H. Clark and Kimberly A. Nicholas - Urban food forestry: leveraging urban tree diversity to improve urban food security and catalyze social innovation	4:00PM - 4:20PM	Tim Delshammar, Johan Östberg, Cecilia Öxell - Public opinion on urban trees and ecosystem disservices – a pilot study
4:20PM - 4:40PM	Wendy Y. Chen - Contingent valuation of heritage trees in Guangzhou, south China	4:20PM - 4:40PM	Peter De Lacy - Tree species composition and congregant appreciation of the cultural and spiritual services provided by cemeteries and churchyards in Grahamstown, South Africa
4:40PM - 5:25PM	Matthew Wells - London, New York & Los Angeles: The challenges of urban tree diversity *Assembly Hall (in Alnarpsgården)*		
5:40PM	Busses depart from Alnarpsgården		
	Explore Malmö's restaurants!		

Wednesday June 18th, 2014		
Time		
9:00AM	Buses departs from Malmö	
9:00AM - 4:00PM	Excursion 1 - Alnarp and Malmö, including the Alnarp campus, Landscape Laboratory, Bultofta park in Malmö, biocultural diversity in Malmö. (Guides: Arne Mattsson, Ola Melin, Björn Wiström, Eva Delshammar)	Excursion 2 - Greater Copenhagen area, including urban trees in Copenhagen, Vestamager nature area, new greening in the Örestad city district. (Guides: Jens Ole Juul, Lars Christensen, Oliver Bühler)
4:00PM	Back in Malmö	

Singapore, a green and biodiversity-rich city state, against the odds

Dr Leong Chee Chiew

Commissioner of Parks and Recreation / Deputy Chief Executive officer, National Parks Board, Singapore, leong_chee_chiew@nparks.gov.sg

Dr Leong joined the Singapore Parks and Recreation Department in 1983 as a research officer. He did a stint in the Strategic Planning Division of the Ministry of National Development from 1987 to 1989. In 1990, he was appointed Deputy Executive Director of the National Parks Board. When the Parks and Recreation Department merged with the National Parks Board in 1996, he became the Deputy Chief Executive Officer (Specialist Services Department). In 2000, he took over the Board's Parks Management Department. He is currently the Commissioner of Parks and Recreation, and also the Deputy Chief Executive Officer (Professional Development and Services Cluster) of the Board in charge of Policy and Planning, Streetscape and Arboriculture, Horticulture and Community Gardening, Industry Development and Centre for Urban Greenery and Ecology, Conservation, National Biodiversity Centre, Singapore Botanic Gardens, and Singapore Garden Festival. Dr Leong chairs the Singapore Landscape Industry Council, the Heritage Trees Panel, the Workplace Safety and Health (Landscape) Sub-Committee and Co-chairs the inter-ministry Technical Committee on Coastal and Marine Environment. He is a Board Member of Singapore Garden City Private Limited, Singapore Environment Council, and the Garden City Fund. He is also a member of the Centre for Livable Cities Experts Panel.

Urban sites are made for plant diversity

Prof. Dr Nina Bassuk[1], Prof. Dr Jason Grabosky[2]

[1]Department of Horticulture, Cornell University, USA, nlb2@cornell.edu,

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Nina Bassuk has been a professor and program leader of the Urban Horticulture Institute at Cornell University for the past 30 years. She is co- author of 'Trees in the Urban Landscape", a text for landscape architects and horticultural practitioners on establishing trees in disturbed and urban landscapes. In addition, Dr Bassuk has authored over 100 papers on the physiological problems of plants growing in urban environments, including improved plant selections for difficult sites, soil modification including the development of 'CU-Structural Soil' and improved transplanting technology. She works closely with municipalities to help implement best practices in urban forestry management.

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Aliens in the city!? Considering context dependence helps calming down the heated alien-native debate

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Ingo Kowarik is professor of Ecosystem Science/Plant Ecology at the Department of Ecology, Technische Universität Berlin. He also serves as voluntary State commissioner of Nature Conservation and Landscape Management of the federal state of Berlin and functions as president of NEOBIOTA, the European group on biological invasions. Ingo Kowarik has a background as landscape planner und plant ecologist. His scientific interests focus is on (i) urban biodiversity patterns and underlying processes, (ii) impacts of plant invasions inside and outside cities, and (iii) approaches to assess and enhance biodiversity functions and ecosystem services of the urban green infrastructure.

Landscape as infrastructure: Towards an Ecological Urbanism

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Nina-Marie Lister is Associate Professor and Associate Director of Urban + Regional Planning at Ryerson University in Toronto, and Adjunct Associate Professor of Landscape Architecture at University of Toronto. From 2009-2013, she was was Visiting Associate Professor of Landscape Architecture at Harvard University, Graduate School of Design. In 2012, Prof. Lister was named Senior Scholar with the Centre for Humans and Nature. A Registered Professional Planner (MCIP, RPP) with a background in landscape ecology and environmental planning, she is the founding principal of plandform, a creative studio practice exploring the relationship between landscape, ecology, and urbanism. Prof. Lister's research, teaching and practice focus on the confluence of landscape infrastructure and ecological processes within contemporary metropolitan regions. She is co-editor of Projective Ecologies (with Chris Reed, Harvard GSD and ACTAR Press, 2014) and the The Ecosystem Approach: Complexity, Uncertainty, and Managing for Sustainability (with David Waltner-Toews and the late James Kay, Columbia University Press, 2008), and author of more than 30 professional practice and scholarly publications.

London, New York & Los Angeles: The Challenges of Urban Tree Diversity

Matthew Wells

City of Santa Monica, California, USA

Matthew Wells is the Urban Forester for the City of Santa Monica in California. Santa Monica is regarded as having one of the most planned, systematic and integrated urban forestry programs in the US. His area of expertise is municipal tree management. Prior to his current appointment, Matthew was the Director of Tree Preservation for NYC Parks for nearly six years. He has also worked in Central London as a Tree Officer. Matthew's international experience of urban forestry lends its self to a unique global perspective. He has presented multiple papers and workshops at urban forestry conferences throughout the world. Matthew is a past Trustee of the Tree Research and Education Endowment (TREE) Fund and is a Chartered Arboriculturist.

Urban tree selection in a changing climate

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Trees in urban ecosystems are especially vulnerable to climate change since general warming will be exacerbated by urban heat island effects. Urban heat island effects generally add 4 degrees C to air temperatures of cities compared to surrounding rural areas but may range as high as +9 degrees C for summer daytime temperatures in cities in the central United States. Urban foresters need to incorporate climate predictions into tree selection decisions since trees are long-lived organisms and will experience changes in climate during their projected lifespans. Selecting trees that are adapted to changing environmental conditions is essential to the future of urban forestry. Since trees are sessile organisms and are unable to move when environments become unfavourable, their ability to acclimate to changing conditions is an important mechanism to adapt to climatic change. In our current research, we are investigating the potential impacts of warming temperatures on growth and physiology of urban trees. We conducted an intensive greenhouse trial to determine the relative ability of street tree cultivars to acclimate their physiological responses to changing temperature regimes. We grew container-grown trees of six common street tree cultivars under three temperature regimes; Ambient, Ambient + 5 deg. C, and Ambient +10 degrees C. After 12 weeks of acclimation we compared optimum temperatures for photosynthesis, respiration temperature quotient (Q10), leaf thickness, stomatal density, and carbon isotope discrimination. The degree of temperature adjustment in physiological and morphological parameters varied among cultivars, suggesting that street tree genotypes differ in their ability to acclimate to increasing temperatures. These results will provide insights into future selection by identifying key physiological factors that may guide selection for projected urban stress conditions.

Examination of Sugar Maple provenance responses to increasing temperature and drought

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Future climactic changes have been modelled and predict extended periods of water deprivation and increasing thermal loads in the north-eastern United States. Historically, plant selection in urban forestry has prioritized aesthetic value of trees without fully considering the urban forest's capacity to withstand intensifying environmental conditions. Provenance characteristics can influence species capacity to survive when facing novel environments. When establishing plant selection criteria it is crucial therefore, to consider species provenance. A species might be aesthetically desired for a particular site; however, within and among species, there can exist enough genetic variation that successful selection of transplanting stock can be suggested. One example is *Acer saccharum*, or Sugar Maple; a member of a group of closely related taxa, known as the "hard maple group." In the north-eastern United States, sugar maple occupies a broad geographical range with varying soils, weather patterns, and elevations, with high economic value and ties to cultural identity. Sugar maple is sensitive to many conditions found in the urban environment and has been modelled to suffer a reduction in natural forest populations in the north-eastern United States over the next 50 years. Sugar maple seedlings of various provenances were collected and subjected to drought and temperature stress through a series of controlled environment studies to show the impact of provenance on whole plant response to environmental variables of water availability and temperature. A LiCor 6400 Portable Photosynthesis System was used to measure and compare provenance responses of *Acer saccharum* ssp. saccharum and ssp. leucoderme. The relationships between physiological response to increasing thermal loading and water deficits, within a factorial study design will be discussed in correlation with genetic diversity and morphological expression within the same common garden and field measure within their natural forest setting.

Testing of ornamental trees in harsh winter conditions at Ås, Norway

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An experimental plot comprising 86 tree species and hybrids and 22 seed sources was established during the period 2005-2011 at the University of Life Sciences at Ås, Norway. The main objective was to study the winter hardiness and to demonstrate the ornamental value as well as the tree properties in general. Tree growth and phenological stages were recorded annually. General appearance was observed continuously. During the test period the trees were exposed to very tough conditions in the winters of 2007/2008, 2009/2010, 2010/2011 and 2012/2013. All these winters may be regarded as "bottlenecks" representing unstable, very cold or very dry winter weather. Severe stem damage was observed in 2008, 2010, 2011and 2013. The damage was fatal for *Acer campestre* cvv. and *Prunus virginiana* 'Canada Red'. In 2008 frost damage to the buds were frequent on *Prunus*. In 2013 major damage occurred on stems and crowns of *Quercus*. Some of the injuries may be caused by pathogens and will be studied closer. After the winter 2012/2013 another kind of growth disturbance was observed as well; impaired growth and dwarf leaves on *Prunus*, and most pronounced on *Prunus avium*. Different tree species- and cultivars were severely damaged during the four winters illustrating the challenge of predicting climatic bottlenecks when selecting trees for the future. In spite of difficult winter conditions and severe pest attacks in this experimental plot 20 tree cultivars had no or minor damage during the period 2007 – 2013. Furthermore about 15 cultivars had moderate damage and can be considered very hardy. Most of these trees are not commonly used in Norway and can be recommended for more extensive use. Among the more recently established trees about 10 species or cultivars seems promising.

Evaluation of street tree varieties in the Netherlands

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Urban green is increasingly important for multiple reasons. Trees in many cases are the most visible and because of their size the most effective part of urban green. However, in urban environments, and especially along streets, buildings, closed pavements, compacted soils, pollution, traffic and restricted growing space strongly reduce the possibilities for trees to grow. Sound knowledge on growth characteristics and potential of specific varieties is therefore essential for a successful species choice. In the Netherlands at least more than thousand tree cultivars are being grown commercially and several hundreds of these are being used regularly as street trees. New cultivars are also continuously released to the market. In order to provide designers and managers of urban plantings as well as growers with independent information on cultivars' value as street trees (and especially of these new ones), a research project was initiated 15 years ago. The new street tree species and varieties are tested in "real-life". For this purpose, a network has been developed of municipalities that cooperate with the project. Experimental plots were established in 20 cities and villages across the country. In these plots over 2000 trees of 75 species and cultivars were planted and a monitoring scheme was started. Recently all data from the monitoring were evaluated and processed into two-page descriptions of the species and varieties tested. These descriptions together with additional data have been used to build a website (www.straatbomen.nl) that provides as a source of information for designers and managers of street tree plantings. The paper summarizes the main results and will demonstrate the use and contents of the website. Also the plans for a follow up project designed in cooperation with urban green managers and the tree nursery industry will be discussed.

Identifying physiological characteristics associated with stress tolerance in ornamental trees

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Selection of trees for urban plantings is primarily based on aesthetics (flowers/bark colour etc.). Consequently the stress tolerance of many ornamental trees remains largely unknown. As a result 100,000s of trees die annually from inappropriate site/species selection. Although the ecological and anatomical features of trees that confer stress tolerance are appreciated the influence of inherent physiological and biochemical characteristics are not. Objectives of this presentation are to: 1. Discuss physiological and biochemical characteristics in ornamental trees (leaf photo-oxidative pigments, stress metabolites, protection of the leaf photosynthetic system) that are associated with robustness and survivability under harsh environmental conditions. 2. Show how these characteristics can be used as screening criteria without expensive and labour intensive field trials to rapidly gauge the stress tolerance of species that possess the desired aesthetic characteristics but whose performance in urban landscapes remains unknown.

The role of trees in enriching dense suburban environments: incorporating residents' values into suburban forest design and care

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Researchers and urban designers have recently focused on new ways to design the suburbs so that they are healthier for humans, the local environment, and for the planet. One approach is to increase residential densities within the suburban environment. Another approach is to increase the tree canopy cover and diversity of the suburban forest. Both approaches provide many benefits to local residents: they reduce carbon dioxide emissions, save energy, and can even improve human health. Yet these two approaches are at odds: both compete for limited physical space. Confounding this issue is the fact that many trees in residential settings are neglected, vandalized, and live significantly shorter lives than trees in forested settings, a problem likely to be further exacerbated by climate change. This project examines the stated preferences of suburban community residents for trees and compares these with the existing suburban tree cover within their community. The study site is the community of East Clayton in Surrey, BC. This neighbourhood was recently developed as a more sustainable, higher-density alternative to traditional suburban development, and has earned awards for its sustainable approach, yet it falls short in its suburban forest diversity and tree canopy cover. This research aims to understand attitudes of current residents towards trees at the neighbourhood scale: for example, do they want more trees and tree diversity than they have, or are they supportive of the removal of certain trees and low canopy cover? The paper reports methods and initial findings from interviews with local residents, including a pattern of preferences for more mature trees and more native species. It also tests a method of simple spatial analysis of historic, current, and projected canopy cover, as a basis for comparison with stated preferences. By gaining a better understanding of Canadian suburban residents' preferences in relation to tree types, distribution, and other evolving suburban forest characteristics, key lessons may emerge that could help future developments create more successful suburban forests in dense suburban environments.

Regulating ecosystem services and sustainable planning - the role of tree species and strategic planting

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Urban trees are not an anonymous mass of a green infrastructure performing a wide range of benefits to the community. Different species will, depending vitality and site specific context, deliver quite different services during different seasons of the year. This is however not usually recognized in the planning and building process. Similar to the arts of building engineering and the detailed attention nowadays given to e.g. the thermal transmittance of specific windows and insulation properties of particular façade materials, trees also need to be materialized and discussed in terms of species and strategic location whilst linked to different ecosystem services. Based on a case study in southern Sweden, the aim of this study was thus to discover how different species depending location and time of year would contribute to wind speed mitigation and mean radiant temperature in a newly developed area, Lomma Harbour, by the seafront. The microclimate simulation tool of ENVImet® helped illustrate how different species of trees and shrubs would contribute to microclimate amelioration throughout the area. The results also helped exemplify how the strategic placement of vegetation interlaces with the environmental goals and initiatives of the development companies and the local municipality. i.e. how the individual tree or a specific group of trees help contribute to the objectives of energy efficiency, less wear and tear on building materials, a better microclimate strengthening recreational values, community benefits and human wellbeing etc. Although the study is case specific to Lomma Harbour, a secondary aim has been to encourage a discussion in how to bridge green infrastructural planning to a site level perspective – from anonymous green structure to species quality and performance, and how this in turn may influence and strengthen an overall landscape resilience.

Modelling urban distributions key host trees for invasive forest pests

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To reasonably estimate the spread and impact of invasive forest pests, it is critical to have good representations of the distributions of their host trees. While data sources such as the US Forest Service's Forest Inventory and Analysis (FIA) plots provide a solid foundation for estimating host distributions in natural forests, urban forest inventories are a less reliable data source: relative few communities have surveyed their forests, and these surveys have often been restricted to street trees or a subset of community lands. We compiled urban forest data, collected and organized in various scales and formats, from more than 350 communities across the eastern and central US. Our objective was to use these data in models to estimate the presence of key host trees in non-sampled communities throughout the study region. For each inventoried community, we determined the relative proportion of its total basal area associated with three genera, maple (*Acer* spp.), ash (*Fraxinus* spp.), and oak (*Quercus* spp.) that serve as hosts for major invasive pests. We applied two modelling methods, boosted decision trees and decision tree forests, to a suite of geographic, demographic, and climatic explanatory variables. In preliminary analyses, both methods performed well for maple and oak, in maple explaining more than 70% of the variance. Both methods identified similar suites of important variables, although boosted decision trees yielded somewhat better predictions. For ash, neither method explained much variance or predicted well, which we attribute to the variability in urban ash proportions across the study region. Nevertheless, our success with maple and oak shows the promise of the approach. Future steps include adding other host genera and expanding the study area to Canada and the western US. Ultimately, our approach should help fill an important knowledge gap in the modelling and mapping of invasive species risks and impacts in North America.

Seed vitality of exotic species in their northern introduced range

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Invasion success of exotic plants depends on their reproductive success in their new range. Inbreeding and Allee effects in small populations, combined with low temperatures and short growing seasons may limit the seed set and seed quality in exotic species growing at their northern introduced ranges. Such reductions in reproductive success may lower the risks of invasiveness of exotic species. We conducted a study to test seed vitality in a set of open-pollinated exotic trees and shrubs introduced to SW Norway by testing their stratification requirements and germination under different environmental conditions. Ripe seeds of 55 exotic taxa were collected at Bioforsk, Rogaland Arboretum, Stavanger Botanical Garden and in private gardens. Seeds were collected from small stands of a few trees, some only as single-trees. Seeds were sown in pots and stratified for 0, 6 or 24 weeks or given a cycle of warm and cold periods. Seeds were also tested in a seedbed under field conditions at two levels of temperature. We found a high seed set and a high germination rate in the majority of the species, but with some contrasting germination strategies: some without dormancy, some requiring only short 6 weeks stratification, while most germinated best after 24 weeks stratification. A few species benefited from a 3 weeks warm period before 24 weeks stratification and some species had good germination under all treatment combinations. Seventeen taxa had some direct germination in autumn, but only 7 of these showed more than 50 % germination in autumn. We found a high seed and seedling quality and an adapted germination strategy in most of the tested species. Hence, these factors cannot explain the observed lack of naturalisation. For the few species that are invasive, high germination rates and seed vitality was observed.

Does adjacent late-successional forest prevent plagiosere of fragmented and abandoned secondary forest in sub-urban Japan?

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In fragmented and abandoned forests near urban areas, vegetation succession often follows a plagiosere, but the direction of succession may vary depending on the surrounding landscape. We investigated edge effects and 5-year change in stand structure of an abandoned secondary deciduous forest located adjacent to agricultural fields and near lucidophyllous forest. During the five-year study period, in the secondary forest, the number and basal area of evergreen-species increased, while many small individuals of deciduous species died. Size, number, and basal area of evergreen species increased from forest edge to interior, while mortality of deciduous species increased. Although newly established trees included many bird-dispersed species, more than half of these were lucidophyllous forest components, dispersal was not concentrated near the forest edge, and no ornamental or invasive species were observed. Thus, we inferred that the vegetation change in the secondary forest is not following a plagiosere. We predict that evergreen species will spread from the interior toward the forest edge, shade-tolerant evergreen species will increase in the lower canopy, and tree species composition of the secondary forest will become more similar to the nearby lucidophyllous forest. In a landscape where mature forests may function as seed sources, vegetation change in fragmented and abandoned forests may not divert to a plagiosere.

Defining canopy metrics of urban trees with high density ALS data

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There is a growing interest in monitoring of urban trees. Both park and roadside trees offer various benefits, including recreational and aesthetic ones. As the benefits have become recognised more widely, the need for urban tree inventories has also been established. In contrast to the trees in commercially managed forests (where the main interest is in stem volume), the value of an urban tree is determined through the benefits a living tree provides through its presence. Also, an average urban tree is more significant to its surroundings than a single tree in more natural surroundings. Thus it is meaningful to collect and maintain accurate, individual tree level data from urban trees. Accurate data enable efficient maintenance of urban trees as well as value assessment in terms of ecosystem services.

Airborne laser scanning (ALS) data can be utilized to retrieve detailed 3D information from individual tree crowns. Accurate measurements provide urban tree management solutions (e.g. the i-Tree software suite developed by the USDA Forest Service) with different tree metrics. For example crown volumes can be derived from ALS point clouds. Although laser measurement methods, such as terrestrial laser scanning (TLS) and mobile laser scanning (MLS) enable more detailed data collection, ALS is usually the most efficient method for inventories covering large areas (i.e. whole cities). In our case study, dense leaf-off ALS data (≈20 pulses per m2) are utilized to predict four key characteristics of tree crowns: crown width and height, crown volume, and crown height from the ground. Our test site is located in city of Helsinki, Finland. The urban tree population studied consists mostly of deciduous trees (mostly *Tilia europaea*, *Acer platanoides* and *Betula pendula*). In leaf-off conditions, the dense ALS data describes well also the lower parts of the crown and hence gives accurate estimates for crown metrics.

Change analyses of urban forests in Mari El republic, Russia with the use of remote sensing

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Historically development of the urban forest infrastructure around Russian cities has shown significant differences compared to Europe and North America. During the Soviet period the main recreational activities were focused on creation of the forest belts around the cities. Nowadays there is tendency for transformation of forest areas through landscape design into a network of parks and green areas around and inside the cities. Such activities change the spatial distribution of the forest areas and groups of trees. Monitoring and analyses of land use change and urban landscapes can be most efficiently done with the use of remotely sensed imagery of middle and high spatial resolutions. The objective of the research was to monitor land cover change in urban forests around the main cities of Mari El Republic of Russia with the use of multi-temporal Landsat scenes acquired between 1983 and 2013, as well as with high resolution Rapid Eye images. Change detection and thematic mapping techniques were used to diversify the land cover, forest structure, species composition and evaluate the fragmentation indices for the urban forest sites with the use of ENVI-5.0 and ArcGIS-10.0 programs. The overall accuracy of the thematic mapping classification was assessed as well. Research results quantify the land cover change patterns in the urban forests of main cities in Mari El. They show the high potential of remote sensing imagery for providing accurate data for more sustainable recreational and landscape management.

Analysis of urban and natural forest composition across North America

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It has been suggested that urban forestry tree planting practices are creating a homogenous urban forest, with the same limited number of species dominating urban landscapes across North America. However, to date urban forest inventory data have been limited, and data collected from different cities were often incompatible. To begin to address the issue of urban forest composition, tree species data were obtained from 450 U.S. and Canadian cities which had conducted inventories for use with the i-Tree Eco (UFORE) or i-Tree Streets (STRATUM) software or which maintained comprehensive street tree databases. Relative basal area of each species was calculated by city and land-use class and for each city as a whole. Those data were combined with data from nearby natural forests from the U.S. Forest Service Forest Inventory and Analysis (FIA) Program. The data were then analysed using PC-ORD to determine which cities' urban forests were most similar to one another (using cluster analysis) and how species composition related to large-scale environmental variables (using NMS ordination). Environmental and geographic explanatory variables included latitude, longitude, elevation, total annual precipitation, and plant hardiness zone.

Preliminary analyses showed that urban forests as a whole clustered by species composition data along rough geographic and climatic lines. More intensively managed portions of the urban forest (e.g. street trees) tended to cluster in ways less closely related to geography and climate. Analyses also indicate that urban forests are more similar to one another than they are to nearby natural forests. Street tree populations were most similar in their species compositions, while other components of the urban forest showed greater variation. More intensively managed segments of the urban forest were also less similar to adjacent natural forests. Urban forests also tend to resemble the natural forests of the eastern U.S. more than they resemble western forests.

Urban forestry plantations assessment in a global change perspective

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Over the past three decades, the phenomenon of climatic change has particularly affected Southern Europe. In Milan, the average annual temperature has increased by 1.5°C rendering it more similar to the Mediterranean climate and affecting the condition and health of trees that make up the urban forest. To study these effects, the Life + Emonfur Project set up a research plot network in Milan's metropolitan area. In these urban forestry plantations the project assessed climatic and dendrometric parameters, soil features, plant disease, floristic composition, and so forth. The impact of global change was evidenced by the monitoring activity, which demonstrated how the different climatic conditions favoured certain diseases, such as thermophylic or thermotolerant pathogenic endophytes, previously unknown to exist at this latitude. This project brought forward important considerations for disease virulence prevention by selecting tree species less susceptible to these pathologies and by adopting appropriate silvicultural practices resulting in resilient ecosystems in an ever-changing environment. The Emonfur Project also defined monitoring standards for urban forests, while the research activity highlighted some of the ecosystem services. In particular, it was possible to assess the effect of forestry plantations for carbon sink in the trees and soil, the safeguarding of biodiversity, mitigation of the heat island effect, and the like.

Assessing and comparing composition and diversity in urban trees populations in Northern Italy

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Scarce research exists on urban tree diversity and species composition drivers for urban forests in Italy. Data from complete urban forest inventories conducted over the last 5 years in cities of different sizes in coastal and inland areas of north-eastern Italy have been used to assess and compare street and park tree populations. The main aim of the study was to identify differences in species composition and diversity between tree populations according to urban size (cities ranging from 10,000 to 300,000 inhabitants), geographic areas (coastal versus inland), and types of tree population (parks versus streets). The most commonly used diversity descriptors such as Shannon-Wiener diversity index, Inverse of Simpson Index of diversity, Maximum equitability and Equitability species indices were used in the analysis. Data from the inventory included not only taxonomical but also included structural data (and in particular DBH). Therefore tree age classes were also considered in studying possible trends in species selection throughout time (prior to 1970, between 1970 and 1990, and after 1990), and in identifying possible drivers of species choice in urban planting and how these have changed over the past sixty years.

Spatial configurations of urban forest in Denmark and Sweden – patterns for green infrastructure planning

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While forest plays an important role for urban ecosystem functioning and the well-being of urban populations, little is known about the interrelationship and geography of the enormous variations in forest provision between cities. We used GIS to quantify forest cover and spatial configurations (patch size and frequency) for all Danish and Swedish cities with >10,000 inhabitants (n=176), and general linear modelling to investigate the relationship with (i) regional landscape type, (ii) population size and demographic trends 1960-2010, and (iii) the gradient from urban area (<0.2 km from city boundary), through the urban fringe (0.2-2 km), to the urban periphery (2-5 km). We found that regional landscape type outweighed urban processes in determining forest cover, increasing significantly from cities in large-scale agricultural regions of Denmark and Sweden to cities in regions of Sweden with mosaics of forest and small-scale farming, and further to cities in forest-dominated regions of Sweden. However, urban processes determined the spatial configuration of urban forest by distance from the city, being lowest in the urban zone and peaking at the urban fringe rather than the urban periphery, irrespective of regional landscape type and population characteristics. Furthermore, forests had an exponential size distribution where 'pocket woods' (<2 ha) accounted for >50% of patches in all three urban zones, irrespective of regional landscape type. These patterns may help inform the integration of urban forest resources into multifunctional green infrastructure planning strategies that are replicable across cities.

Creating tree diversity in school grounds with focus on children's perspectives on vegetation establishment

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Children spend much of their time in school grounds, but these are often barren, with little biodiversity. Through school ground greening projects, children can access woody vegetation which supports their healthy development. Children's participation in such projects might increase the benefits and also improve the vegetation establishment results. Woody plants need to be protected from too much wear and tear, particularly during the first few years after planting. The greening process should therefore support the development of a positive relationship between children and new woody vegetation. This study explored the influence of planning, management and maintenance approaches on children's school ground use and experiences during the establishment of a landscaped area with mixed woody plants at a school in Malmö, Sweden. Field observations were conducted at three occasions during one and a half years following the first planting. The methods included documentation of vegetation growth and damage, observations of use and short informal interviews with children on-site. The plants developed rather well, except for in the most accessible parts and close to much used hills with meadow. Children participated during the planting but not during the following maintenance. Especially younger children (up to around 11 years) were positive to the project and also used the area much, such as for running games and pretend play. Older children did not find as much to do in the new areas as did the younger ones. Continuous participation and physical use of the area appeared important for children establishing a positive and caring relationship with it. School ground greening including the subsequent maintenance should therefore be well integrated with pedagogic activities. The establishment of woody vegetation was supported by practical solutions including establishing other landscape elements that are attractive for play and using fences without hindering access.

Shaping diverse identities in urban forestry: Influences of metaphor, language and agency

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Urban forestry contains dominant and hegemonic stories that are seen as the norm in the management of urban trees. However, there are also marginal and under-represented stories relating to the language use, labour processes, the agency of trees, and the educational norms of the profession and practice. This presentation will explore two such narratives. My first narrative explores metaphor as it relates to identity (ecological and social; individual and collective) and examines how this impacts arborists' self-awareness. My second narrative provides a closer look at arborists' interactions and feelings, about the external (urban) nature they serve, protect, nurture and sometimes destroy. Using discourse analysis and accounts from semi-structured interviews with arborists in Southern Ontario, Canada, and drawing on information from participant observation, I first explore how metaphors: cultivate identity constructions; imbue identity influences; and, propagate identity paradoxes; and second, I examine how arborists negotiate the urban forest, physically and emotionally as a place of work. Using a political ecology lens, my research examines how communicating underrepresented narratives in urban forestry, using arboriculture, can inform a more socially inclusive urban forest integration and how examining the consumption of urban forests through the eyes and experiences of field arborists, can influence the future of urban forest practice. Results showed that language is dynamic and terms are often adopted, branded and contorted depending on their intended use, and sometimes altogether unintentionally; and that field arborists' proximity to urban trees creates a unique (physical and emotional) relationship with the urban forest. Findings suggest that re-imagining urban forestry practice and communication in Southern Ontario (as well as across the globe) can influence its praxis towards more sustainable, ethical and transdisciplinary directions.

The good, the bad, and the abiotic: a survey of urban tree composition and tree problems in the San Francisco Bay Area (USA)

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Tree species composition in cities is known to influence urban forest management problems, such as pest outbreaks or infrastructure damage. However, systematic regional information on either the tree composition or the management challenges remains somewhat scarce. To obtain this information, we surveyed urban forest managers ("city foresters") in the San Francisco Bay area, a large conurbation of about 100 cities and towns. A questionnaire, sent to 55 city foresters and completed by 50, asked for ranked lists of five tree species of the (1) most common, (2) best- and (3) worst-performing trees in their city, as well as five most troublesome (a) insects, (b) diseases, and (c) abiotic problems. Additional questions examined other characteristics of each city's urban forest. We found that the urban forest size varied predictably with the city size, but density and other characteristics were largely independent of the residents' income, city size, age, or microclimate. Despite several lethal pests being reported, the insect and disease problems were ranked below those caused by abiotic (and human) factors, and the perceived pest problems were driven largely by the pest species infesting the most numerous trees, regardless of the pest's severity and independent of the city's management approaches. Urban foresters' tree species preference appeared to be inversely related to tree size, with mostly small or medium-sized trees listed in the "best-performing" category, contrasting with the reported "most common" trees where medium to large-sized species predominate. The "worst trees" were assigned to that list in equal proportions because of their high maintenance, their incompatibility with infrastructure damage, and – surprisingly – their pest problems. Results confirm the phenomenon of the "shrinking" of the future urban trees observed elsewhere, but also suggest that, in the absence of catastrophic outbreaks, the everyday importance of urban tree pests may be underrated in self-reported assessments.

Where have all the mature trees gone? - A meta-analysis

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This presentation explores the existence of mature trees in cities, their role, and measures to protect and retain them. While discussions of species selection and species diversity are topical and relevant, less attention is paid to structural diversity. However, we know that numerous urban forest benefits are directly related to tree size, so it's worth assessing whether our cities contain sufficient numbers of large, mature trees. Pressures such as redevelopment, citizen preference, modern health and safety standards, or pest and disease outbreak can lead to a distinct gap at the upper end of an ideal tree size distribution. The results of a meta-analysis of published urban forest inventories will be presented, with specific attention given to tree structure. We will also explore examples of tools used to protect large, mature urban trees.

The importance of urban tree diversity

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Overlooked and undervalued our urban tree population represents a living resource that is acutely vulnerable in a time of global change. A shared resource, improving the environmental quality of human habitat while positively contributing to health and well being. Derived from one of the narrowest cloned gene pools propagated by an even narrower supply chain. With poor robustness to survive outside of a high input resource use environments. This vulnerability is explored along with strategies to increase robustness. Integral to developing sustainable urban ecosystems fit for the future. This paper establishes the evidence base for improved tree selection and placement to grow a more resilient urban tree resource through; 1) Evaluating the structure and composition of our urban forests (age, size and species and clonal composition); 2) establishing how such information can aid the determination of likely impacts from various agents on the urban forest resource; model the limited diversity effect, establish a potential cost of lost ecosystem services and for their replacement; and 3) exploring strategies to increase urban tree diversity in order to provide better resilience in the Urban Forest.

Urban tree diversity in Finland

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"It all starts with the planning process", it is said. This is certainly true in Finland where urban tree species diversity is becoming a hot topic. Climate change, new pests and diseases and public awareness have all contributed to this. During the past few years, major steps have been taken in different projects, conferences and articles. As more and more of planning processes become 'privatized', sound guidelines are needed. The cities of Turku and Helsinki are leading the way. According to a recent study of tree species diversity in ten major Nordic cities the situation in both Turku and Helsinki is rather typical. While Turku boasts more proportional tree diversity, both cities rely heavily on a few species only. To improve this situation the City of Helsinki published new guidelines in 2009. The city wants to follow Santamour's 30-20-10 model as a general rule. So far the results have been mixed. The City of Turku faced the subject heavily when a project to renew tree plantations around the cathedral started in 2006. Several city administrations took part in extensive negotiations. As a result, uncommon tree species were planted in the old centre. This has attracted great interest in the landscape industry. Afterwards dozens of new tree species have been planted around the city and many species are tested in suburban areas. A new tree species strategy will be written during 2014. It is not simple to promote tree species diversity in Finland. Domestic nursery production concentrates on certain species as a result of rationalizations. These few species are available and thus easily ordered. Uncommon species have been imported for a long time. However this does not come without several risks. First of all, the genetic quality is not the best for Northern conditions. Secondly, imported nursery stock from the South may contain new diseases. However, Swedish E-planta production offers advantages. The City of Turku has used this material with good results for several years.

Young tree vitality: A tree nursery benchmark system

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The assessment of quality in nursery trees has depended entirely on the evaluation of morphological criteria. While this is valuable there has long been a need for a science-based assessment of the physiological condition of nursery trees. Working together, Barcham Trees and Bartlett Tree Research Laboratories have collated data over a four year period using leaf fluorescence. Chlorophyll content and electrolyte leakage were applied as non-invasive and non-destructive tests. Over 60,000 trees have been tested over the period using these methods. This has involved over 300 species and cultivars with over 300,000 leaf samples being used. From the data a nursery benchmarking system for assessing the physiological health of nursery trees has been created. This system can be extended into the landscape following planting for an assessment of tree vitality against known criteria. Keith Sacre of Barcham Trees and Glynn Percival from Bartlett Tree Research Laboratories will deliver a joint presentation explaining why the nursery decided to invest in such extensive research, the value of such a benchmarking system to professionals involved in urban tree management and the science behind the tests used.

Mulching as a means of controlling root rot pathogens

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Selection of trees for urban plantings is primarily based on aesthetics (flowers/bark colour etc.). Consequently the stress tolerance of many ornamental trees remains largely unknown. As a result hundreds of thousands of trees die annually from inappropriate site/species selection. Although the ecological and anatomical features of trees that confer stress tolerance are appreciated the influence of inherent physiological and biochemical characteristics are not. Objectives of this presentation are to: 1) Discuss physiological and biochemical characteristics in ornamental trees (leaf photo-oxidative pigments, stress metabolites, protection of the leaf photosynthetic system) that are associated with robustness and survivability under harsh environmental conditions; and 2) show how these characteristics can be used as screening criteria without expensive and labour intensive field trials to rapidly gauge the stress tolerance of species that possess the desired aesthetic characteristics but whose performance in urban landscapes remains unknown.

Restoration of urban forests after Emerald Ash Borer (EAB) and relevance of an Urban Fit Matrix in Replant Selection in North America

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Studies were conducted at 40 sites at locations within the EAB distributional range in North

America from 2004 through 2013. Several aspects of the community responses to EAB including ash tree removals, ash tree preservation and restoration after removals were evaluated. Significantly more trees in the smaller (< 12.5 and 15- 25 cm and largest > 100 cm diameter at breast height (DBH) classes) were removed pre-emptively as un-infested trees compared to the middle range DBH classes (28- 63 cm and 65-100 cm). In an overall assessment of studied sites, the number of replanted trees accounted for 62 % of the number of ash trees removed. The compensatory values (i-tree.org) of several species of 12.5 cm DBH replanted trees were comparable to an existing 38 cm DBH ash tree after as early as 10 years after restoration. An urban fit matrix (UFM), a measure of tree fit in the urban forest was developed to gauge real time health and rate projected establishment success of 19 replant species. Trees that provided highest compensatory values had lowest UFM scores indicating these species may need more input for establishment. The data suggest that compensatory values coupled with UFM scores may better enhance plant material selection in restoration efforts. This work focuses on an invasive species that has the potential to become established in North America. The lessons learnt here add to our arboricultural experience and ability to formulate better plans thus limiting impact of future invasions in our urban forest systems.

Root severance and urban trees: a four years' study evaluating growth, physiology and stability

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The aims of this study were: 1) to evaluate the effect of two different levels of root severance on tree growth and physiology of two shade tree species supposed to differ in their tolerance to root manipulation; and 2) to evaluate consequence of root severance on the uprooting resistance and on safety of trees. In March 2004, 48 *Aesculus hippocastanum* (10-12 cm circumference) and 48 *Tilia x europaea* (10-12 cm circumference) were planted in a loamy soil and were allowed to establish for 5 years. In June 2009, when trees were 25-30 cm circumference, the following treatments were imposed: 1) roots were severed only on one side of the tree by excavating a trench (70 cm deep and 50 cm wide) 40 cm apart from the root flare (Moderate Damage); 2) roots were severed at two opposed sides of the tree by excavating two trenches (both 70 cm deep and 50 cm wide) 40 cm apart from the root flare (Severe Damage); and 3) roots were not damaged (control). Shoot and stem diameter growth, leaf gas exchange, chlorophyll fluorescence and water relations were assessed for the 4 years following the damage. Roots were dug with Airspade a few months and 4 years after the damage to assess the size of the root plate. The pull test was performed immediately after the severance and after 4 year using Orebla analysis software. Even in very rainy years, root severance induced a mild to moderate drought stress on severed trees, resulting in decreased photosynthesis and growth and less favourable water relations. In the 4 years after trenching, recovery from stress was slow and incomplete, particularly in *Aesculus*. Also, the safety index of severed trees was reduced, thus increasing the risk of failure.

Growth of *Prunus avium* street trees is increased by addition of biocharcole to a structural soil

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The process of planting urban trees is costly and it commonly includes many inconveniences for the habitants in the area. The survival and a secure establishment of urban trees are therefore very important and there are a number of different constructions and soil amendments are proposed to increase the planting success. We have tested the effect of adding biochar to a structural soil plantation of trees. *Prunus avium* was planted at a street in Stockholm Sweden with three different types planting beds. Structural soil has a framework of stones that is compressed to give stability and a growth medium for the roots added between the stones. One third of the total soil volume is available for root growth. In this study a structural soil with a growth medium containing 50% biochar was compared to a conventional structural soil and a soil constructed purely of the framework stones. Stem diameter was 35% higher in the trees that grow in the biochar medium compared to those in conventional structural soils. Surprisingly the trees growing in the pure stone had the same stem diameter as the trees growing in the structural soil. The trees growing in the biochar amended soil also have a wider crown and a larger aboveground biomass. Soil moisture in the planting pit was increased by the addition of biochar in the structural soil and also by the removal of growth medium in the pure stone soil. Biochar significantly increases the growth of urban *Prunus avium* in a Scandinavian climate. This effect is probably due to the ability of the biochar to retain nutrient and particularly nitrogen is the soil. It is well known that biochar increases the efficiency of nitrogen fertilization to plants. This indicates that fertilization might be reduced at planting if biochar is used.

Redirecting rainfall runoff into nature strips to improve the performance of urban street trees in residential suburbs

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Water sensitive urban design (WSUD) has increased in many cities to improve retention and reuse of runoff for raingardens, biofilters and street tree pits. However, WSUD is often expensive and restricted to wealthy, inner-city areas. Residential suburbs actually provide the greatest area of urban impervious surface cover and would benefit most from an increase in tree canopy cover as suburban street canyons are not self-shading. In this study, two types of WSUD kerb modification are being compared in a BACI design. The design of these two systems has been determined through detailed hydrologic modelling according to variation in five key parameters: 1) street runoff catchment size, 2) kerb redirection efficiency, 3) gravel trench volume, 4) gravel water filled pore space and 5) soil type and therefore rate of trench exfiltration (hydraulic conductivity). These 3000 model iterations are being used to optimise the WSUD engineered system to make use of the majority of street runoff produced in a typical rainfall distribution year in Melbourne, Australia. To validate model predictions and provide a 'proof of concept' we are measuring soil moisture, tree growth and tree water stress before and after kerb gutter modifications adjacent to three tree species: *Lophostemun confertus*, *Pyrus calleryana* and *Ulmus parvifolia*. Nine trees of each species, six being kerb modified and as continuous controls. Rainfall runoff is redirected into a gravel trench (0.6 m deep) installed beyond the canopy drip line Soil moisture is measured continuously at two distances from the tree and at five depths to 1.2 m. Tree water stress is measured through monthly pre-dawn leaf water potentials. If this study proves cost-effective, this will open up residential suburbs to targeted WSUD installations with potentially huge impacts upon catchment stream and river ecology as well as street tree health, resilience and suburban ecosystem service benefits.

Diversity, now and then, and what is still being over-planted

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Urban forests generally have greater species richness than existing natural forest. We have found that the urban forest has approximately three times more tree species than a natural forest in the same vicinity. However, that diversity is a created or designed biodiversity. The comparison of urban forests in selected Midwestern USA cities in the past to the same urban forests in a recent study, indicates that we are unfortunately still over-planting many of the same species. In fact, there are a total of eight species of trees that are considered to be overplanted and these eight tree species account for nearly 75% of all public trees. The genus Acer accounts for nearly 40% of all the public trees. Species wise, ash (*Fraxinus* sp.), Norway maple (*Acer platanioides*), sugar maple (*Acer saccharum*), silver maple (*Acer saccharinum*), pin oak (*Quercus palustris*), linden (*Tilia* sp.) pear (*Pyrus* sp.), and red maple (*Acer rubrum*) are public trees that are considered overplanted. Of these eight species, silver maple and Norway maple are also considered overplanted on private property. The urban forest has many species of trees that are already growing in the city where more individuals could be added. For instance, in 1980 there were 42 species of trees and in 2003/2005 there were 46 tree species in the urban forest where each species made up less than 0.1% of the urban forest. This could possibly be expanded to include tree species that currently make up less than 1.0% of the total species richness, in 1980 there were 70 species and in 2003/2005 were 81 species. So, our research indicates that we are relying on too few species where we could add individuals of other species that are growing in the cities and maintain high diversity of trees in the urban forest.

Making the Halifax treescape more native: Initiatives in planting native tree species in parks, streets, and institutional lands

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Research into citizens' values associated with trees in the city of Halifax, Canada, reveals a widespread desire for naturalness of forest condition and native biodiversity. Rationales for this desire relate to sense of place, learning opportunities, and enhanced experiences with other native species, particularly birds, that prefer native-tree habitats. Inventory work in Point Pleasant Park (south end of the Halifax peninsula), Halifax streets, and the Dalhousie University campus in downtown Halifax reveals a preponderance of trees of alien species. Plans for the management of the tree canopies in these urban ecosystems, all prepared within the last five years, call for a shift toward plantings of native tree species. In Point Pleasant Park (ca. 70 ha), over one hundred thousand seedlings were planted as part of a restoration program following canopy destruction from Hurricane Juan in September 2003. In the Halifax streets, the canopy is strongly dominated by Norway maple, European linden, and American elm. Under the new Urban Forest Master Plan, street-tree plantings are to be predominantly of species native to Nova Scotia. Dalhousie's Halifax campus, measuring some 30 ha, is home to about 900 trees, mostly of alien species. In a special planting in spring 2014, the two hundred new trees will almost all be of native species. For each plan, the paper summarizes the tree inventories, and then relates the details of recent, current, and future plantings of native tree species. Challenges in making the shift from alien to native tree species in urban settings are discussed. Future research priorities should be, first of all, on the survival and growth of the new trees, and secondly on the degree to which citizens are cognizant and appreciative of the species shifts.

A tree is not a tree is not a tree – the importance to talked about details in the urban tree planning

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Throughout the urban landscape, trees make up important elements of the overall green infrastructure – providing us with numerous ecosystem services of which we depend on as a community. Trees also help us orientate and relate to the spatial context around us, creating an architectural transition from bold and often large scale buildings down to ground level as experienced by man. In the past, city trees would mirror the prosperity and cultural affluence of a society and as such, trees were planted mainly for beautification and aesthetics. Today, we know that the qualities of the urban tree stock reach beyond these concepts. With current challenges of climate change and rapid urbanization, the focus on trees has shifted towards many of the regulating ecosystem services much needed in the urban landscape. The role of urban trees today and in the future will thus be to help mitigate the urban heat island effect, shade buildings and thus reducing energy consumption, slow down surface runoff, act as noise filters, and purify the air through capturing particulate matter, carbon dioxide, ozone and other air pollutants originating from traffic and industrial activities. Whilst such services are generally measurable, urban trees also provide for more boundless qualities increasing recreation, health and wellbeing for the community – and yes, aesthetics too. However, in order to plan and subsequently secure a sustainable succession and development of our urban trees, we need to reach a better understanding and increase our knowledge of how different species respond in different situations – all in order to provide for different ecosystem services. With the limited space in towns and cities, and with current and future change occurring in climate and pattern of urbanization, multi-functionality and reliable plant material will become increasingly important. As such we need to begin a new discourse where focus is directed towards what kind of tree species we are using and from which cultivar the species originate? For the urban tree planner and landscape professional, a better understanding of the indigenous background and strategy of different tree species will in the end provide a robust platform from which decisions can be made in order to plan, design, and manage a sustainable urban landscape. With examples of how to link biological tree strategies as found in nature to the current urban context the presentation will provide some illustrative examples from eastern Europe, China, and the U.S. and how knowledge from nature will help in the selection of site adapted species choice for different urban environments.

The developing profile of urban forestry in the UK

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This paper focuses on the evolving thinking and current initiatives concerning urban forestry in the UK, much of which - rather surprisingly - has been precipitated by the arrival in the UK of *Chalara fraxinea* [ash die-back disease]. The 'official' acknowledged arrival of *Chalara fraxinea* in the UK was February 2012, and the immediate robust and accusatory response of the national press/media stimulated two significant and on-going responses from the UK Government. First, the lack of a functional national bio-security policy was recognised, and steps taken to remedy the situation. Secondly, the benefits that the nation receives from the proximity of trees, be they environmental, economic, societal or cultural benefits, was recognised and gained political traction as a result. It was also officially noted however that these benefits could be compromised by the lack of tree species diversity, and thus a lack of resilience to incoming pests and diseases. Whilst dealing with such matters in the wider landscape present a significant challenge, dealing with these issues in and around urban areas - very much the focus of this paper - where people and trees are in much closer proximity to each other and where the arbor-benefits are arguably even more important, is proving to be even more of a challenge. However, significant progress is being made.

This paper will consider and discuss the issues associated with deploying new and mostly introduced tree species into the urbs, including shade, canopy density, gender, ease of management and close proximity to people and built form. It will also consider issues surrounding the retro-fitting of existing poorly-treed urban areas, and will particularly consider the new urban design thinking that is taking place associated with the 2 million new urban homes that will be constructed in the UK by 2020.

Managing urban trees through a life cycle of exotic insect and disease pressures

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A global economy has truly created a global urban forest. From the movement of trees from locales far away to the tree management site or the movement of insects and diseases to an urban forest near you, the urban forest manager is faced with challenges of not creating the next invasive plant problem and responding to the next exotic forest health problem. This talk will focus on two forest health issues that have globally changed the way we manage a diverse urban forest. Results from nearly 40 years of managing Dutch elm disease (DED, *Ophiostoma ulmi*) and a more recent decade with managing emerald ash borer (EAB, *Agrilus planipennis*) show hope from the initial face of doom. This story shows how science-based research led to developing a management approach to culture the urban forest into the next generation of a more diverse urban forest. The economics of urban tree management are an integral part of this research that demonstrates how maintaining trees through several decades is a strategy that is favoured to doing nothing or reacting aggressively and removing a population of susceptible tree hosts. First, the Minneapolis, Minnesota urban forest portrays how an active and *successful* DED management program provided the time necessary to culture the next generation of urban trees. Further research by the presenter shows how elms have continued to repopulate the urban forest and a long-term elm management program continues to make sense. Similar research findings with a management approach to prolong ash trees in harms' way from EAB provide time to reforest the urban forest. Economic analysis of treatments options show retention of ash having the greatest net benefit. Finally, outcomes from these two research projects shed light on integrating sustainable urban forest management through the lens of sociological, ecological, and economic factors.

Municipal parks managers' development visions and attitudes towards urban forestry in South African towns

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The planting and maintenance of trees in public areas of South African towns is the responsibility of local municipalities. Therefore, it is necessary to appreciate the visions and attitudes of municipal officials and decision-makers in charge of such activities for an understanding of the distribution and abundance of trees along streets and in urban green spaces. We hypothesised that the town size and current extent of trees in public places would influence the visions of such officials. We therefore conducted semi-structured interviews with the officials responsible for urban tree planting in 24 towns in the Eastern Cape province, whilst also assessing the abundance of street trees via GIS counts. The density of street trees was variable, with 29 % of the towns having low densities, 50 % had medium densities and 21 % had relatively high densities. There was a significant positive relationship between town size and street tree density. Several of the managers did not include environmental issues or trees in vision of the future for their town, although most did. There was no relationship between the managers' visions for the future and attitudes and current street tree density. Most of the managers experienced several constraints in trying to implement their vision, notably a lack of funds for urban forestry, limited space for tree planting in low-cost housing developments, vandalism, and lack of skilled personnel.

The support of biodiversity by street trees in the City of London, UK

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Little is known of the support of biodiversity by trees growing in ultra-urban environments such as the core of large cities, in this case London. This study focussed on a sample of trees set in the harshest of surrounds, the streets, and sought to measure the biodiversity, across five key groups, they supported. Using rapid biodiversity assessment techniques, epiphytes, fungi, birds and mammals were all found to be depauperate in the City street trees but a clear distinction between species of tree in the support of arthropods, both in terms of abundance and species richness, was apparent. There was a clear distinction between native species of trees, that generally performed better than the non-natives. The findings of this study provide a first picture of the support of biodiversity in the City. It revealed that trees are not retained in to old age. Features of veterancy were considered to be defects so triggering dualism between safety and support of biodiversity. The planning of green infrastructure seemed not to take account of the value of each 'service-providing unit', the tree, in ensuring an effective ecological network was formed within the urban environment.

There are wide reaching implications for the management of tree stocks within urban centres as informed by this study: 1) Species selection should take account of the support of biodiversity; 2) reducing the reliance on a few species being most abundant; 3) multiple species selection as part of ecological site design will deliver maximum ecosystem services; 4) retain trees bearing 'defects' where they do not severely compromise safety. Further study would help build a picture of the contribution each species of tree makes to the support of biodiversity.

Urban street trees before, during and after a heat wave and pedestrian thermal comfort

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In the past, during extreme periods of drought urban policy makers have invoked strict water restrictions for residential, commercial and public green space managers. This has led to high tree water stress levels and high levels of tree mortality, thereby loss of all the ecosystem services associated with those urban trees for many years until canopy cover is replaced. Perhaps a contrary policy of applying precious urban water to street trees and nature strips during extended droughts and heat waves would reduce tree stress, improve tree resilience and provide microclimatic cooling benefits when they are of greatest benefit to thermally stressed street pedestrians.

In a residential street of Lophostemun confertus (Brush box) trees in the City of Monash, Australia, six trees were instrumented with stem micro-dendrometers and soil moisture sensors. Three of the trees received daily irrigation during a heat wave period of high vapour pressure deficit, whilst three did not. Before and after irrigation the microclimate at 1.0 m height was measured on the pedestrian walkway both under canopy and away from the canopy of all six trees. Air temperature, relative humidity, wind speed, solar radiation and mean radiant temperature were measured to determine pedestrian thermal comfort through physiological equivalent temperature. Levels of tree water stress was also monitored through measures of pre-dawn and midday leaf water potential and stomatal conductance using an infra-red gas analyser.

The evidence of both tree health and human health benefits from this study give greater credence to both the use of precious drinking water supplies but also investment in engineered water sensitive urban designs that make use of stormwater runoff to maintain urban tree functions and resilience.

Research on indicators for evaluating the temperature-moderating function of ecological components

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Considering the mega city problems and ageing population in Tokyo, it is important to manage ecological components, such as trees and soils, in cost-efficient way without losing their ecosystem services. Temperature-moderating function is one of the most important accessible ecosystem services in urban area. Many studies have claimed enhanced risks of heat strokes, increased demand for energy, and concentrated downpour caused by the heated environment. To contribute to the effective urban ecological management, therefore, this research aims to identify useful indicators, based on spatial information, which explain temperature-moderating function of ecological components. Firstly, ecological components were digitized in several ways of geometric calculation such as tree canopy coverage, tree volume and natural ground coverage, which are hereafter called as "indicators." Secondly, the values of indicators in 8 different ranges from the measuring points of air temperature were calculated at 14 measuring points in Tokyo's 23 wards. Finally, correlation analyses were conducted between the values of indicators and the observed value of air temperature in various temporal-spatial conditions. As a result, the following is clarified. For the practical evaluation of temperature-moderating function of ecological components, 1) it is more reliable to divide features of green spaces into at least two indicators: tree volume and ground coverage, rather than applying ratio of green space; and 2) it should be stressed that the relation between indicators and air temperature entails seasonal and hourly trends.

Assessing the value of urban trees with i-Tree: its applicability to international audiences and overcoming limitations

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Trees and forests in urban areas provide critical ecosystem services that enhance environmental and human health. To help managers and citizens assess their local urban tree population—and the ecosystem services they provide—the USDA Forest Service has partnered with private industry, professional associations, non-profit groups, and universities to develop a freely accessible, public domain urban forest assessment suite of tools called i-Tree (www.itreetools.org). Since the initial release of the i-Tree Tools in 2006, thousands of communities, non-profit organizations, consultants, volunteers and students have used i-Tree to report on individual trees, parcels, neighbourhoods, cities, and even entire states. By understanding the local, tangible ecosystem services that trees provide, i-Tree users can link urban forest management activities with environmental quality and community liveability. Whether your interest is a single tree or an entire forest, i-Tree provides baseline data that you can use to demonstrate value and set priorities for more effective decision-making. While originally developed for a North American audience, i-Tree is being successfully used all over the world and is being enhanced to better suit international demand. This presentation will provide an overview of the i-Tree tools, their international implementation and limitations, and the on-going research to refine the models and develop new assessment tools.

Urban food forestry: leveraging urban tree diversity to improve urban food security and catalyse social innovation

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We examine the potential role of perennial woody food-producing species ("food trees") in cities in the context of urban sustainable development and propose a multifunctional approach that combines elements of urban agriculture, urban forestry, and agroforestry into what we call "urban food forestry" (UFF). We used four approaches at different scales to gauge the potential of UFF to enhance urban sustainability and contribute to food security in the context of urbanization and climate change. First, we identified 37 current initiatives based around urban food trees, and analysed their activities in 3 categories: planting, mapping, and harvesting, finding that the majority (73%) only performed one activity, and only 8% performed all three. Second, we analysed 30 urban forestry master plans, finding that only 13% included human food security among their objectives, while 77% included habitat for wildlife. Third, we used Burlington, Vermont as a case study to quantify the potential fruit yield of publicly accessible open space if planted with *Malus domestica* (the common apple) under 9 different planting and yield scenarios. We found that 108% of the daily recommended minimum intake of fruit for the entire city's population could be met under the most ambitious planting scenario, with substantial potential to contribute to food security even under more modest scenarios. Finally, we developed a Climate-Food-Species Matrix of potential food trees appropriate for temperate urban environments as a decision-making tool. We identified a total of 70 species, 30 of which we deemed "highly suitable" for urban food forestry based on their cold hardiness, drought tolerance, and edibility. We conclude that substantial untapped potential exists for urban food forestry to contribute to urban sustainability via increased food security and landscape multi-functionality. Additionally, our investigation into urban food forestry initiatives indicates that food tree diversity can provide a strong catalyst for social innovation.

Contingent valuation of heritage trees in Guangzhou, south China

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Heritage trees in cities represent special natural-cum-cultural assets. In addition to exceptional age, their tell-tale features include large canopy size, special habit, and outstanding history. These trees could contribute substantially to the quality of urban life and social welfare through the provision of an array of ecological, aesthetical and cultural benefits. There is a growing appreciation of heritage trees by various stakeholders, which has attracted scholarly interest in the need to conserve this valuable natural asset, improve our knowledge and understanding of its contribution to the sustainability urban ecosystem and human welfare. Despite the occurrence of important heritage trees in densely populated areas, little attention thus far has been paid to this rare and unique natural asset in Chinese cities. There is an urgent need to communicate these trees to the public in a way which reflects their true value to the society. The present study estimated residents' willingness-to-pay (WTP) for the conservation of old and valuable trees in Guangzhou, south China by applying the contingent valuation method (CVM). A total of 462 residents were interviewed based on stratified sampling. The results revealed that the mean WTP was about RMB22-26 and RMB17-20 for rare tree species and trees older than 300 years, respectively. For common old tree species the mean WTP was only RMB2.0. The study demonstrated that there was a large consistency in residents' perception of various benefits associated with old trees but people attributed high value to rare and old trees. This provided insights into how urban biodiversity conservation can be improved in rapid developing cities.

The Trees and Design Action Group (TDAG): an innovative and successful approach for building tree diversity into urban design

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Trees are a central part of what makes cities beautiful and liveable, but there is a challenge that faces those who want to ensure they are included in the design. Professionals who know about trees are in a separate subculture from professionals who design and plan cities. “Green professionals” are seen to talk with each other in a different language to other professionals and perceive themselves as being low in the professional hierarchy.

In 2007, a new approach was tried out in London, and seven years later it is thriving, with over 200 member organisations, has significant impact and is being replicated in other cities in England. TDAG works cross sector and disciplinary (in public and private sectors) to increase awareness of the role of trees in the built environment. The aim of TDAG is to bring together different kinds of knowledge and research and facilitate better dissemination.

TDAG has evolved from its early format as a bi-monthly discussion forum, to a focus on producing best practice guides using evidence, practical advice and case studies to inform decision-making on urban trees both for practitioners and politicians. It has developed interdisciplinary case studies using examples of work with different disciplines and professionals as case studies, e.g. work in Bristol on a national highway infrastructure project, work in Hackney with the Olympics. It is also now focusing on identifying evidence and research gaps. A particular achievement of the TDAG guides is to engage many different professions and work with many different professionals to do this. TDAG looks to work with existing social and institutional structures, it does not challenge professional hierarchies rather it facilitates communication across different work cultures. The model is also easy to adapt and could be replicated across Europe by stimulating either new organisations or affiliating groups to TDAG.

Green cover may be a good indicator for Serenity as a restorative factor

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Serenity in outdoor spaces is one of eight characteristics that meet restorative needs as defined by Grahn and Stigsdotter (2010). Their specific definition of Serenity is "A place of peace, silence and care. Sounds of wind, water, birds and insects. No rubbish, no weeds, no disturbing people." The characteristic of Serenity has been shown to be of particular value for stress reduction (ibid). For the city of Kristianstad, NE Skåne, Sweden we have compared different ways to analyse the presence of the characteristic Serenity: (1) Focus group driven classification with representatives from the municipality visiting all areas of urban Kristianstad rating the degree of all the eight mentioned characteristics, including Serenity; (2) the large Scanian public health survey of 2008 in which respondents were asked to which degree the characteristic of Serenity was available within 5 to 10 minutes' walk from their homes; and (3) Green cover analysis using an IR aerial photo in which the amount of green cover was rated in five steps. For the characteristic of Serenity we found that the respondents of the public health survey agreed with the focus group classification to a significant degree ($p=0.001$), indicating that the focus group methodology used to assess the eight landscape characteristics indeed may be a useful tool to accurately map landscape features relevant to public health. We also found a positive correlation between reported experience of neighbourhood Serenity in the public health survey and the amount of green coverage found in the IR aerial photo at the respondents dwelling coordinates ($p=0.001$). This may indicate that trees in an urban context are of importance for the experience of Serenity, and thus an important factor for stress reduction and public health.

A diversity of species, perceptions and settings: patterns of tree species richness, abundance and uses in small towns in South Africa

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Understandings of the patterns and perceptions of urban trees is dominated by work from the developed world and from large cities and so lacks a diversity of perspectives and contexts. In contrast, in this paper I examine tree patterns and residents' perspectives within and between several small towns in the poorest provinces of South Africa. Both between and within towns there are marked differences in diversity and density of urban trees and green space, corresponding to legacies of historical development processes and current socio-economic attributes. The highest diversity and density of urban trees are found in richer towns and areas within towns, whilst poorer towns and zones have limited diversity and density of trees (richer areas have approximately four times higher tree species richness in green spaces and 2–4 times higher species richness of street trees). Conversely, the diversity of uses is highest in poorer areas, where residents balance both consumptive and non-consumptive uses, in contrast to more affluent areas where residents focus on non-consumptive uses. Mean tree species richness in gardens of poorer households is approximately four species, being slightly higher as age of the suburb increases. In poorer areas, approximately 40 % of households collect fruits from trees on their own plots and 50 % collect them from other urban trees. Corresponding figures for firewood were 38 % and 50 % from own trees and other urban trees, respectively. The use of consumptive products from urban trees represents approximately 20 % of total household income. Town residents are acutely aware of the differences between different areas, as are most town officials, but they face a number of challenges in addressing these patterns, including limited vision in some instances, insufficient resources, limited space and high levels of tree damage.

Forest Foodways and existing edible urban landscapes: The case of urban forests in New York City and Philadelphia, USA

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Scholars are waking up to the importance of urban forests for food provisioning. The wide-ranging literature on urban food production focuses on gardens and calls by designers to integrate food-producing species into diverse urban landscapes. This literature highlights the importance of urban gardens for maintaining cultural practices tied to cuisine, medicine, and healing and social-cultural knowledges critical to managing ecosystem services. For example, home gardens become places that hold memories for immigrants, allowing individuals to re-connect with their home landscapes and ecologies. Parallel research on urban food provisioning documents the practice of harvesting wild and semi-wild edible plants in the urban forest. Urban foraging raises important questions about the role that existing urban landscapes--parklands and other forested spaces—already play in the everyday culinary practices of city residents. In exploring the links between urban foragers and existing edible landscapes, we recognize foraging as supporting culturally distinct livelihoods and as a practice that cuts across social, cultural, ethnic, and political distinctions. Drawing on case studies of foraging by a local "foodie" group in Philadelphia and Chinese immigrants in New York City, this paper explores the ways immigrants and non-immigrants turn to city forests to find prized species, including key ingredients for customary cuisines, to assure their well-being. Parks and quasi-public spaces, and the access to species they already provide, create a sense of connection to home and support practices that foster social learning and memory. Our results demonstrate that: a) foraging is a practice undertaken by diverse communities in these cities, and b) finding food in existing forested landscapes is central to processes of social memory and ecological learning, but c) ethnic identity may shape distinct links between social memory of places far away and existing edible urban landscapes close at hand.

Public opinion on urban trees and ecosystem disservices – a pilot study

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Though research on ecosystem performances lately has focused on services, several researchers have pointed out that disservices must be taken into account. Only a few attempts have been made to summarise or categorise ecosystem disservices. Thus there is an obvious lack of knowledge on ecosystem disservices. In urban areas the environment is governed by experts and there is a multifaceted public with different interests and needs. The public's perspective may deviate from the experts. As a consequence, there is a need to assimilate views from the public in a comprehensive assessment of services and disservices derived from trees in an urban environment. There is also a need for both a conceptual model to interpret the public opinion and a system to collect and assess views from the public. The aim of this study is to explore how a municipality's department for complaints can be used as a source of knowledge for tree management. The questions for the study are what kinds of ecosystem disservices from urban trees are reported in the department for complaints and how are the complaints distributed among the residents? The complaints records from three Swedish cities were studied with regards to the feedback on urban trees that the public had contributed with.

Tree species composition and congregant appreciation of the cultural and spiritual services provided by cemeteries and churchyards in Grahamstown, South Africa

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Urban greening has been used to combat the problems associated with increased urbanization. However, little attention has been provided to the spiritual and cultural ecosystem services urban greening offers. Here we consider the urban environment, cultural and spiritual ecosystem services, and sacred sites. We sampled 30 church gardens and five cemeteries. At each site were inventoried all trees and shrubs and took a soil sample for analysis, as well as administered a questionnaire to congregants to ascertain the cultural, spiritual and aesthetic value of trees and the sacred area, as well as the intangible benefits that these provide. There was an average density of 100 trees per ha across all the sampled sites, of which approximately two-thirds were exotic species. Older and larger sites had a greater density and richness of woody plants. However, the greatest influence was that of the socio-economic status of the area in which the garden or cemetery occurred. In affluent areas the sites were better maintained and contained a higher richness tree species compared to those that occurred in the poorer areas. There was no effect of religious denomination on the tree species richness or abundance. With respect to the spiritual services provided site age had little influence, while area, as well as tree abundance and diversity strongly influenced the expressed experiences of the congregants. With regards to cemeteries, many felt that due to the lack of maintenance and safety, it was very difficult to appreciate the cultural and spiritual services provided by these areas.

Selection of trees and shrubs for harsh urban climate in Iceland - Results of the project YNDISGRÓÐUR 2007-2012

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The growing need for urban green environments in Iceland, where over 90% inhabitants live in towns (and 65% in the Reykjavík capital city area alone), has increased the demand for hardy and valuable garden and landscape plants. Most species and cultivars used in Iceland have resulted from long experience and selection of plants of native and foreign origin that have proved to be well adapted to the harsh Icelandic climate. However, presently imported cultivars, often badly adapted to Icelandic climate, are pushing old and well adapted cultivars and provenances from the market due to EU regulations. In 2007 it was considered an urgent task to identify and select the material which has demonstrated its suitability in Iceland for the benefit of consumers and nursery growers. The aims of the first part of the project Yndisgróður (2007-2012) were to: a) define and select suitable plant material and to classify valuable species based on their applicability, b) register cultivars and provenances of selected species that are successfully grown in the country and describe important qualities, c) collect the main cultivars and provenances of trees and shrubs in a clone collection for conservation and research, d) investigate defined cultivars of important species in order to form a basis for elite plant research, e) establish clone archives and demonstration gardens in several places in Iceland, and f) establish a connection between researchers, stakeholders and the public, and provide information and knowhow with those groups. The main benefits of the project were envisaged as improved quality and availability of valuable plant cultivars. An important product of the project is a list of cultivars and provenances that can be recommended to be used in Iceland. In terms of the project's results, over 700 cultivars of approximately 180 species of Icelandic cultivars and valuable imported cultivars, mainly shrubs and trees have been registered in the project database. During 2007-2012 six clone archives and demonstration gardens have been established with over 500 cultivars of about 150 species. Demonstration gardens have been established in six towns around the country and in order to cover important market areas and different climatic conditions. A selection of 120 species and cultivars has been identified as hardy and valuable garden and landscape plants and recommended for use in Iceland. A list and description is available on the projects homepage http://yndisgrodur.lbhi.is/. In terms of publications, the project has resulted in a description and evaluation of 17 cultivars of *Spiraea japonica* (2012), description and evaluation of 30 cultivars of *Rosa* (2012), an evaluation of use, history and plant selection of street trees in Reykjavik

(2012), an evaluation of shrubs suitable for use in shelterbelts in Iceland (2012), and a publication on collection and description of native cultivars of *Salix* (2013). A description of 20 Icelandic cultivars of shrubs will be published in 2014. All rapports are available on our homepage (in Icelandic).

Phosphite and fertilization effects on tree vitality in Phytophtora infected beech stands in urban parks

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Pildammsparken is Malmös largest and most visited park. The park mainly consists of large older beech trees (*Fagus sylvatica*). In 2010 a decrease in tree vitality was noticed and infections of *Phytophthora* (*P. plurivora* and *P. cambivora*) were found. An investigation showed that 20% of the trees had bleeding cankers typical for *Phytophthora* infections, suggesting that the area is heavily infected (Witzell and Agostinelli, 2012). *Phytophthora* pathogens mainly infect fine roots and the infection is primarily reflected in the tree by sparse crowns with small light green leafs and dead branches. Due to the disturbed root functions the vitality of the infected trees is reduced and the weakened trees are easily infected by secondary damaging agents, such as rot fungi that often kill the tree. Preliminary studies show that addition of phosphite may increase the vitality of the trees and strengthen their ability to resist *Phytophthora* damages. This study aims to compare three different treatments and their effect on trees in *Phytophtora*-infected beech stands. Parallel treatments used are: 1) Addition of Proalexin (potassium phosphite, 11.6 g K, 9.6 g P/tree) applied to the canopy by spraying from a helicopter, 2) addition of Proalexin (as above), applied by planting tube into the soil close to the roots and 3) fertilisation with ashes applied on the soil surface (130 kg K, 40 Kg P/ha). During 2013 and following two growing seasons the vitality of the trees will be recorded by using a set of standard parameters: Leaf area index, inventories of the tree crowns, fine roots length, diameter and biomass, stem water potential and stomatal conductance. Here we will present results on tree vitality from the initial season 2013 and some preliminary results from season one after treatment.

Urban trees as mediators of social Interaction in the historical parks of Zagreb, Croatia

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The 19th century's middle class's need for affirmation of social status was arguably articulated through the establishment of urban green spaces as a 'neutral' environment for social interaction. Public promenades, parks and squares, accessible to all classes, were places for overcoming social differences. Those were places to chat and relax, to enjoy the beauty of nature and occasionally to show a new dress. Urban development projects in the city centres of Vienna, Paris and Berlin became a model for other European cities. In 1882, in the Croatian city of Zagreb, then part of Austro-Hungarian Empire, authorities decided to establish the first public park in the heart of the city. The 'Zagreb Green Horseshoe', reflecting the model of Vienna's 'Ringstrasse', covers 25 hectares and represents a sequence of seven parks and one botanical garden which act as a green framework, encompassing buildings of national institutions, built in historicist style. Although Zagreb had only 70,000 inhabitants at the time, it was a city of cosmopolitanism and multiculturalism, which was evident from the choice of tree species for planting in parks, dominated by plane trees, limes, horse chestnuts and maples. Park became a social playground, with trees as catalysts and mediators of social change. In order to provoke admiration of flâneurs and eventual conversation between park visitors, native ornamental species were abundantly planted. Thus, exotics such as *Trachycarpus fortunei*, *Phoenix dactylifera* and *Musa basjoo* were determined as focal points in the park. Today, from the eight 'Zagreb Green Horseshoe' composition parts, only the Botanical garden, an institution of scientific character, has maintained its original historical species richness. Therefore the reduction of importance of exotics as drivers of social interaction is apparent and indicative. Reasons can be found in the modern hectic way of life and universal availability of exotic tree species.

Pursuing a moving target: restoration of natural secondary forests in urban Japan

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Among the various methods for forest restoration in urban areas of Japan, restoration of natural secondary forests is gaining popularity. Mid-successional, secondary forests in Japan have high biodiversity. Therefore restoration of secondary forests greatly contributes to maintenance of the biological diversity in urban areas. In many restoration projects, the neighbouring natural secondary forest is often chosen as the target vegetation. However, specific methodology for restoration of natural secondary forests is not yet established. In this study, we compared stand structure and tree species composition between a restored stand (ten years after planting) and the neighbouring natural secondary forest. Our objective was to contribute to basic data documenting vegetation change of a secondary forest restoration project. We found that restoration contributed to increasing tree cover, but the vertical structure of the stand was poorly developed, because all trees were planted at once. Moreover, the species composition of the neighbouring secondary forest had changed markedly in ten years, especially due to the outbreak of pine-wilt disease. As a result, vegetation of the restored stand did not resemble that of the target stand. We conclude that although forest restoration contributes to increasing urban green space, single plantings of native species does not always lead to restoration of natural secondary forest, especially because vegetation of the target stand is constantly changing. Therefore, multiple plantings predicting the future direction of forest succession are necessary in order to successfully restore natural secondary forests with high tree species diversity in urban areas of Japan.

Urban tree diversity and environment-human health in Beijing

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Urbanization will certainly be the main trend in China for the next thirty years. Its negative impacts in terms of environment and human aspects include: air pollution, water pollution, noise, heating island effect, eco-diversity degradation, etc. Urban tree diversity can alleviate or decrease such effects in many ways: evaporating oxygen to improve the air quality, generating negative oxygen ions to benefit the residents, absorbing or filtering air to decrease dust content in the air, obstructing the noise spread, keeping the moisture and temperature at a proper level, erasing and reducing hazardous materials including smog (the most dangerous environment threat in Beijing), restraining or even killing some bacterium and virus to prevent the epidemics. In the past twenty years, a large sum of money has been invested in Beijing to make the one of the biggest city in the world become greener. The problem is that a lot of species are not suitable in Beijing, while some are too expensive and 'luxury transported' from southern part of China or even from aboard. The main purpose of this is just to create beautiful landscapes, not to pay attention to environment and human health effects. The results are that the city's tree diversity is far from satisfactory, the plant community structure is simple and weak, the landscape is becoming more and more similar and environmental sanitation has a longer way to go. The suggestions are that we should improve environment and human health through urban tree diversity. City dwellers and policy makers should enhance tree diversity in urban planning and strategy, change the focus from money cost and aesthetics to ecology and health interests, choose local trees and form the best mixture of different species, while planting the right trees in the right places according to the the principles of ecology and society.

Urban greeneries' impact on health status of small-leaved lime (*Tilia cordata* Mill.) in South Lithuania

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Small-leaved lime (*Tilia cordata* Mill.) is the dominant tree species in urban plantings throughout Lithuania. During 2009-2013, several sanitary parameters of the state of small-leaved lime, namely defoliation, leaf deformation, necrosis, drying branches in tree crown, diseases intensity, pest abundance and average damage were evaluated in the urban spaces of southern Lithuania. Lime sanitary state was better in recreational greeneries than in street plantations due to worse edaphic and microclimate conditions, and particularly low soil humidity there. Dry and light soils in the drought period of the 2009 summer induced the highest dechromation (1.01 ± 0.08) and defoliation (1.26±0.2) of premature leaves. The warm summer of 2013 without heavy rain was favourable for the spread of aphids (average damage 2.83 ± 0.03), and later for the settling of the pathogen fungus *Apiosporium piniphilum* (average damage 5 ± 0.28). The average damage of leaf spots pathogen (agents *Mycosphaerella microsora*, *Apiognomonia errabunda*) was 1.86 ± 0.05. Leaf spots (*Mycosphaerella microsora*) prevailed in recreational green areas (1,01± 0,57 iki 3,0 ± 0,08) and therefore might be selected as an indicator of clean air. The sufficient values of both precipitation and temperature fostered the spread of this disease during 2010-2011 across all green area types. Small-leaved lime was relatively healthy in recreational green areas during 2009-2013, i.e. defoliation, leaf necrosis, the drying branches in the crown were evaluated by one point. Only cutting grass may have injured young tree trunks. Consequently, this species could be preferred for urban greening in southern Lithuania.

Species composition of macroarthropods and bryophytes in tree stumps

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To meet the European Union targets of reduced CO2 emissions, energy production has to rely on renewable biofuels and harvest of tree stumps is a possible scenario. The Swedish Energy Agency initiated a program that aimed to investigate the ecological sustainability of increased stump harvest in 2008. Biodiversity in tree stumps originating from different tree species and different management regimes was investigated. Bryophytes were investigated in stumps in thinned, clear-cut, or burned clear-cut areas (Rudolphi et al. 2011). Saproxylic insects were investigated in birch and spruce stumps in dry and wet clear-cuts (Ols et al. 2013). Macroarthropods were investigated in spruce and pine stumps of different age (Persson et al. 2013). Many bryophytes are depending on a shady environment and thinned stands had higher species richness than clear-cut sites. The number of saproxylic insects was higher in birch than in spruce stumps. Stumps in dry clear cuts had more species than in wet clear cuts. Retention of stumps in wet areas is recommended to protect the soil against negative effects of disturbance by machines but this will not protect the stumps that are most valuable for biodiversity. Macroarthropods were present in high numbers in stumps irrelatively of tree species. The stumps were a favourable substrate for some millipede and centipede species and the ant species *Lasius platythorax*. Intensive stump harvesting would reduce the preferred habitat for these animals. The amount of natural dead wood is decreasing in production forests. In addition, dead deciduous wood is rare in production forests in Sweden. In urban environments deciduous trees are common but stumps are often removed after tree felling. These stumps may, however, be a source for arthropods and bryophytes. The importance of stumps for biodiversity in cities should be investigated and taken into account when planning urban green structures.

Ecological value of urban allotment gardens in Lithuania

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Human existences and well-being depends on healthy environments, also in megacities. However, recent civilization has resulted in the development of the megapolis with emerging/challenging ecological problems, namely heat islands, dust, buildings instead greeneries area, etc. These problems call for prompt solutions. Urban allotment gardening activity might contribute to sustainable maintaining of urban biodiversity, greening as well as human social activity. The president of the International Office of Allotment Gardeners and the Dutch Association of Allotment Gardeners (AVVN), Chris Zijdeveld, presented his long term experience with allotment gardening management in an inspiring talk under the heading Extremely Valuable, Grossly Underestimated, Shockingly Unknown - with good examples of allotment gardens around Europe (COST, 2013). An amateur garden (AG) is used for growing plants for both food production and ornamental reasons. Amateur gardening comprises of an activity aiming to create leisure and living conditions in the garden, to grow and produce agricultural produce (i.e., fruits, berries, vegetables, flowers, bee products, etc.), as well as to manage the landscape and use it for recreation, while sustainably maintaining it. There are also larger community gardens that are cultivated collectively by a group of people. The vast majority of AGs are located within cities. There is a great variety of AGs in terms of their location within the urban structure, their abundance, parcel size, type and intensity of use, constructions (shed for tools, cabin, bower, dacha, etc.) due to different administrative rules and regulations, environmental conditions and historic developments within Europe. Nevertheless also the impacts of the use of the AGs regarding urban biodiversity have to be considered. Therefore, the indication of biodiversity in allotments is of great importance attributed to describe its ecological impacts on urban environment.

Ovipositing preferences of the Japanese gypsy moth in a suburban secondary forest

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The larvae of Japanese gypsy moth are highly polyphagous and considered a serious forest pest in urban forests of Japan. They are also an invasive pest that have invaded parts of Europe and North America, where eradication programs were employed. In order to develop effective methods for eradication of Japanese gypsy moth, we analysed the occurrence and spatial distribution of egg masses across various evergreen tree species within a secondary forest in western Japan after a major outbreak to elucidate their ovipositing preferences. We found that egg masses were concentrated on the undersurface of the leaves of a few evergreen tree species. Species with egg masses present were those with large leaves. The spatial distribution of egg masses were clustered at scales around 1-2 m. Our results indicate that if an affected tree is found, nearby trees of the same species are also likely to have egg masses. Eradication of egg masses is a potentially effective method to prevent large outbreaks of Japanese gypsy moth.

Trees in the urban environment: response mechanisms and benefits for the ecosystem

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The urban environment constrains tree growth and survival: drought, poor soil quality, soil compaction, light heterogeneity, transplant shock, pollutants, salinity, pathogens and conflicts with human activity often cause premature plant death, thus reducing the net benefit by urban green areas. It is therefore important to better understand the dynamics leading to tree decline in the urban environment, and to develop strategies and techniques aimed at improving the horticultural tolerance (i.e. the capacity to provide benefits, not only to survive, under stressful conditions) of urban trees. These include nursery preconditioning techniques and post-planting management techniques, but a key role is played by species selection. Hundreds of species are used in the urban environment, but selection criteria are frequently based upon aesthetics and whether the species are native or not, rather than on the tolerance to typical stresses imposed by the built environment and on the capacity to provide substantial benefits therein. This has led to only limited knowledge about the ecophysiology of shade trees, if compared to fruit trees and crop species. The International Society of Arboriculture supports research in the area of tree selection for tolerance of urban conditions so that the service life of trees in our communities is extended and the benefits provided by trees are maximized. Therefore, tolerance mechanisms of species with validated and potential ornamental use, and cultural techniques for either pre-conditioning plants in the nursery or alleviating stress after planting will be reviewed in the presentation.

Comparing tree health and urban compatibility of native and exotic street trees in Rio de Janeiro, Brasil

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This study presents the results of a street tree survey of 3,508 specimens in the City of Rio de Janeiro, Brazil, comparing tree health status and urban compatibility of the ten most planted exotic and native species evaluated, that correspond to more than 70 % (seventy percent) of the total population surveyed. Proportionally, eight of the ten exotic species analysed had more than 80% (eighty percent) of the individuals assessed in a good health status, while among native just three of ten species reached these same results. Two native species were evaluated to have bad tree health status in more than 8 % (eight percent) of individuals. These data point to a better tree health status of exotic trees compared to native. Urban space compatibility evaluation of trees showed exotic and native trees with the same behaviour, with six species presenting more than 80 % (eighty percent) of good status. Exotic species *Handroanthus pentaphyllus* (L.) Mattos., *Mangifera indica* L., *Ficus microcarpa* L., *Ficus benjamini* L. and *Roystonea oleracea* (Jacq.) O.F. Cook., and native species *Syagrus romanzoffiana* (Cham.) Glassman, *Cocos nucifera* L. and *Pachira aquatica* Aubl. presented better results in tree health status and in urban space compatibility. However, the exotic species *Senna siamea* (Lam.) H.S. Irwin E Barneby., and the natives *Licania tomentosa* Benth and *Schinus terebinthifolius* Raddi., had the worst results in both tree health and urban space compatibility. We concluded that more research is necessary, in order to support the idea that exotic tree planting in streets is not a good practice, once the results of this study indicate that these trees had better plant health status, when compared to native species. We also reinforce the need of more studies in silviculture and management of native trees to be used in street tree planting, especially in tropical areas.

Urban riparian trees – open gates for the distant and inconsumable spread of *Acer negundo*

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Alien tree box elder (*Acer negundo* L.) is one of the most invasive of woody plant species in Lithuania. This species is undemanding for soil richness, quickly growing, rapidly pervasive on riversides, penetrates to forests. The aim of this study is to determine whether cities near rivers are the largest 'hotspots' for uncontrollable spread of the box elder. Influence on spread intensity and distance were investigated in different places: in the woods, urban parks and urban riverside. The effect of control methods was also examined. Seedlings from parent trees farthest spread growing on the riverside. Street tree seedlings do not grow because of lawn mowing. Box elder planted in forest stands been stunted because they were shadowed by other tree species. Current regulations do not allow for the use of pesticides near water. These restrictions make it difficult to eridicate. After tree cutting without the use of pesticides, box elder does not die, but regenerate even more vigorously, with many stems shooting up from the stool.

Monetary valuation of native and exotic trees, legally protected and unprotected, in Rio de Janeiro, Brasil

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This study presents a first attempt to access the monetary value of urban trees in the City of Rio de Janeiro, Brazil. Twenty trees, four specimens of five species, two exotic, *Terminalia catappa* L. and *Tamarindus indica* L., and three native, *Libidibia ferrea* (Mart. ex Tul.) L.P.Queiroz*, Caesalpinia echinata* Lam. and *Lecythis pisonis* Cambess., were evaluated applying the Importance Index and a constant to compare each tree with the cost of a young tree recently planted. Importance Index takes in account tree specific characteristics (availability, desirable parts, development and adaptability), health, location, diameter at breast height and stump height. For each species two protected specimens and two without any kind of protection were chosen and evaluated. There are two main kinds of protection, one based on environmental laws, and the other on cultural regulations. Results showed that the most valuable tree was a native protected one*, Caesalpinia echinata* Lam., at U$ 25,834.95, followed by another (unprotected) native, *Libidibia ferrea* (Mart. ex Tul.) L.P.Queiroz. The third most valuable was an exotic protected specimen of *Tamarindus indica* L.. Native trees showed greater monetary value than exotic trees, with 16.67 % (sixteen point sixty seven percent) presenting values above U$ 20,000.00, while all exotic trees presented minor values. A second comparison between protected and unprotected trees presented best results for protected trees, as 60 % (sixty percent) of protected trees showed monetary values U$ 10,000.00 or more, and only 30 % (thirty percent) presented values under U$ 10,000.00, while unprotected trees presented 30 % (thirty percent) with monetary values of U$ 10,000.00 or more, and as high as 60 % (sixty percent) presented values under U$ 10,000.00. This work indicates the need for more studies in urban trees valuation to better understand factors affecting the monetary value of trees and its implications to urban forest management.

Low and high deciduous canopy cover: Microclimate benefits to pedestrians

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The localised climatic conditions associated with 'urban heat island' effect can greatly influence human thermal comfort. Urban trees can improve pedestrian thermal comfort, however the benefit of low and high deciduous tree covers to street microclimate is uncertain. Similarly, how these microclimate benefits vary on cloudy and sunny days and in winter and summer months, remains unclear. Microclimatic measurements were conducted in North-South oriented residential streets of with high (70%), low (42%) and no (18%) *Platanus x acerifolia* canopy cover on sunny and cloudy days in summer and winter months. Repeated measures of air temperature, relative humidity, wind speed, solar radiation and mean radiant temperature were made on both sides of these streets between dawn and late afternoon. Physiological Equivalent Temperature (PET) was calculated to estimate Human Thermal Comfort throughout the day. On sunny day in winter, there were no great differences in microclimate between low and high canopy cover. However, on cloudy day in winter, low canopy cover offer a slight decrease of the air temperature, mean radiant temperature and human thermal comfort than high canopy cover and might due to increase in the wind speed. On the other hand, during a really hot sunny day in summer (37°C day), low and dense canopy had similar air temperature at certain times of the day even there were differences in solar radiation (up to 222 W/m^2). However, street with no *Platanus x acerifolia* canopy cover had higher air temperature than low and high canopy cover. This implies that in summer, deciduous canopy cover is beneficial to reduce summer heat load on pedestrians. This study has wide applicability to urban managers and planners when estimating the benefits projected by urban tree canopy cover for better target of canopy cover improvements.

The impact of natural environment changes on the vitality of trees on construction sites

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During the last 25 years about 50% of trees along the main streets in Warsaw were cut. Trees inside Polish cities are in dramatically poor condition. Most difficult is to prove cause-and-effect relationships with damage of tree and construction activities after years. There is a lack of precise and objective means to gauge damages and the real values of trees that would be used when construction activities are planned and realized. This research looked at 130 trees in which root areas different construction activities were carried out, such as trenching, soil compaction, changes in soil depth. Every group of damaged trees was compared with a control group of trees of the same species and age that grow nearby in a natural environment. Visual evaluation and other analyses, including phonological reactions of trees and checking the content of starch in twigs, were used to check the physiological response (reaction) of trees to mechanical damages. The study presented two years of observations and comparisons of the reactions of damaged trees to control group. The study was done on two species (*Tilia cordata*, *Fraxinus excelsior*), two types of damage (dip and shallow excavation), two different periods of damage (4 resp. 8 years before the beginning of the research). Tree physiology and symptoms connected with damages were assessed using statistics, resulting in a tree vitality qualification taking into consideration tree life expectancy after the completion of construction activities.

Case study of freezing responses of rarely-used street tree taxa in Helsinki, Finland

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In 2012, The City of Helsinki Public Works Department planted a test area for possible new street tree taxa for the city: *Carpinus betulus* 'Fastigiata', *Corylus colurna*, *Crataegus monogyna* 'Stricta', *Ginkgo biloba*, *Malus baccata* 'Columnaris' and 'Pyramidalis' ('Street Parade'?), *Prunus avium*, *Pterocarya fraxinifolia*, *Quercus palustris*, and *Sorbus incana*. These taxa, fairly commonly planted in Southern Sweden but rarely used in Finland, were studied to determine suitable indicators for their winter hardiness.

2-4 branches per taxa were collected in February (assumed fully winter hardy stage) and early April 2013 (assumed during dehardening) and tested for freezing responses with five different methods during controlled freezing to -25˚C in a weather chamber. We measured ion leakage at -17˚C and -25˚C, osmolality of xylem sap before and after freezing, and temperature below bark, ultrasound acoustic emissions, and diameter variation during temperature drop to -25˚C. Freezing exotherms, relative reversible and irreversible diameter shrinkage, and Index of Injury (Flint et al. 1967) were determined from the data.

Ion leakages at -17˚C and -25˚C were correlated with each other at both sampling times. The ratio between irreversible and reversible diameter shrinkage increased with increasing Index of Injury at -25˚C. Osmolality of xylem sap decreased with increasing ion leakage at -25˚C. On the other hand, no correlations were found between reversible and irreversible diameter change or osmolality and freezing exotherms. Additionally, ultrasound acoustic emissions did not correlate with other measured freezing injury indicators. The indicator correlating best with recommended hardiness zones was relative irreversible diameter shrinkage (R2=0.83). Two species appearing most vulnerable to freezing were observed to show winter damage in visual assessment in early 2014.

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Research on genetic diversity of *Bretschneidera sinensis* in different scales

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Inter Simple Sequence Repeats (ISSR) analysis was applied to examine the genetic diversity and genetic structure of an endangered species, *Bretschneidera sinensis* –a beautiful ornamental tree with pink or white big flowers, in different scales with samples from 22 populations in Minjiangyuan Nature Reserve and 7 geographic populations in Fujian province. Results showed that: 1)72 amplification sites were detected with 10 primers exhibiting a relatively high genetic diversity at population level. The value of the average percentage of polymorphic bands (PPB) was 69.44 % among geographic populations, and 62.5 % among 22 populations. At species level, the value of Nei's gene diversity was 0.2321±0.204, and the Shannon's information index was 0.3464±0.2858. The coefficient of gene differentiation among populations (Gst) was 0.8462, showing that genetic diversity among geographic populations based on Nei's genetic diversity was high. The value of Nei's gene diversity, the Shannon's information index and the coefficient of gene differentiation (Gst) among 22 populations were 0.2022±0.1983, 0.3053±0.2814 and 0.8462 respectively, which showed that there was a low genetic differentiation within populations and a high genetic diversity among populations. 2) Based on Nei's genetic identity and genetic distance, dendrograms of 7 geographic populations and 22 populations were constructed by UPGMA. The populations might be divided into three categories at the threshold value of the genetic distance of 0.30, meaning thatcthe genetic diversity differentiation was related closely with the geographic factors, such as the separation of revers. 3) Mantel test revealed that genetic distance was significantly related to geographical distance($r=0.69$, $P<0.05$).

Estimation of urban forests for ecotourism development (Mari El case study)

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Under the current conditions ecotourism being one of sustainable types of tourism is moreover one of the most exploited segments of tourist industry. There are general methods of evaluation ecotourism objects with regard to international standards. Our research is aimed at evaluating ecological and tourism potential in Yoshkar-Ola, Mari El using international criteria. For the purpose of our research we examined the major green areas in Yoshkar-Ola: city parks, mini parks, “Sosnovaya Roshcha” (Pine Grove), “Dubovaya Roshcha” (Oak Grove). An ecological index was taken as the ground when evaluating the criterion of species diversity of urban forests and their spatial distribution to define the level of forest cover. Species composition of suburban forest is sufficiently diverse and represented by the principal species of broad-leaved forest: pine, spruce, linden, birch, aspen and oak. Foliage species and shrubs prevail in city parks. It was identified that no significant changes occurred in the existing species composition in parks and suburban forests in the long run which proved that the ecosystem is rather resistant to human impact. Social and economic indicator was evaluated in the research when processing surveys and statistical data and included the following criteria: income of population, level of geographical accessibility, monetary availability of the tourist objects and units as well as the range of goods provided; population coverage with eco-tourist services; availability of road network; marketing and public service quality; employment index and cost and revenues of population. Cultural and historical potential was evaluated using spatial and temporal availability in GIS environment of the architectural sites, local attractions, natural and artificial landscapes. As a result of the analysis done, it was identified that ecological and tourist infrastructure of Yoshkar-Ola and suburban area can be characterized by high potential for development. In accordance with the long-term evaluation of the natural and environmental index, stability of species composition in urban forests it is proved that forest-park ecosystems are resistant to human impact. The research results of examination of recreational potential of different types of urban forests and the choice of possible models of recreational use will foster a deeper understanding of urban ecotourism development patterns.

Influence of Aerosol Pollution on Russian Urban Forests

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Exposure to aerosol pollution has a dramatic influence on climate and environment in urban areas. The consequences of this phenomenon result in degradation of forest ecosystem. Processing a huge amount of ground data, which is necessary to solve the problem, is too time consuming and costly. Satellite images considerably ease the task and make it possible to track both temporal and spatial transportation of aerosol over long distances. The objective of the research was focused upon the premises of major air pollution sources in Volzhsk (refinery, industrial enterprises, etc.). In order to examine the environmental impact, a number of multi-temporal images were considered in the research. These included MODIS Aerosol Product (MOD04), ENVISAT MERIS RR and Landsat (2002-2011). Sample plots around the main sources of air pollution included the identification of GPS-points of prevailing winds. Inventory indices of forest stands using visual taxation method were identified. Generic environmental assessment of forest ecosystem was carried out. Satellite images MODIS Aerosol Product (MOD04), ENVISAT MERIS RR and Landsat data obtained during a ten-year period (2002 - 2011) were processed. Sanitary protective and buffer zones were established using ArcGIS 10 software package in every object under study. Spectral indices of chlorophyll index MTCI and aerosol optical thickness were obtained for the purpose of assessing the vegetation condition in the refinery premises using ENVI 5.0 software package. Research results revealed that the significant changes in MSCI index at a distance between 4.8 and 8.0 km towards the northern edge of the objects under study. Additionally, the high values of aerosol optical thickness (AOT) correspond to low values of MTCI. This point to the fact that aerosol pollution exerts influence upon neighboring forest stands.

Urban Forests Assessment by Means of Remote Sensing

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In order to plan measures in protection and sustainability of urban forests, it is important the nature protection institutions had an accurate picture of real situation in forests and knew about types, vegetation species structure and spatial distribution of forests. Urban forests inventory is traditionally used to settle the problem. It costs much money which is spent on field and cameral research. An approach of assessment of species composition in urban forests and their spatial distribution with the use of remote sensing data was used in the study. The object of the study was Yoshkar-Ola green zone represented by parks, squares, boulevards, gardens and urban forests. Spatial analysis and assessment of species diversity were carried out by complex software packages ArcGis 10.1 and ENVI 5.1 with the use of high resolution images Canopus made in 2013 vegetation period. Beforehand, the images were subjected to atmospheric and geometric correction. A classification of images on the basis of widely used index NDVI was carried out to make a detailed assessment of vegetation cover distribution. As a result, several classes of earth cover were revealed. The next step was second classification of vegetation cover in a species composition. An assessment of accuracy of the obtained data was made on the basis of field researches, topographic and cadastral maps and general plan of the city.

In the course of the study the area of green plantations per one citizen was determined and assessment of forests sustainability to environmental pollution by transport and industry was carried out. As a result of satellite images classification, a graphic map in condition, special distribution and species composition of urban forests was obtained. The obtained data provide evidence of irregularity and fragmentation of Yoshkar-Ola forests. Most of the forests are located in south-east of the city. Species composition is mainly represented by Birch, Pine, Spruce, Larch, Oak and Lime trees of natural and artificial origin. The results of the study may be used to elaborate a new strategy directed to conservation and development of urban forests; they are recommended to be used by nature protection institutions.

Visual appearance of urban trees during the establishment phase in relation to water status

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Securing a good establishment is the first step towards ensuring long-term survival for urban trees. During the establishment phase, trees generally have a lower vitality, as a result of impaired water uptake ability. Irrigation reduces transplanting stress and expedites the establishment process. However, irrigation is costly and therefore often restricted. Understanding when a tree is fully established is important, since however expensive the irrigation, the cost for replanting new trees after failed establishment, is higher.

Today, vitality and establishment assessments are mainly performed visually. Recognizing how morphological features that affect visual evaluations are correlated to water status in trees, could provide information on how we determine vitality visually. Correlations between morphological features and water status could provide a tool for making the visual assessments more accurate.

The objective of this study was to investigate if results from visual evaluations on newly planted sweet cherry and red oak trees could be correlated to levels of stress expressed by water status. The study was conducted in three parts. First, the morphological features: color, size, and length of leaves, and canopy silhouette were determined. For red oak, also leaf shape and number of lobes per leaf were included. Secondly, visual evaluations were performed by selected professional tree establishment evaluators. The evaluations were followed by a survey, in which the evaluators discussed the importance of the mentioned features. The third part correlated visual evaluations and morphological features with determinations of the water status in the trees.

The study was conducted on trees from five different production methods, transplanted at one urban and one rural site. Determinations of water status and morphological features, and visual evaluations were made in the third season after transplanting. The results identified differences between stress and adaptation/acclimation, and between morphological features. Ways to improve visual evaluations will be discussed.

Coordinating organisations of the conference: