



EUROPEAN CONFERENCE OF ARBORICULTURE

*Planning the Green City:
Relationships Between Trees and Infrastructures*



CONFERENCE AND ABSTRACTS BOOK

Edited by Giordano L., Ferrini F. and Gonthier P.

Turin 26th-28th May 2014
Torino Incontra Conference Centre

EUROPEAN CONFERENCE OF ARBORICULTURE - *Planning the Green City: Relationships Between Trees and Infrastructures*: CONFERENCE AND ABSTRACTS BOOK

Edited by:

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WELCOME FROM THE

Turin Municipality - Councilor Policies for Innovation and Development, Public Works, Environment, Urban Green and Sanitation

Enzo LAVOLTA

The City of Turin distinguishes itself for the entrenched tradition of urban arboriculture. Trees are fundamental elements of the urban landscape: they have high symbolic, historical and environmental value. Therefore, Turin is honored to collaborate once again with SIA (Società Italiana di Arboricoltura) and ISA (International Society of Arboriculture) for the European Conference of Arboriculture. In the next future the urban green spaces will play a major role in our cities, which are evolving towards more comfortable and “green” places. In this scenario, the Public Administrations are expected to adopt policies and strategies of urban planning inspired at a vision of trees as active components of sustainable development, and not mere optional accessories. Turin is characterized by hill and forest landscapes that confer to the city an important tourist-recreational function. Few urban contexts can be so proud of naturalistic itineraries, located at less than two kilometers from the center yet offering an impressive variety of landscapes, natural beauties, cultural and historical heritages. The valorization of this extraordinary geographic, naturalistic and historic heritage is a duty involving the full responsibility of the Public Administration. For this reason a thick calendar of events will be organized in order to approach citizens, and in particular children, to parks, in agreement with the cultural and social role played by green areas in the urban context. In the late 15 years, Turin has been deeply transformed and reshaped with the realization of the first metro line and the structures for the 2006 Winter Olympic Games. This evolution is not yet concluded and we foresee in the next years a totally different, “smart” and greener city. The subject of the Conference “Planning the green city: relationships between trees and infrastructures” is very actual and in full agreement with the ongoing development of the City of Turin. Therefore, this Conference is a special event, a meeting where administrators, technicians and experts from all around the world can discuss and share experiences. I wish to express the City, the Mayor and my own welcome in Turin to all participants, with the hope they will spend a pleasant time in our city and that they will come back again as our welcome guests in 2016 for the World Conference of Landscape Architecture (IFLA).

MESSAGE FROM THE

Chairperson of the Conference

Gianmichele CIRULLI

In 2014 we celebrate the 20th Anniversary of the ISA Italy Chapter, which is the major professional association dedicated to tree care, with over 22,000 members worldwide. This is an important goal for the SIA, which deserved to be marked with a special event like a meeting aimed at discussing of trees and sharing experiences with colleagues coming from all over the world. Such a meeting is the best way to celebrate the “culture of the tree”, that our Association is charged to pursue for its members and for all the operators in this sector. The last ISA European Conference took place in Turin in 2008 and was organized by the SIA: once again this happens in 2014! Thus a heartfelt thanks to the ISA which decided to support this event, to the City of Turin which agreed to accommodate us providing staff and facilities, to the National and International Partners who supported the event and to the Sponsors that, despite the period of economic difficulty, provided their financial contribution. Finally, thanks to all the speakers who helped to create a program of great interest and quality. My experience in the board of SIA began in Turin in 2008 with the organization of the European Conference and ends now; six years of intense meetings and activities spent and shared with the colleagues of SIA boards and with all the members who supported and sometimes disapproved our work. Thanks for this experience that enriched me a lot from the human point of view and hopefully also from the professional one!

ORGANIZING COMMITTEE

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Co-Chair **Enzo Lavolta** (Turin Municipality Parks and Gardens Councilor)

Turin Municipality - Parks and Gardens Councillorship and Department

Turin Smart City Foundation

Turin Chamber of Commerce, Industry, Agriculture

ISA Italy Chapter (Board - Secretariat & Volunteers)

International Society of Arboriculture - ISA

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PROGRAM AT A GLANCE

Monday 26th May	Participants registration		10.00-14.00
	Welcome and opening	Room Cavour	15.00-16.30
	Plenary and keynote session	Room Cavour	16.30-18.00
	Welcome cocktail		18.30-21.00
Tuesday 27th May	1. Trees and infrastructures and green infrastructures	Room Giolitti	8.45-10.45
	2. Management of diseased, infested and declining trees	Room Einaudi	
		Coffee break	
	1. Trees and infrastructures and green infrastructures	Room Giolitti	11.15-12.45
	2. Management of diseased, infested and declining trees	Room Einaudi	
		Free lunch and poster viewing	
	1. Trees and infrastructures and green infrastructures	Room Giolitti	14.15-15.45
	3. Tree management in a global change scenario	Room Einaudi	
	4. Tree risk assessment and biomechanics	Room Cavour	
		Coffee break	
3. Tree management in a global change scenario	Room Einaudi	16.15-17.15	
4. Tree risk assessment and biomechanics	Room Cavour	17.15-18.45	
	Poster viewing		
Workshop: Manage the tree risk and public tree heritage renewal: open discussion between public administrators and professional technicians	Room Cavour	17.15-18.45	
4. Tree risk assessment and biomechanics	Room Cavour	8.45-10.45	
5. Tree benefits and tree value in the urban context	Room Giolitti		
	Coffee break		
4. Tree risk assessment and biomechanics	Room Cavour	11.15-12.45	
5. Tree benefits and tree value in the urban context	Room Giolitti		
	Free lunch and poster viewing		
Wednesday 28th May	4. Tree risk assessment and biomechanics	Room Cavour	14.15-15.45
	5. Tree benefits and tree value in the urban context	Room Giolitti	
		Coffee break	
	4. Tree risk assessment and biomechanics	Room Cavour	16.15-17.00
	5. Tree benefits and tree value in the urban context	Room Giolitti	
	Poster viewing	17.00-18.45	
Workshop: Tree Risk Assessment (TRA)	Room Cavour	17.00-18.45	

SCIENTIFIC PROGRAM

Monday 26th May

<u>Time</u>	<u>Program</u>
10.00-14.00	Participants registration
15.00-16.30	Welcome and opening <i>Room Cavour</i>
16.30-18.00	Plenary and keynote session <i>Room Cavour - Chairperson: Ferrini F.</i> 1.5 CEUs (All, Bm)* Trees of green – beyond the Green Infrastructure agenda <i>Konijnendijk van den Bosch C. (invited speaker)</i> Why do trees fall down? <i>Nicklas K.J. (invited speaker)</i>
18.30-21.00	Welcome cocktail

Tuesday 27th May

<u>Time</u>	<u>Program</u>
8.45-10.45	Concurrent session 1 - Trees and infrastructures and green infrastructures <i>Room Giolitti - Chairperson: Smiley E.T.</i> 2 CEUs (All, Bm)
8.45	“GreenInUrbs”: Green Infrastructure approach - linking environmental with social aspects in studying and managing urban forests <i>Calafapietra C. (invited speaker)</i>
9.15	The Green Infrastructure approach: from theory to case study <i>Sanesi G., Laforzezza R., Colangelo G.</i>
9.30	Urban forest policy and governance in the Green Infrastructure approach <i>Krajter Ostoić S., Paloniemi R., Jones N.</i>
9.45	Tree protection regulations in town of Oakville, Ontario, Canada <i>Vava C.</i>
10.00	Linking people and landscapes: can understanding public perceptions help guide urban forest management? <i>Ries P.D., Baur J., Driscoll A.</i>
10.15	Planting trees in the contemporary cities: understanding of the city functioning <i>Bianchi T., Cantù A., Cozzi V., Frangi P., Papponi L., Parisini M., Piatti V., Pusterla M., Strada M., Valagussa M., Balder H., Shears I.</i>
10.30	The tree heritage in suburban landscape: criteria and strategies for conservation and management <i>Bounous G., Beccaro G.L., Devecchi M., Larcher F.</i>
8.45-10.45	Concurrent session 2 - Management of diseased, infested and declining trees <i>Room Einaudi - Chairperson: Gonthier P.</i> 2 CEUs (All, Bp)
8.45	Dieback of ash and elm: current situation in north Europe <i>Vasaitis R. (invited speaker)</i>
9.15	Detectives do the dirty work: diagnosing and managing the interaction of urban trees with associates, pests, and other humans <i>Meilleur G.</i>
9.30	Combining three specific site sustainability practices, in unison, improves overall tree health and reduces the need for pesticide applications for insects and disease <i>Murphy L., Ap L.</i>

* ISA CEU credit assignment. Legend at the end of the Scientific Program

-
- 9.45 New and effective plant protection products and modes of delivery to control tree pests and diseases
O'Callaghan D.P., Percival G.
- 10.00 Overview on wood decay fungi of ornamental broadleaves and conifers in the city of Genoa
Giordano L., Sillo F., Guglielmo F., Costa G., Gonthier P.
- 10.15 Research on pests and diseases in urban trees and forests of Ljubljana City, Slovenia
Jurc M., Jurc D.
- 10.30 European ash (*Fraxinus excelsior*) dieback as a biodiversity conservation challenge
Pautasso M., Ans G., Queloz V., Holdenrieder O.
- 10.45-11.15 Coffee break**
- 11.15-12.45 Concurrent session 1 - Trees and infrastructures and green infrastructures**
Room Giolitti - Chairperson: Smiley E.T.
1.5 CEUs (All, Bm)
- 11.15 Environmental services of Green Infrastructure and Urban Forests and implications of climate change
Samson R., Niinemets Ü., Calfapietra C.
- 11.30 The certificate in arboriculture as a fundamental objective to achieve healthier and longer living trees in towns, parks, gardens, or where trees are grown to beautify Europe
Nellen C., Read G., Pestalozza A.
- 11.45 Environmental index for the reduction of construction impact, the proposal of Modena's Institute of Agronomists and Forestry Professionals to regenerate an industrial area of Modena
Di Paolo A.
- 12.00 The floristic diversity in the quarry San Giuseppe di Basovizza - Trieste
Balbis P., Bozzato F.
- 12.15 Geomatics applications for survey, management and tourism exploitation in the green areas. A case study: the Racconigi Royal Park
Boniforte A., Garnero G.
- 12.30 Retrenching hollow trees for life: fitting smaller and stronger trees into cities
Meilleur G.
- 11.15-12.45 Concurrent session 2 - Management of diseased, infested and declining trees**
Room Einaudi - Chairperson: Gonthier P.
1.5 CEUs (All, Bp)
- 11.15 The North American invasive fungal pathogen *Heterobasidion irregulare* is a new threat to European parklands and urban pinewoods
Gonthier P., Anselmi N., Garbelotto M.
- 11.30 Emerald ash borer management planning in a Canadian context
van Wassenaeer P.
- 11.45 The parasitic fungus *Ustulina deusta*: identification and way of decaying inside the tree
Pecollo D., Leone C., Fruscione C.
- 12.00 A rapid molecular diagnostic assay for the detection and identification of wood decay fungi of conifers
Sillo F., Giordano L., Guglielmo F., Garbelotto M., Gonthier P.
- 12.15 Use of the electronic nose for the detection of *Anoplophora chinensis* on standing trees: preliminary results
Villa G., Bonanomi L., Guarino D., Pozzi L., Maspero M.
- 12.30 A special challenge: a pluriannual (2007-2014) project aimed at saving an historical tree and its associates
Castiglioni M., Zanzi C., Zanzi D.
- 12.45-14.15 Free lunch and poster viewing**
- 14.15-15.30 Concurrent session 1 - Trees and infrastructures and green infrastructures**
Room Giolitti - Chairperson: Sanesi G.
1.25 CEUs (All, Bm)
- 14.15 Durable tree-growth in an UNESCO World Heritage Site: designing the growing site for trees along canals in the urban jungle of Amsterdam city centre
Voeten I.J.G.W.F.

- 14.30 The effects of the tree growth regulator Paclobutrazol (PBZ) on fast growing trees and application to utility arboriculture
O'Callaghan D.P., Percival G.
- 14.45 Growing trees in an urban plaza environment: a comparison of below pavement treatments and their impact on tree growth
Smiley E.T.
- 15.00 Tree response after severe root damage: monitoring the risk of failure, performing pulling tests after four years. Competition between crown growth and root restoration process
Pestalozza A., Guzzi D.
- 15.15 Health treatments and measures taken to stability of the monumental *Platanus x acerifolia* of La Spezia (Italy)
Fruscione C., Leone C., Fantini L.
- 14.15-15.45 Concurrent session 3 - Tree management in a global change scenario**
Room Einaudi - Chairperson: Nowak D.
1.5 CEUs (All, Bm)
- 14.15 Gray city or Green City? Let's plan a green and sustainable future using trees wisely!
Ferrini F. (invited speaker)
- 14.45 Climate change and landscape modifications: re-thinking of urban vegetation
Breganni F., Butté F.
- 15.00 A new national project - planning the green city in the global change era: urban tree species function and suitability for predicted future climates (TreeCity)
Bussotti F.
- 15.15 Silvicultural and arboricultural management of a nineteenth century landscape
Luison S., Sgrò S., Semenzato P.
- 15.30 Private trees management in urban areas: positive experiences
Malandrino P.E., Pascucci R., Della Torre D., Scifoni G., Lai N.
- 14.15-15.45 Concurrent session 4 - Tree risk assessment and biomechanics**
Room Cavour - Chairperson: Rinn F.
1.5 CEUs (A, M, Bp)
- 14.15 Arborists: the hidden threat to Arboriculture!
Barrell J. (invited speaker)
- 14.45 Tree biomechanics: where are we now?
van Wassenaeer P.
- 15.00 Urban tree heritage management: from visual tree assessment to tree life expectancy in an urban contest. The experience of city of Turin
Cirulli G.
- 15.15 Balancing risks from falling trees with the costs of risk control: quantified tree risk assessment validates balancing the likelihood and extent of potential harm from tree hazards with the many costs of risk mitigation
Ellison M.
- 15.30 Tree hazard assessment and monitoring in Florence
Degl'Innocenti C., Cantini C., Rubellini P., Cerchiarini S.
- 15.45-16.15 Coffee break**
- 16.15-16.45 Concurrent session 3 - Tree management in a global change scenario**
Room Einaudi - Chairperson: Nowak D.
0.5 CEUs (A, M, Bm)
- 16.15 Repeated pruning cycles differently affect tree structure and physiology of *Acer pseudoplatanus*, depending on how pruning is carried out
Fini A., Faoro M., Amoroso G., Piatti R., Frangi P., Ferrini F.
- 16.30 Biogenic Volatile Organic Compounds emitted from peri-urban forest fires
Centritto M., Ciccioioli P., Loreto F.
- 16.15-17.15 Concurrent session 4 - Tree risk assessment and biomechanics**
Room Cavour - Chairperson: Rinn F.
1 CEU (A, M, Bp)
- 16.15 Tree stability evaluation: the importance of monitoring programs
Cevenini L., Corradini M., Minelli A., Pasini I., Zuffa D.

- 16.30 Procedures to manage tree risk assessment in extensive green areas
Fruscione C., Rezza G.
- 16.45 Using the ISA Best Management Practice Method for tree risk assessment
Smiley E.T.
- 17.00 Views from the top: an expedition to the redwood canopy
van Wassenauer P.

17.15-18.45 Poster viewing

Workshop

Room Cavour - Chairperson: Cirulli G.

1.5 CEUs (A, M, Bm)

Manage the tree risk and public tree heritage renewal: open discussion between public administrators and professional technicians

Wednesday 28th May

Time	Program
8.45-10.45	Concurrent session 4 - Tree risk assessment and biomechanics <i>Room Cavour</i> - Chairperson: Niklas K.J. 2 CEUs (A, M, Bp)
8.45	From biomechanics to tree-statics <i>Rinn F. (invited speaker)</i>
9.15	R3 TREES: an innovative tool for the integrated management of urban green areas <i>Viskanic P., Cattaneo N.</i>
9.30	Orebla, a simple model for tree risk assessment <i>Sani L., Strazzabosco L., Blotta V.</i>
9.45	Study of Italian stone pine assessment in urban environment <i>Morelli G., Moretti G., Duntemann M.</i>
10.00	A protocol for risk assessment of veteran trees <i>Strazzabosco L.</i>
10.15	Development of a tree risk index associated with ornamental trees inside historic parks. Case study of Villa Lante, Bagnaia (VT), Italy <i>Tomao A., Giuliarelli D., Quatrini V., Saccoccia D., Agrimi M.</i>
10.30	Checktrees.com - collect, update and share data about trees <i>Kolarik J., Szórádová A.</i>
8.45-10.45	Concurrent session 5 - Tree benefits and tree value in the urban context <i>Room Giolitti</i> - Chairperson: Ries P.D. 2 CEUs (A, M, Bm)
8.45	Assessing urban forest ecosystem services and values in Europe <i>Nowak D. (invited speaker)</i>
9.15	Rationale for the increased use of evergreen and deciduous conifers in terms of urban ecosystem benefits <i>Clapp J.C., Ryan H.D.P. III, Bloniarz D., Harper R.</i>
9.30	Vegetal evolution as renewed relationship between nature and mankind. Analysis and development of tangency scenarios between industrial design and vegetation in contemporary cities <i>Ceraolo S.</i>
9.45	Sustainable urban regeneration and Green Infrastructure (GI) implementation: competitive gains from tree planting at an economic, environmental and social level <i>Andreucci M.B.</i>
10.00	Complementarity of functional traits in urban trees and ecosystem services <i>Bussotti E., Pollastrini M.</i>
10.15	Urbanization vs rooting: the city that moves "around" the silent work of the trees <i>Farronato S., Nichele P.</i>
10.30	Cultivations and divisions inside of Tusculum agrarian landscapes, further on archaeology and villas. The role of the vegetation in the course of time <i>Marani M.E., Fabrini G.</i>
10.45-11.15	Coffee break

11.15-12.45 Concurrent session 4 - Tree risk assessment and biomechanics

Room Cavour - Chairperson: Niklas K.J.

1.5 CEUs (All, Bp)

- 11.15 The Neto Park renovation project using the digital method – Calenzano (Florence, Italy)
Martelli S., Mainardi P., Poli J., Lutri A., Grassi M.
- 11.30 Installing cables did not affect annual radial increment in co-dominant stems of red oaks
Kane B.
- 11.45 Designing special anchoring systems for special trees
Passola G.
- 12.00 The effect of leaves and steel support cables on the dynamic properties of northern red oak (*Quercus rubra*) with co-dominant trunks
Reiland M., Kane B., Modarres Sadeghi Y., Ryan D.
- 12.15 Determining strength limits for standing tree stems from bending tests
Detter A., Rust S., Rust C., Risse M.
- 12.30 Determination of the tree safety factor – error source analysis
Divos F.

11.15-12.45 Concurrent session 5 - Tree benefits and tree value in the urban context

Room Giolitti - Chairperson: Ries P.D.

1.5 CEUs (A, M, Bm)

- 11.15 Valuing and managing veteran trees: the VETree Project
Meilleur G.
- 11.30 Protection of monumental trees: the implementation of law n. 10, January 14th 2013, and new profiles of collaboration between government and stakeholders
Farina A.
- 11.45 The Smart Tree initiative and permanent polycyclic plantations in the city of Turin
Motta R., Berretti R., Boetto G., Vacchiano G., Miglietta P., Cirulli G.
- 12.00 Treegraphy (Arborgraphia - Alberografia): a way to appreciate and popularize the existence of our urban trees, a way to enlighten our towns
Fratus T.
- 12.15 Georol: a participative approach to input and output data of VTA urban trees census
Maroé A., Stamanato A., Favero A., Bobbera A.
- 12.30 The influence of forest areas on the Urban Heat Island effect: a case study in Italy
Mariani L., Parisi S.G., Cola G., Craveri L., Colangelo G., Lafortezza R., Sanesi G.

12.45-14.15 Free lunch and poster viewing

14.15-15.45 Concurrent session 4 - Tree risk assessment and biomechanics

Room Cavour - Chairperson: Niklas K.J.

1.5 CEUs (All, Bp)

- 14.15 Interpretation of instrumental data in tree stability evaluation: limitations of tools to obtain scientifically correct results
Cevenini L., Corradini M., Minelli A., Pasini I., Zuffa D.
- 14.30 Pruning did not affect sway response of large sugar maples
Kane B., Seyed-Aghazadeh B., Reiland M., Modarres-Sadeghi Y.
- 14.45 Results of a 20 year assessment of damage to the roots of street trees in London
Crane B.G.
- 15.00 Assessing the impact of root loss on tree stability
Smiley E.T.
- 15.15 Effect of aspect ratio and included bark on branch attachment strength
Miesbauer J.W., Gilman E.F., Harchick C., Paz M.
- 15.30 Improving sprout attachment strength for crown restoration of storm damaged trees
Miesbauer J.W., Gilman E.F., Harchick C.

14.15-15.45 Concurrent session 5 - Tree benefits and tree value in the urban context

Room Giolitti - Chairperson: Cirulli G.

1.5 CEUs (A, M, Bm)

- 14.15 The role of bioarchitecture on the carbon sequestration of urban greening: the "Ecovillaggio" case study
Minelli A., Minelli M., Santi F.

-
- 14.30 Environmental benefits derived by urban parks: carbon dioxide (CO₂) lowering and microclimate amelioration
Gratani L., Bonito A., Natmoli M., Varone L.
- 14.45 Analysis of surface temperature under different ground cover and shading condition: a case study in Florence
Napoli M., Brandani G., Massetti L., Petralli M., Orlandini S.
- 15.00 Urban surface temperature patterns in relation to vegetation within the metropolitan area of Palermo
Pipitone G., Motisi A., Georgiadis T.
- 15.15 Gardens without pollen - Examples of allergy-free green realizations
Zangari F.
- 15.30 *Cupressus sempervirens* and allergy: genetic improvement and plant selection to reduce pollen production
Barberini S., Della Rocca G., Lambardi M., Danti R.

15.45-16.15 Coffee break

16.15-17.00 Concurrent session 4 - Tree risk assessment and biomechanics

Room Cavour - Chairperson: Niklas K.J.

1.75 CEUs (All, Bp)

- 16.15 Residual growth stresses in *Acer pseudoplatanus* and *Tilia cordata* enhance the breaking resistance of tree stems
Brudi E., Kaczensky T., Woodward S.
- 16.30 Risk assessment of maple trees subjected to wind and decay effects on that risk
Ciftci C., Brena S., Kane B., Arwade S.
- 16.45 Wood decay fungi associated with standing and failed conifer and broadleaf trees as detected through molecular assays: inferences on their host preference and their role on tree stability
Gonthier P., Sillo F., Guglielmo F., Giordano L.

16.15-16.45 Concurrent session 5 - Tree benefits and tree value in the urban context

Room Giolitti - Chairperson: Cirulli G.

0.5 CEUs (A, M, Bm)

- 16.15 Qualiviva: the quality of the national nursery-floriculture industry through the use and divulgation of varietal plant palettes and procurement specifications for green areas realizations
Resta E.
- 16.30 Some native, rare and endemic tree species with ornamental potential in Turkish forests
Yilmaz M., Yavuz Z.

17.00-18.45 Poster viewing

Workshop (Room Cavour)

1.75 CEUs (All, Bp)

Tree Risk Assessment (TRA)

Flanagan T.P., Smiley T.

ISA CEU credit legend

All - A, U, T, M, L, B

A - Certified Arborist

U - Utility Specialist

T - Certified Tree Worker

M - Municipal Specialist

L - Aerial Lift Specialist

B - Board Certified Master Arborist (BCMA)

Credits for BCMA are further divided into three categories: Science (Bs), Management (Bm) and Practice (Bp)

ORAL PRESENTATION ABSTRACTS

PLENARY AND KEYNOTE SESSION

Trees of green – beyond the Green Infrastructure agenda

Konijnendijk van den Bosch C. (invited speaker)

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Focus on the role of green spaces in providing resilient and attractive cities has increased. New, integrative approaches have emerged, including that of Green Infrastructure (GI) planning. These approaches have attempted to “lift” green space issues to the level of political and planning debates on the basic infrastructure and services that cities should provide for their inhabitants. The European Commission’s efforts to implement GI as a policy tool as well as agenda for delivering its environmental policies is an illustration of this. But there is a risk that green space and trees become conceptualized merely as technical service providers, helping to clean and cool the air, manage storm water run-off, and so forth. This overlooks the many social, cultural and psychological benefits green space and trees provide to urban residents. This could imply that the “human dimension” of green space gradually disappears, at least in political and planning domains, but possible event amongst citizens. This contribution will take a critical look at the “technification” of urban green space and urban trees. By revisiting the Urban forestry (Uf) concept, which is soon approaching its 50th anniversary, an attempt is made to enrich the urban green space debate. Questions to be addressed include: What are the pros and cons of the current focus on GI? How does Uf fit in and how can it help deliver the “green agendas” of today and tomorrow? The questions are answered based on a review of literature and examples from across Europe. Finally, a new European research project on GI and urban biocultural diversity (called GREEN SURGE) is presented as an attempt to address some of these concerns.

Why do trees fall down?

Niklas K.J. (invited speaker)

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Like all engineered structures, trees experience different physical forces that can be crudely sorted into two broad categories: static loadings (the effects of

gravity, snow, ice, epiphytes) and dynamic loadings (the effects of wind pressure, falling objects). Static loadings generally do not result in the catastrophic failure of healthy trees; dynamic loadings can cause the collapse of branches, trunks, or roots if they exceed the mechanical tolerances of bark or wood. This talk will provide a review of some of the most important basic mechanical properties of trees to explore how, where, and when they are likely to cause failure. It will also review some of the very large gaps in our knowledge regarding the mechanical behavior of trees. The goal of this talk is to provide some guidance when assessing the safety and mechanical stability of trees.

SESSION 1 – TREES AND INFRASTRUCTURES AND GREEN INFRASTRUCTURES

“GreenInUrbs”: Green Infrastructure approach - linking environmental with social aspects in studying and managing urban forests

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Green Infrastructure (GI) has recently gained prominence as a planning tool at regional and local levels. GI provides a range of ecosystem services, and new initiatives can build on state of the art research and on delivery mechanisms such as Urban forestry (Uf). However, greater attention is needed on integrating the environmental and social benefits produced, particularly in the context of climate change adaptation and mitigation. Under this perspective within COST (European Cooperation in Science and Technology), one of the longest-running European frameworks supporting cooperation among scientists and Researchers across Europe, the Action GreenInUrbs was launched in 2013. The Action, involving 40 countries and lasting for 4 years, will allow to carry out several initiatives including conferences, workshops, training schools, researchers-exchange, scientific and technical publications with the main aim to increase the understanding of the role of Urban Forests (UF) and green spaces in the context of GI, especially focusing on services provided to people and to the urban environment. Trees, parks, urban and peri-urban woods (green spaces categories included within UF) can mitigate temperature, decrease pollution, water run-off and soil erosion, increase aesthetics and quality of places, provide a place for recreation, education and learning. Trees can also contribute by direct and indirect ways to reduce CO₂ in the atmosphere and contrast “global warming”. In brief, trees in our cities considerably improve quality of life, increasing health and well-being of the people. Targets of

GreenInUrbs are: 1) to increase the knowledge from a scientific and a socio-economic perspectives, 2) to identify priorities and challenges for future research in the field, 3) to provide indicators and/or thresholds to be included by policy makers at local, national or international regulations about GI and UF, and 4) to develop guidelines for GI planners and managers on how to implement GI approaches with an emphasis on maximizing the environmental and social services of UF.

The Green Infrastructure approach: from theory to case study

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Over the last few decades, the Green Infrastructure (GI) approach has progressively taken root in European planning. This approach has been adopted and suggested by European institutions through recent declarations, rules and other institutional means. The GI approach is inextricably linked to the concept of ecosystems and the ability to provide ecosystem services. GI networks are discernible at different scales and across urban, peri-urban and rural landscapes. GI is considered supportive of ecological processes by contributing to improved human health and well-being, particularly in urban regions. This presentation illustrates examples of GI across all of Europe, with an original contribution to the metropolitan area of Milan. The authors provide guidelines for undertaking initiatives and future research on GI in the emerging context of ecosystem services and human well-being.

Urban forest policy and governance in the Green Infrastructure approach

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Urban Forests (UF) provide many important ecosystem services, the notion supported by the growing body of scientific evidence. The urban green elements are incorporated into a wider urban fabric through the concept of Green Infrastructure (GI) that positions UF to provide ecosystem services for

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urban population in a cost-effective way. Thus, proper UF policy and governance are needed to serve that goal. In its widest meaning governance is a process of making decisions, which means that it involves certain actors, rules applied and resources allocated, aiming to achieve defined objectives. The concept of GI has been largely promoted by European Commission as a mean to tackle biodiversity loss and climate change. However, UF policy and governance have not been comprehensively addressed so far in a scientific literature. Activities of the Working Group 3 (WG3) of the COST (European Cooperation in Science and Technology) action FP1204 dealing with UF in the context of GI aim to fill that gap. The goal of this presentation is to discuss the importance of UF policy and governance in the GI approach. Furthermore, rationale, organization, activities and expected outputs of this WG will be presented.

Tree protection regulations in town of Oakville, Ontario, Canada

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Town of Oakville with a population of 183,000 is located in the Greater Toronto Area (GTA) province of Ontario, Canada. The town's Forestry Section manages Oakville's urban forest using a long term, sustainable strategy of development and maintenance in order to provide a perpetual green cover on public lands. In 2007, the town of Oakville was named the Forest Capital of Canada by the Canadian Forestry Association. The town of Oakville completed an inventory in 2010 to catalogue and map its approximately 138,000 street and park trees. Trees in Oakville are recognized as Green Infrastructure (GI) in the towns' Official Plan and tree protection regulations are in place to ensure trees are protected. These include: a by-law to protect the public trees; a by-law that regulates the removal of the private trees and a procedure for construction near trees that outlines the required actions to protect trees during construction. This procedure represents the standard specifications for tree protection whenever tree protection measures are required by the town.

Linking people and landscapes: can understanding public perceptions help guide urban forest management?

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Are there linkages between what people know about urban forestry and what management strategies they will support? What do community leaders such as local elected officials think about how their constituents value urban forestry programs? Researchers from Oregon State University conducted two recent studies that address questions like these, using the Portland, Oregon, USA metropolitan region as a focus area. In the first study, residents were surveyed to gauge their perceptions of urban forestry, urban forest management strategies, and ecosystem services. Clean water and outdoor recreation opportunities ranked as the most highly valued ecosystem services. The implications for urban forest managers include a need to target public education and outreach strategies to what residents value most. In the second study, elected officials and municipally employed natural resource professionals were surveyed to understand their perspectives on urban forestry issues, including what their public constituents know and value about the urban forest. Results indicate that while the public is familiar with and cares about many of the benefits that urban trees provide, many jurisdictions are not managing to take full advantage of those benefits and that some discrepancies exist between the opinions of elected officials and the practitioners regarding the management of urban forestry programs. Findings from studies like these can help urban forestry professionals tailor their public education messages and their urban forest management strategies for maximum effectiveness.

Planting trees in the contemporary cities: understanding of the city functioning

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How is the real relationship between tree and city? The last publication of Minoprio Foundation tries to answer this questions thanks to the experience and the research of its authors, synthesizing all the elements about trees and cities (biological and urban needs, historical and architectural landscape, standard and rules environment, climate, nursery, good practice on tree development and tree maintenance) in a guide for municipalities, designers and technicians. The focus is the relationship between root system,

underground public utilities and paving system, understanding and matching city needs with tree needs. A green city is a working city.

The tree heritage in suburban landscape: criteria and strategies for conservation and management

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The tree-species heritage is a very important component of the historical Italian landscape, related to its monumental and ornamental value. In Italy, the law n. 10, January 14th 2013, represents a valuable tool for the protection and valorization of the natural landscape. Specifically, the art. 7 is useful for the protection and conservation of monumental trees, particularly for their valuable natural, architectural, historical and cultural heritage. For the first time, the rows and the tree-lined with high landscape, monumental, historical and cultural value are considered. This innovative protection strategies unfortunately fit in a framework of concerns about the potential disappearance of tree-lined by the controversial application of the Italian highway code. In recent years, a discussion has been opened up with several pressing questions: why are we deleting the last tree-lined? Are the tree-lined roads really dangerous even if well controlled and managed? What are the applications of the law in Italy and in other European countries? Is it possible to save the last remaining tree-lined roads and reversing the situation? Can the new law help to save the particularly valuable tree-lined? This research aims to focus on these aspects in order to provide some answers to these questions by stimulating the discussion and promote good designing strategies in the European countries.

Environmental services of Green Infrastructure and Urban Forests and implications of climate change

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Green Infrastructure (GI) and Urban Forests (UF) provide a large number of environmental services over a broad range of issues, e.g. dealing with air (including CO₂ and air quality), water, biodiversity, delivery of goods,

climate and protection against the former issues (like flooding, climate change and air quality). Although the importance of GI and UF is largely acknowledged, environmental services are mostly studied for forest ecosystems outside the urban environment. Working Group 1 (WG1) of the COST (European Cooperation in Science and Technology) action FP1204 has several objectives like: i) making an up-to-date inventory of the existing knowledge and studies dealing with above mentioned environmental services in relation to climate change over the broad European territory, ii) writing overall or more topic-related position papers on these issues, and iii) summarizing this knowledge in a species-list which can be used by policy-makers in Europe dealing with GI and UF. This presentation will give more insight into the activities and objectives of WG1, and how scientists and policy-makers can contribute to our objectives.

The certificate in arboriculture as a fundamental objective to achieve healthier and longer living trees in towns, parks, gardens, or where trees are grown to beautify Europe

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The European Arboriculture Council (EAC) has elaborated the training and further education program which leads to the qualification of “European Tree Worker (ETW)” and to the “European Tree Technician (ETT)”. Within the framework of the European Leonardo da Vinci Programme, the ETW was developed from 1996-1999. The objective was and is to harmonize the field of tree care, which is a very special field, in the unified Europe, to assure high quality tree care operations and a high level of training and to facilitate the international exchange of tree workers. The ETW carries out operations on and in amenity trees with the aim of keeping the trees healthy and safe. They act on the basis of arboricultural knowledge and take conservation matters, environmental protection and safety regulations into account. Tree care operations require a profound and highly qualified training with a special focus on work safety. In order to reach this objective, the EAC has developed an examination and certification system for ETW. This system has been installed and accepted in 15 European countries now. The examination and certification system contains not only a curriculum but also examination regulations and a ETW Certificate, as well as a handbook. Through the project, Europe got for the very first time a ETW diploma which is based on the same exam regulations all over Europe. This diploma is mutually recognized by all the member countries and leads to

international cooperation and cross-border quality. So employees can get a highly-qualified training and employers high-qualified employees. At the same time, European cooperation will be reinforced. An ETW is defined as a person employed in, or aspiring to, junior or middle management, or taking a supervisory role in arboriculture. ETT are skilled in operations on and in amenity trees with the aim of keeping them healthy and safe whilst bearing in mind the demands of biodiversity. In particular they act on the basis of current best practice within arboriculture, conservation, environmental protection and work safety. Their field of competence will also include technical knowledge, organisational and supervisory skills.

Environmental index for the reduction of construction impact: the proposal of Modena's Institute of Agronomists and Forestry Professionals to regenerate an industrial area of Modena

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Elements that can play a fundamental role in the requalification and regeneration of our cities regard both the adoption of innovative urban and environmental policies and the application of technologies and design solutions that increase the sustainability and environmental well-being. The Institute of Agronomists and Forestry Professionals of Modena in the occasion of the regeneration project of the industrial area Villaggio Artigiano, undertaken by the municipality of Modena with the Institutes and Technical Colleges in Modena, drafted and refined a proposal (developed by the working group from within the Institute) which is based upon the BAF (Biotope Area Factor) procedure. The motives that led Modena's agronomists to use this urban index are the following: the possibility of having available an efficacious tool for environmental mitigation and balance and the appreciation of the landscape; the safeguarding and increase of the microclimate and the health of the atmosphere; the control of the use of soil and water; the improvement of living spaces for the human beings; aesthetical and qualitative improvement in individual buildings and/or in general the whole village. Useful environmental mitigation and balance tools are represented by the integrated application of technologies for the management and recovery of rainwater with the realisation of green surfaces: reduction in soil waterproofing; introduction of technologies of hanging green and green-walls; strengthening of traditional green spaces. BAF is de facto an urban index able to evidence the relationship between ecologically useful (or

efficient) surfaces of the lot and the surfaces of the whole lot. The various parts of the (ground) surfaces are weighed differently based upon what is defined as “ecological value”. Thus a specific ABACUS was worked up by which the various types of surfaces are related to specific values and these, in turn, are multiplied by the surface area effectively present. Some additions to this index have been subsequently made by technicians of the municipality of Modena and thus approved and incorporated in the city plan regulations for Villaggio Artigiano. Requalify or regenerate signifies not only giving perceptive, residential and industrial dimensions that allow a higher quality of life on the strength of society’s desires, but also adopt procedures and solutions for a true improvement in the environment; an improvement evoked by all but not always achieved.

The floristic diversity in the quarry San Giuseppe di Basovizza - Trieste

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The main objective of the study was the scientific evaluation of environmental restoration achieved so far and the determination of a set of procedures for the future recovery of the quarries, which could be used in all the Group’s quarries. In addition, Italcementi Group deemed that it was necessary obtaining reliable data on the results of work carried out in order to improve the quality of methods and the effectiveness of future operations. For these reasons, in 2009 a collaborative program for a floristic biodiversity research began between Italcementi Group and the Department of Agricultural and Environmental Sciences of the University of Udine. The 10th August 2010, the Italcementi Group has signed an agreement with the above cited Department in order to evaluate the levels of biodiversity in the study area. The research has had a total duration of about three years; during this period, the site has been divided into operational areas, the flora was then detected with four annual inspections for each transect and two inspections on the entire study area. This way, the research team created a punctual list of the vascular flora, with the exact quantitative determination of the species existing in the site. The amount of data collected has been imported into a database in order to perform statistical analyses.

Geomatics applications for survey, management and tourism exploitation in the green areas. A case study: the Racconigi Royal Park

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The Collegio dei Periti Agrari e dei Periti Agrari Laureati of Turin and Aosta Valley, in collaboration with the Interuniversity Department of Regional and Urban Studies and Planning (University and Polytechnic of Turin), has implemented a project of the census and the computerization of all green areas of the Racconigi Royal Park (CN, Italy). The project aims at: i) taking a survey of the green areas of the Park, including the tree-lined; ii) optimizing the management and maintenance of the green, reducing operating costs; iii) making available to visitors the green; iv) informing in real time about the amount of CO₂ offset by the greenery of the Park; v) making available via the web through the areas through augmented reality applications and virtual tourism; vi) self-financing part of the costs of management of the Park through the profits of direct and virtual tourism. The implementation of an efficient Geographic Information System (GIS) has made possible: 1) storing and effectively managing information related to the area [planimetry, alphanumeric databases, traditional and by Unmanned Aerial Vehicle (UAVs) aerial surveys]; 2) geo-referencing objects surveyed, detecting the position using Global Navigation Satellite System (GNSS) equipment; 3) planning and managing the ordinary and extraordinary maintenance activities; 4) producing the progress of the work reports; 5) performing predictive analysis to support decisions. The introduction of QRcode technology, evolution of the two-dimensional bar code, allows you to make available the information gathered in the field and historicized in the database for educational purposes and tourism. By adding the survey data with the standards of CO₂ absorption of each tree will be made available on the website and in the Park, in real time, the amount of CO₂ offset. Through a project of augmented reality and virtual tourism it will be able to visit the Park by obtaining information from any pointed object and virtually visit the Park on the web.

Retrenching hollow trees for life: fitting smaller and stronger trees into cities

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As trees grow large, they no longer fit around urban infrastructure. Roots and branches are often harshly reduced to make room for human activities. Retrenchment pruning is a phased form of crown reduction that retains biomechanical integrity by shedding small branches and developing a lower

crown. International pruning standards agree, with some variations, that specifying this work can meet the objective of sustaining the substantial benefits from older trees. Systematic specifications for retrenching the branches and roots of trees with hollows and other perceived hazards have maintained reasonable costs and risks on trees with hollows and other perceived hazards, around the world.

Durable tree-growth in an UNESCO World Heritage Site: designing the growing site for trees along canals in the urban jungle of Amsterdam city centre

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Having healthy trees along the canals in the historic city centre of Amsterdam is not only desired by the city, its inhabitants and visitors, but also required by UNESCO, as the entire centre is designated a World Heritage Site. With necessary reconstruction of old and sometimes unstable canal walls and their foundations, existing trees have to be removed, and new ones have to be planted after construction completion. Aiming at minimally 70 years of successful growth of healthy trees along the canals, a huge challenge had to be overcome to create sufficient and suitable underground growing space, considering the very high ground water tables, high intensity use of above-ground urban space, high density of underground infrastructure, high frequency of change in the urban environment and high quality standards set by both UNESCO and the city of Amsterdam. This presentation will discuss all growing site solutions and innovations, in terms of soil volume, aeration, water and nutrient supply, materials and techniques used to create growing site and pavement stability, tree stability, and root protection, to durably enable coexistence of roots and underground utilities.

The effects of the tree growth regulator Paclobutrazol (PBZ) on fast growing trees and application to utility arboriculture

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Trees are one of the most common causes of unplanned interruptions to the supply of electricity. Following major incidents in United Kingdom, Europe and the USA in 2002-2003, the regulatory authorities have placed legal obligations on the utilities to maintain their networks free from tree-caused

service interruptions as far as is reasonably practical in both normal and abnormal weather conditions. Utilities discharge these obligations through proactive Utility Vegetation Management (UVM) programmes based on cutting cycles. The rate at which trees re-grow following pruning is one of the key factors in determining the appropriate cutting cycles. Research data show that trees are growing much faster than was previously thought in response to climate change and this has major implications for UVM programmes and costs. The results of a 5 years research project between 2009 and 2013 that investigated the potential of the tree growth regulator Paclobutrazol (PBZ) to retard the growth of fast growing trees commonly located on or adjacent to the electricity networks are presented. This project is the largest trial of PBZ ever undertaken. Results indicate that PBZ has positive effects on tree health and vitality and none of the 2000 or so treated trees showed any signs of phytotoxicity through the 5 year trial. The results also show that PBZ effectively controls the growth of some of the most important genera and that it could be used cost effectively in UVM programmes. The implications for UVM programmes and possible applications for PBZ in the amenity and urban forestry sectors are discussed.

Growing trees in an urban plaza environment: a comparison of below pavement treatments and their impact on tree growth

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To grow trees in an urban environment the soil above the root system often needs to be covered with concrete to allow pedestrian and vehicular traffic. There are several methods of treating the soil below the pavement that have been used in these situations. The goals of the research were to assess the impact of treatments on tree growth and on pavement longevity, and to assess the maintenance needs of the trees. The treatments that were installed were a mixture of gravel and soil, porous gravel, compacted soil, and non-compacted soil with the pavement being supported on piers. A nine years period was considered.

Tree response after severe root damage: monitoring the risk of failure performing pulling tests after four years. Competition between crown growth and root restoration process

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During 2007, the east line of a double tree-lined avenue of 88 large *Celtis australis* located in Sassari (Italy), suffered severe root damage by a trench realized less than 50 cm from trunk edges. Root loss involved 47 trees. Immediately afterward, all trees were drastically pruned (35% to 40% reduction). The municipality council then commissioned Dendrotec S.r.l. for a study. The first air excavation revealed portions of damaged roots and a classification protocol based on the number of injured roots and their dimensions was settled. After that, all damaged trees were classified by pulling tests comparing the injured trees values with some coming from untouched ones. As a result no trees were removed and only 22% of trees required a rigid support system anchored to the ground. Pulling tests only partially confirmed results coming from investigations made with air excavations. Organic compounds and microorganisms of the soil were given in the remaining rooting area. During 2011, a second study was committed in order to evaluate the static assessment and, particularly, the crown growth versus the increase of resistance of the root ball. Wind load analysis was also applied to all trees involved. The crown area before the pruning was very large and considering a height of the center of the crown at 8 m, brought a stem base bending moment of 77 kN*m. After the pruning the crown lost more than 80% of the sail effect, so the bending moment decreased at only 6 kN*m. In these four years, fortunately the trees has reacted to the drastic pruning and, at first, they reformed the main branch near trunk. In this way, the center of the crown is lower and the bending moment has only increased to 11 kN*m. Pulling tests allowed to calculate the tip over load using the Stuttgart curve and in that way we calculated the tipping load and we compared the 2007 tests with the 2011 ones. The mean value of safety factor after 4 years was 6.36 compared with 4.35 recorded on 2007. The 88% of the trees increased the root stability. The maximum increase was 134%. These results show a general improvement of the root ball stability. The treatment with beneficial fungi and bacteria inoculum, and fertilizers together with the natural tree tendency to repair damages, produced the improvement of vigour and stability. A final pulling test control in 2014 can confirm a complete restoration of static and physiological conditions of the tree population.

Health treatments and measures taken to stability of the monumental *Platanus x acerifolia* of La Spezia (Italy)

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In the period 2008-2013, the Studio Verde S.a.s. of Turin realized a number of health treatments and measures taken to stability of the monumental *Platanus x acerifolia* of La Spezia (Italy), included in the list of monumental trees with regional law n. 4, 22th January 1999, by Liguria Region. This tree was interfered by the realization of the underground parking in front of the railway station of the city: the area around the tree was completely excavated with the exception of a limited portion, that was preserved in order to keep alive the tree. Before the opening of the construction site, the Studio Verde S.a.s. realized soil exploration to inspect the development of tree roots and proposed measures taken to consolidate the tree and to prevent structural failures of root clod. The tree was pruned with modern arboricultural techniques and was realized a cabling system. During the further construction works, the Studio Verde S.a.s. did a number of health treatments with fertilizers and root stimulant to balance the damages suffered. In the year 2013, the construction works of the parking were completed and the area around the tree was reorganized with benches and other public structures. The tree looked in good health conditions and in the same year could start the operation to remove tree cabling, according to a monitoring planning under the supervision of Studio Verde S.a.s.

SESSION 2 – MANAGEMENT OF DISEASED, INFESTED AND DECLINING TREES

Dieback of ash and elm: current situation in north Europe

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Currently, severe Ash Dieback (ADB) is observed in most European countries. This is an emerging disease caused by invasive alien fungus *Hymenoscyphus pseudoalbidus* of East Asian origin. The disease results in massive ash mortality, and currently threatens the existence of tree species on a continental scale. Also Dutch Elm Disease (DED) is a lethal disease, which during the last 100 years has led to a massive mortality of elm trees in Europe, threatening the existence of the species over large geographical areas. DED is caused by invasive alien fungi from the genus *Ophiostoma* originating both from Asia and North America. However, data from clonal seed orchards of ash have demonstrated that different tree genotypes exhibit different levels of susceptibility to ADB. Moreover, numerous reports indicate that there are individual ash trees without any symptoms in otherwise ADB devastated areas. Due to the fact that the massive amounts of pathogen spores are distributed by wind, all ash in such areas must have

been about equally exposed to the disease. Therefore, presence of symptomless ash would suggest tolerance or resistance to the disease. Moreover, it has been known for decades ago that different elm genotypes are not equally susceptible to DED, and trials for breeding of elms against DED in Europe have historical roots. As a result, recently a number of DED-resistant elm clones were developed and registered for practical use. Currently ongoing and planned activities include: i) establishing seed orchards by planting available resistant genotypes of ash and elm; ii) initiating silvicultural trials by replanting resistant trees in affected ecosystems; iii) monitoring and mapping vital ash and elm in nature for future use in breeding; iv) continuous breeding for resistance against ADB and DED for more resistant genotypes and their propagation; vi) biodiversity studies in areas devastated by ADB and DED.

Detectives do the dirty work: diagnosing and managing the interaction of urban trees with associates, pests, and other humans

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Diagnosing associates in urban trees is a difficult challenge. Which are beneficial? Which are neutral? What makes good guys turn bad, from partner to pest? Diagnosis is facilitated by adopting the scientific mindset of the detective: detached, systematic, objective. Tree associates are innocent until proven guilty. Detective Dendro™ has solved many difficult cases within the pages of ISA's Arborist News magazine. By reviewing those challenges with a European connection, and the diagnostic paths that led to solutions, we journey into systems that interact with each urban tree. Many twists and turns lead to dead ends. Paradigms shift, and the course is reversed. Some solutions seem to occur by chance, pure luck, but they are the result of tightly focused research and tireless persistence.

Combining three specific site sustainability practices, in unison, improves overall tree health and reduces the need for pesticide applications for insects and disease

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Combining three specific aspects of site sustainability can strengthen ornamental trees and reduce the need for pesticide applications in the urban environment. These practices include irrigation efficiency management, site-specific fertilization and Integrated Pest Management (IPM). Irrigation efficiency management is the use of irrigation auditing practices, drip

irrigation and smart controllers, in the landscape. These innovative techniques control overwatering while also stewarding the occurrence of an insufficient supply of water to the trees in the landscape. When selecting the components, each site becomes a case study within itself. The proper irrigation considerations add value because overwatering predicated conditions for increased disease pressure, while insufficient watering compounds drought stress, thereby weakening the trees and creating a hospitable environment for insect infestation. Secondly, significant focus should be placed on slow release fertilization and organic supplementation. A prescription fertility and micronutrient program should be developed, choosing nutrients that coincide with the deficiencies determined by soil testing. Taking this a step further, nutrient choices are directed towards requirements of the type of trees, by species. The final component of site sustainability, is the implementation of an IPM program. This aspect of the three step process sets up benchmarks for the insect and disease pressure that are tolerable prior to treatment with a pesticide application. Scouting for the presence of unacceptable pressure becomes primary, and initial treatments are limited solely to organic sources. There are many products, biologicals and beneficial insects that could be implemented prior to treatment with pesticides. When we do finally treat with a pesticide application, the treatment then becomes extremely target specific, hopefully with systemic products that provides longer residual characteristics. An opportunity also presents itself at this juncture to utilize injection methods for even greater efficiency.

New and effective plant protection products and modes of delivery to control tree pests and diseases

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Trees are vital to human health and well-being and we must do all we can to keep our existing tree population healthy and take every opportunity to plant more trees. Britain's trees are threatened by increasing number of invasive pests and diseases and all can seem lost. New plant protection products have been developed that are effective in controlling Oak Processionary Moth (OPM - *Thaumetopoea processionea*) and Horse Chestnut Leaf Miner (HCLM - *Cameraria ohridella*) and other possible pest introductions. The results of field trials of the products in the UK are presented. A new closed and environmentally responsible system of delivering the products into the trees, based in recent developments in trunk

injection technology, and thus controlling the pests is described, the use of which requires operators to hold a new competency. Control of these invasive pests is essential to human health and innovative approaches and strategies to controlling these pests are described. Research data are presented that show how, using the new plant protection products and delivery system, it would be possible to eradicate OPM in the short term and to provide effective control of HCLM in the intermediate terms with a prospect of eradication in the long term. Research data are presented which demonstrate the immediate and serious impacts on human health through the loss of trees to pests and diseases. The positive benefits of tree pest and disease control on human health are described and the balance that has to be struck between the use of plant protection products to preserve trees and human health and well-being is presented for the consideration of decision makers.

Overview on wood decay fungi of ornamental broadleaves and conifers in the city of Genoa

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In the Autumn of 2010, a total of 1353 broadleaves and 165 conifers from 76 urban sites in the city of Genoa (Liguria, Italy) were inspected for the presence of fruiting bodies of wood decay fungi. Fungal identifications were performed either through traditional techniques or DNA sequencing. In addition, conifers were sampled at the root collar through a drill-based technique; wood samples were analyzed by using a recently developed multiplex-PCR approach for the detection of wood decay fungi commonly associated with conifers. Tree species included: *Cedrus* spp., *Celtis australis*, *Citrus xaurantium*, *Cupressus* spp., *Pinus* spp., *Platanus* spp., *Quercus ilex*, *Sophora japonica* and *Taxus* spp. 12% of broadleaves displayed fungal fruiting bodies. *Fomitiporia punctata*, *Ganoderma resinaceum*, *Inonotus hispidus* and *Perenniporia fraxinea* were the most frequent fungal species. Only *I. hispidus* displayed strict host preference (97% of fruiting bodies observed on *S. japonica*). 2% of conifers displayed fruiting bodies of either *Fuscoporia torulosa* or *Phaeolus schweinitzii*. Based on results of multiplex-PCRs, 16% of trees were found to be infected by at least one taxon detectable through this molecular diagnostic approach, which allowed to detect *Armillaria* spp., *Fomitopsis pinicola* and *Porodaedalea* spp. in addition to the above fungi. This

finding suggest that diagnosis based on visual inspection overlooks more than 85% of wood decay affected trees.

Research on pests and diseases in urban trees and forests of Ljubljana City, Slovenia

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The city of Ljubljana has 280,000 inhabitants and covers 275 km². The significance of the city lies in its extensive greenery including 110.8 km² of forests and the fact that the forest cover penetrates the city centre from two sides. According to the pilot study made in the years 2010-2013, the following tree genera, largely used in parks and streets, frequently face problems with pests and diseases: *Acer*, *Aesculus*, *Castanea*, *Fraxinus*, *Platanus*, *Robinia*, *Tilia* and *Ulmus*. Numerous native and introduced alien species were detected. The most prominent among native pests are *Thaumetopoea processionea*, *Ips typographus*, *Pityogenes chalcographus*, but invasive alien species are more numerous, such as *Cinara curvipes*, *Dasineura gleditchiae*, *Xylosandrus germanus*, *Phyllonoricter issikii*, *Aproceros leucopoda*, *Dryocosmus kuriphilus*, *Cameraria ohridella*, *Corytucha ciliata*, *Oxycarenus lavataerae*. Some new pathogens were detected: *Eutypella parasitica*, *Chalara fraxinea*, *Splanchnonema platani*, *Erysiphe arcuata*, *Erysiphe elevata* and *Erysiphe flexuosa*. According to the forest decline model introduced by Manion in 1981, many predisposing long term factors can act in the urban context: unsuitable genetic potential, unsuitable soil, drought intensified by the effect of deicing salt, climate change, and air pollution. When the tree is predisposed to harmful biotic and abiotic inciting and contributing factors, this can lead to the death of the tree. Main factor of physical destabilization of weakened trees are wood degrading fungi, which enter the tree through wounds. Their activity and effects are the main reason for wood rots in older trees. The main species of wood degraders comprise the fungi from the genera *Ganoderma* and *Armillaria*, *Schizophyllum commune*, *Fomes fomentarius*, *Laetiporus sulphureus*, *Kretzschmaria deusta* and many others. In urban environment, trees are subjected to many stresses and physical injuries that differ from those in managed forests. Identification and monitoring of harmful factors are only the first step towards developing efficient methods for the preservation of urban trees and forest health.

European ash (*Fraxinus excelsior*) dieback as a biodiversity conservation challenge

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Common ash (*Fraxinus excelsior*), a widespread tree species throughout temperate Europe, is threatened by an emerging fungal disease. Ash dieback first appeared in Poland in the '90s and then spread in all directions, with the first reports in Italy in 2009 and in the UK in 2012. The disease is caused by the ascomycete *Hymenoscyphus pseudoalbidus* (anamorph *Chalara fraxinea*), which is thought to be native in East Asia. The dieback lethally affects ash trees of all age classes, with high mortality levels, so that *F. excelsior* and the many organisms dependent on ash trees are under threat. Based on literature reviews, we provide an overview of ash dieback as a conservation biology challenge and identify practical recommendations for tree managers. The observation of some relatively resistant individual ash trees calls for their retention, unless they pose an unacceptable risk to people's security, so as to preserve genetic diversity for tolerance breeding programmes. Because deadwood is an important habitat, dead and dying ash trees should be left in forests, urban parks and hedges. Tree nurseries have played a role as a dispersal pathway of *H. pseudoalbidus*, avoiding further planting of ash saplings in the landscape would thus make sense. Ash tree mortality could have some beneficial side-effects for biodiversity conservation, such as the creation of forest glades, but these are likely to be temporary and to be offset by detrimental effects, e.g. new opportunities for invasive exotic tree species such as *Ailanthus altissima* and *Robinia pseudoacacia*. Conservation and invasion biologists, forest pathologists, landscape and restoration ecologists, social scientists and tree managers need to engage with the various stakeholders of this Europe-wide conservation challenge. We need to improve awareness of the risks posed by the trade in plants for planting, tree saplings, bonsai, and other plant commodities.

The North American invasive fungal pathogen *Heterobasidion irregulare* is a new threat to European parklands and urban pinewoods

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The North American pine-associated root rot agent *Heterobasidion irregulare* was introduced in central Italy during World War II and is currently distributed in forest stands along 103 km of coastline west of Rome. In this paper we review the pathways of introduction and invasion of the exotic fungus, and we provide evidence that its presence is not limited to monospecific Italian stone pine (*Pinus pinea*) plantations but encompasses urban parks and even small patches of pines. An analysis of the pathogenic airspora performed by combining the entrapment of *Heterobasidion* spores present in the air with a PCR-based diagnostic assay indicates the spore deposition rates (i.e. a proxy of the concentration of spores in the air) expressed as n. spores m² h⁻¹ to be similar in urban parks and in monospecific pine plantations (P>0.05). Observations and experiments conducted in the Fregene Monumental Pinewood suggest the fungus may occasionally infect pruning wounds. However, this infection court should be regarded as of minor importance compared to freshly cut stumps. The prompt removal of dead and declining trees in the absence of preventative treatments against the fungus may explain the significant presence of the pathogen in parklands and urban settings. As weakening of root systems leads to increased chance of windthrow, threats associated with *H. irregulare* are posed not only by tree mortality, but also by tree uprootings, which may be important in recreational sites. It should be noted that up to 2/3 of a root system may be decayed before symptoms appear in the crown, hence the disease may be undetectable at an early stage through visual analysis. Potential impacts are relevant and the exotic pathogen has been recently included in the Alert List of the European and Mediterranean Plant Protection Organisation (EPPO).

Emerald ash borer management planning in a Canadian context *van Wassenae P.*

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Emerald Ash Borer (EAB) (*Agrilus planipennis*) is an introduced, invasive wood-boring beetle which currently threatens billions of ash (*Fraxinus* spp.) trees across North America. The beetle has already killed millions of ash trees across the American Northeast and Midwest, along with many millions of trees in Canada. EAB has also been found outside of its native range in Russia, and may even be present in Belarus and Ukraine. It will likely find

its way to continental Europe in the near future. EAB demands active management by municipal urban forest managers. At a minimum, municipalities will need to remove large numbers of standing dead trees due to the high likelihood of ash tree uprooting failure within two years of EAB-induced tree mortality, due to the rapid onset of root decay. More aggressive approaches may save some trees, but most ash trees in EAB-infested areas will likely be killed. This presentation discusses management approaches that may include infestation surveying, insecticidal control, pre-emptive tree removal, and tree replacement. Four general strategies, which include a wide range of management options and associated cost forecasting, are presented in this talk, along with lessons learned applying these strategies in several different municipalities.

The parasitic fungus *Ustulina deusta*: identification and way of decaying inside the tree

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Professional experience in management and assessment of urban trees of last ten years in Italy suggest us that wood decay by parasitic fungi is one of the main factors in mechanical destabilization of the trees. The growing demand of safety in modern life takes to the necessity of a more precise and earlier diagnosis of trees destabilization factors and particularly of the early identification in field (on the tree) of the wood decay by parasitic fungi. *Ustulina deusta* (now *Kretzschmaria deusta*) is a little known fungal species, but signaling about it in Italy are in continue increase. This paper intends to expose the results obtained in twelve years of direct observations in field (in seminatural and urban environments), supported with instrumental analyses on trees colonized by *U. deusta* (sonic tomography and drilling by resistograph). A particular attention will be given to the following matters: the preferential hosts of the parasite, the typical points of breakthrough of the fructifications on the trees, and the intensity in wood decay of the parasite.

A rapid molecular diagnostic assay for the detection and identification of wood decay fungi of conifers

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Wood decay fungi colonizing the root systems and boles of trees are often responsible for tree uprootings, thus resulting in significant damages especially in urban environment. Hence, an early detection and identification of hazardous wood decay agents may be pivotal during tree hazard assessment or phytosanitary surveys of urban trees. Molecular biology methods are increasingly used in diagnostics, providing efficient and sensitive tools for fungal detection. Furthermore, they allow the identification in the absence of fungal fruiting bodies. In 2007, a molecular diagnostic assay based on multiplex taxon-specific priming PCRs was developed and extensively used for the detection and identification of several wood decay fungi commonly associated to broadleaved trees. As a similar assay for the diagnosis of hazardous wood decay fungi of conifers was still lacking, in this study we designed and/or tested taxon-specific primers to be used in two multiplex PCRs for the detection and identification of twelve amongst the most widespread and harmful wood decay fungi of conifers in the northern hemisphere. Target fungi were: *Armillaria* spp., *Echinodontium* spp., *Fomitopsis pinicola*, *Fuscoporia torulosa*, *Heterobasidion annosum sensu lato* (s.l.), *Laetiporus sulphureus*, *Onnia* spp., *Phaeolus schweinitzii*, *Phellinus weirii* s.l., *Pholiota* spp., *Porodaedalea* spp. and *Stereum* spp. Sensitivity of this method was assessed in both multiplex end-point PCRs and SYBR® Green Real time PCR assays. The assay was validated on 129 environmental samples comprising either fruiting bodies or decayed wood samples collected from conifer trees. This method may represent a simple, rapid and comprehensive diagnostic tool suitable to complement tree hazard assessment or phytosanitary surveys in parklands and urban settings.

Use of the electronic nose for the detection of *Anoplophora chinensis* on standing trees: preliminary results

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For some years on Italian territory the presence of two harmful species of insects of Asiatic origin has been detected: *Anoplophora chinensis* and *A. glabripennis*. The larvae of *A. chinensis* dig tunnels inside the base of the trunk and in the roots. Their activity obviously involves a reduction of the stability of the tree leading to his death. The pest spreads quickly and the only way to contain it at the moment seems to be the removal of the affected plants. For this reason, it is very important the monitoring and the early detection of the

infestation. To this purpose has been initiated, with the support of Lombardy Region, a three-year trial in order to evaluate the effectiveness of the diagnosis of the electronic nose in the identification of affected trees by *A. chinensis* in areal affected of Lombardy. The samplings have been carried out with a pump that enables to collect the telluric air, sucked in correspondence of the selected subjects. The instrumental analysis has been subsequently carried out with sensorial analyzer (Pen3 Airsense - PCA Technologies). The first preliminary test has been done by sampling the telluric air on 74 trees, all belonging to the genus *Acer* of which 62 affected by *A. chinensis*. The affected trees have been subsequently removed, as a result of activities planned for the eradication and control of *A. chinensis* by ERSAF (Regional Agency for Services to Agriculture and Forestry), and then it has been possible to verify the presence of the pathogen. The processing of the data recorded by the instrument has shown, for each session of the analysis, the discrimination between healthy subjects and affected ones; these last ones contrary to the healthy ones, show a high dispersion, that could also be determined to the high grade of infestation of the subject. The preliminary results obtained from these tests are very encouraging as the possible discrimination between healthy and affected trees would allow to use the instrument to diagnose the presence of *Anoplophora*. The research must continue in order to confirm and explore the potentiality of this technique.

A special challenge: a pluriannual (2007-2014) project aimed at saving an historical tree and its associates

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A monumental *Platanus x acerifolia* was planted in 1810 just in the central terrace of the Grand Hotel Villa d'Este, Cernobbio (CO, Italy), one of the leading hotel in the world. It is the symbol of the hotel not only for his historical-botanical importance, but also for his focal position and view from the Lake Como. The patriarch is suffering for the bad handling of the '80s, when he was heavily topped with the false aim to reduce his mechanical problems, a big cavity at the base of the trunk originated from a wound of the '50s. Furthermore, some radical damages were done during the construction of buildings close to the tree. To let the things worst we face with the very bad condition of the soil (strong compaction and drawing up of new ground on the roots to create a recreational area for the guests). The new owner entrusted us to study its stability and to establish a plan for recovering. Long term studies are presented here with descriptions of

methods carried out. The studies on stability, repeated from 2007, show a progressive reduction in breaking and tipping safety, while the structural safety has been increasing. The current strong biological decline is due to the reduction of energy reserves. The distribution of chemical fertilizers had caused worsening situation for the delicate ecological condition of the tree and of the natural system all around. It has been developed a natural plant management program. The land has not been totally changed because it would be harmful for the biological activity and for logistical-operative difficulties. It has been distributed new organic substance with dosing specific bio-stimulants. The tree is in theory a system that generates and therefore is eternal. We will also illustrate the creation of a bypass of the root system that is no more functional (about 1/4) with the addition of three new young plane trees whose roots will contribute to the strengthening of the monument plant.

SESSION 3 – TREE MANAGEMENT IN A GLOBAL CHANGE SCENARIO

Gray city or Green City? Let's plan a green and sustainable future using trees wisely!

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The presentation will focus on the technical and practical solutions for the selection of trees that might be the best choice in urban environments for the next 100 years, given differences in urban sites (infrastructures, climate, soils, etc.), species attributes, management requirements and climate change. The presentation will be divided in the following parts: a) climate change effects in the urban environment and b) selection of planting material in a global change scenario. More specifically, factors to consider when selecting trees for city streets or park landscapes include pruning requirements and response, tree stability, drought tolerance, disease resistance, catastrophic insect pests, soil adaptation, complementary planting, shade or sun adaptation, provenance, and adaptive cultivars. As a matter of fact, while we are all aware of all the potential benefits of trees in the urban stands, only in the last ten years some efforts have been done to select plants for this kind of use. On the other hand, to meet all the expectations, we need to select trees that will tolerate the climate change which is predicted to result in altered rainfall patterns with an increase in the frequency and severity of summer drought across different areas in both hemispheres and, probably, in extreme weather events (heavy storms, tornadoes, etc.). Droughts are

predicted to be most significant in the Mediterranean-like climates and this will strongly affect survival and growth of newly planted trees and will probably influence the development of diseases and tree pest resistance. Not only are the short term effects on growth or survival in extreme years important, but the long term impacts on growth have to be considered in selecting planting material. In this scenario possible adaptation measures include changes to establishment practices and tree management, better matching of species to site, both under current and future climates, and the planting of non-native species and provenances in anticipation of climate change. Current opinion is to encourage the planting of local provenances of native species, citing adaptation of provenances to local conditions, and the requirement to maintain biodiversity and a native genetic base. However, local provenances may not be able to adapt to a changing climate, particularly given the rate of change predicted. Sourcing planting stock from regions with a current climate similar to that predicted for the future may provide one option, although care must be taken to ensure that suitable provenances are selected which are not at risk from, for example, spring frost damage as a result of early flushing.

Climate change and landscape modifications: re-thinking of urban vegetation

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In the last few years the shores of Lake Maggiore (VCO, Italy) have suffered some intense atmospheric events. In mid-summer 2012 a small twister in Verbania compromised one of the most important Italian trees patrimony and in late autumn 2013 a tempestuous wind devastated the touristic harbour in Pallanza. Some of the urban trees, in rows, in parks and in the playgrounds near the lake shore were damaged and, in some cases, fell. Luckily there was little damage for the inhabitants but significant economic and environmental losses. These new interconnections between climate, vegetation and people will generate a new urban landscape but also new issue, particularly during the transitions period. What we mean as "transitions period"? It is the time required for nature and man to recreate a shared landscape, where the two components are in balance of power. The focus of this work is the analysis of the interconnections between the decision and policy makers and the new landscape structure in the urban area. The main actors of this scenario are the planners, the council administrators and the residents: by means of participated planning and

social mediation the three contributors will have the responsibility of designing a new sustainable landscape. The role of the planners will be fundamental for two reasons: the identification of objective factors for the determination of the new rules for the design of new landscapes and a new concept for the cohabitation between man and nature. The role of the politics and administrators will be mainly to create the social conditions for the redrawing the city with new concepts and to answer the need of the citizens. Therefore the climate changes, with a shared management, may become a new important factor of modernization of the urban landscape; to achieve this target we need to open our mind and set aside the concept of “green in the city” for the new one “green and the city”.

A new national project - planning the green city in the global change era: urban tree species function and suitability for predicted future climates (TreeCity)

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The alleged climate change may threaten the survival of trees and urban green in the cities, at least in the present form, compromising the related services and benefits. With a proactive management strategy (i.e. acting in advance of a future situation), however, vegetation greening and belts of peri-urban forests have strong potentials to mitigate the impact of global warming phenomena such as extreme heat waves. In this context the research is called to produce solutions for the selection and choice of better adapted tree species and the most appropriate kind of management. The national project TreeCity, that involves eight different scientific institutions, plays a key role in delivering knowledge and services useful to policy makers and urban planners to address global change effects on urban environments. It aims to fill critical knowledge gaps by combining and connecting climate-related scientific multi-disciplinary approaches. TreeCity comprises 4 sub-projects with specific purposes: i) urban plant systems as open air laboratory to evaluate the quality of the urban environment and stress conditions; ii) potential contribution of the urban ecosystems to the quality of life; iii) evaluation of the resistance of tree species to stress by simulating an urban climatic future scenario (2050); iv) integrated modeling. The talk shows the structure of the project and its achievements.

Silvicultural and arboricultural management of a nineteenth century landscape

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Historic parks and gardens are a fundamental cultural resource in Italy, however they are endangered by insufficient and often inappropriate management. Preservation laws and practices for historic monuments are often built around archeological, historical and architectural concepts and are inappropriate for a successful management of trees and vegetation. This is particularly true in landscape style parks, where a careful balance between regeneration of the park's "forest" and the conservation of veteran trees needs to be reached, and choices have to be made to preserve the scenography of the park through a well planned management of an ever-changing forest structure. The restoration of the garden of Villa Revedin Bolasco in Castelfranco Veneto (TV, Italy) has offered an excellent opportunity to propose innovative management solutions. The 8 hectares park was laid out and planted in the second half of the nineteenth century, over a pre-existing garden designed in the baroque style. The park style is the Lombardy-Venetia variation of the English landscape garden, that became very popular throughout the nineteenth century, leading to the transformation of many formal gardens in landscape parks. The relatively small size of such park has forced the designers to employ very detailed solutions to create the picturesque scenography. A restoration and management plan was developed based on a detail study of the existing vegetation. A Geographic Information System (GIS)-based tree inventory was used to point out changes in the tree stands spatial distribution, comparing it with original plans of the park, and information deriving from old photographs and postcards. Needs and priorities for tree stand regeneration and for the planning of management practices aimed to the long term preservation of the original picturesque character of the landscape were developed. In the effort of maintaining many of the historic trees and assuring, at the same time, the safety of visitors, innovative techniques have been employed to evaluate the health and potential risks of veteran trees. In order to assure high quality standards in the implementation of the project, particular attention was given to the technical specification and in the contracting process. In the selection of the contracting firms a 70% score was attributed to the technical quality of the bid and 30% to the economical offer. This choice has allowed us to select candidates on the basis of their technical

and scientific knowledge and operational ensuring the best execution of the works, preserving the natural heritage of the park.

Private trees management in urban areas: positive experiences

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Urban trees must be managed with effective management policies, based on an in-depth knowledge of the natural resource itself and of optimal care and control methodologies. While in the institutional arena we are on the right path, in the private sector we are still far away from it, although the mentality is slowly changing. In this talk we'll present an ongoing implementation effort for the management of several thousand trees planted in the gardens of real estate properties owned in Rome and in Milan by a prominent private pension institution. Due to significant expenditure, modest results, damages and dangers, the technical direction of the institution decided to change their *modus operandi*. Purposes of the work are: i) to eliminate existing and future critical situation, ii) to minimize the related objective responsibilities, iii) to operate correctly on trees and iv) to reduce the expenses. A census has been conducted for all the trees; they have been evaluated and inserted into a five-year management plan. All data are managed with a specific software (R3 GIS). Actually the works planned for the first year on trees are being performed. Carrying out the executive directive, several has been the difficulties faced: formation and control of the "sensitivity" of the different samplers, contrasts with users about the kind of work established and, lastly, the supervision of contract companies, not always qualified. The 17%, of the total 2600 trees submitted to the census, revealed significant problems (Classes C, D and CD), nearly always caused by incorrect treatment and/or planted in the wrong places. Where possible, they have been cared, otherwise fallen. The remaining will be properly cared. By now, there is the resetting of the, clear or potential, critical issues. In the near future significant savings will be recorded. The expected results from here to 2016 are: healthy trees, properly managed, safe and, above all, improved environmental and life of the citizens quality.

Repeated pruning cycles differently affect tree structure and physiology of *Acer pseudoplatanus*, depending on how pruning is carried out

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The aim of this work was to evaluate the effects of repeated pruning interventions using different pruning methods on growth, physiology and breaking stress of sycamore maple (*Acer pseudoplatanus*). In February 2008, established maple were pruned in order to reduce leaf area by 1/3 according to the following treatments: 1) topping, 2) removal cut, 3) reduction cut, and 4) control. In control trees, 6 imaginary cuts per plant were drawn and monitored through the experiment. In February 2010, trees were pruned again using the same treatments. The experimental design was a one-tree per replicate complete randomized design with 7 replicates. Leaf gas exchange, leaf greenness index and shoot starch content were measured several times in three growing seasons following the first pruning event. Biochemical parameters affecting photosynthesis were calculated from CO₂ response curves. Leaf area and leaf mass per area were measured once per year. Wound closure was measured on all cuts using the Woundwood Coefficient. Length, base diameter and slenderness of the pruned branch, of the leader, and of lateral shoots were measured yearly. The stress required to cause the failing of the attachment between the primary branch and 1) the lateral branch which was selected as new leader, 2) the lateral branch originated after topping which was selected as new leader, and 3) the lateral branch normally attached to a primary branch which was selected as imaginary leader were measured 2 years after pruning. Results showed that different pruning methods affect tree structure and physiological processes.

Biogenic Volatile Organic Compounds emitted from peri-urban forest fires

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We provide a short overview of the state of the art on the emissions of Biogenic Volatile Organic Compounds (BVOCs) from peri-urban vegetation combustion, and the critical issue that makes their determination still difficult. In particular, we review factors limiting forest fires in nature and, conversely, the influence of leaf isoprenoids on flammability. The uncertainties on the emission of BVOCs in various stages of combustion are described, together with those limiting their detection in vegetation

combustion plumes. Finally, the importance of standardizing the methodology to assess BVOC emissions during the combustion stages, and of finding the relationships between BVOC signature and vegetation composition of different ecosystems occurring in regions with similar climate characteristics are emphasized.

SESSION 4 – TREE RISK ASSESSMENT AND BIOMECHANICS

Arborists: the hidden threat to Arboriculture!

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Heritage trees, whether they have that status through scientific value, cultural associations or visual impact, are arborists' greatest asset in the struggle to get the general public to engage with trees. People like stories, which is one of the characteristics that these special trees have in abundance. Getting the public interested in these cultural and historical connections promotes the positive perceptions of trees generally, which is essential if arborists are to have a significant influence in the development of sustainable cities. This is, of course, a strategic aspiration, but one that is not well understood by arborists in the United Kingdom (certainly), and around the rest of the world (possibly). This is evidenced by the continual loss of valuable heritage trees, with arborists driving the erosion of this irreplaceable natural asset. On a daily basis, ordinary working arborists are so confused by the complexity of risk management that they are choosing to remove trees on safety grounds rather than take the risk of ending up in court. Those same arborists have been so indoctrinated with the mantra of not topping trees that this absolutely valid management practice has been virtually written out of the specification book. The result is arborists are felling a generation of mature and old trees today that are the source of the veteran and ancient trees of tomorrow. While arborists have been focused on the minute detail of their specialism, trees, many have missed how tree management fits into the wider urban context. The mindset that old trees should be replaced with new trees works fine in the forest, but it has no place as a dominant principle in modern arboriculture. Arborists, and the decisions they make, are the core of the problem and arborists need to be at the heart of the solution. In this talk will be explain why simplifying risk management and the reintroduction of crown reduction into mainstream tree pruning are two changes that will slow the loss of irreplaceable trees. There is an urgent need to shift the strategic arboricultural focus from the

detail to a wider community perspective, and arborists are the professionals best placed to drive that change.

Tree biomechanics: where are we now?

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The talk will provide an overview of recent advancements from North America in tree biomechanics including a participant's perspective on Tree Biomechanics Week 2010 and 2013 and new studies utilizing NASA developed camera technologies.

Urban tree heritage management: from visual tree assessment to tree life expectancy in an urban contest. The experience of city of Turin

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Tree stability assessment arrived in Italy more or less twenty years ago; in that period we started to know, study and appreciate arborists and scientists like Alex Shigo and Klaus Mattheck: it was the beginning of modern arboriculture in Italy. What's happened in this twenty years? Tree management is a sensitive activity strictly related to public safety and at the same way is really connected with citizen's sensibility that appears in every tree removal operation. Tree stability assessment evaluation is currently used in urban management program with different solutions depending on several criteria. Italian urban tree heritages are getting older and older and show a lot of stress factors mainly depending by a contest not so favorable, tree felt caused by storm and strong winds are frequently than in the past, financial resources dedicated had a strong reduction in these last five years. In this scenario not so optimistic, it is dutiful make a serious reflection about tree management methods in use in Italy, discuss about tree assessment sustainability and why not starting to consider life expectancy and tree health and well-being for tree lined boulevards. We would deal with this strategic items using Turin experience as an example of a public administration involved for 25 years in finding an optimal way to manage its old and great urban tree heritage.

Balancing risks from falling trees with the costs of risk control: quantified tree risk assessment validates balancing the likelihood and extent of potential harm from tree hazards with the many costs of risk mitigation

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Robust risk management follows a process of prioritisation whereby the risks with the greatest loss and the greatest probability of occurring are addressed first, and risks with lower probability of occurrence and lower loss are addressed in descending order. However, in practice this process of assessing overall risk can be a difficult, and balancing resources used to mitigate risks with a high probability of occurrence but lower loss versus a risk with high loss but lower probability of occurrence can often be mishandled. Good estimates of tree and branch size and the occupation of land beneath the tree can be achieved with little effort, and where appropriate, measurement can provide greater accuracy. Combining these assessments with an estimate of the probability that the tree will fail, the arborist can provide a reasonable measure of overall risk that can then be balanced with the costs of risk control to inform a proportionate management decision. Using Monte Carlo simulation to calculate the overall risk from ranges of input values, the quantified tree risk assessment approach enables the quantification of risks from falling trees to meet a consistent standard and leaves an audit trail that is open to scrutiny. Providing numerical assessments that allow comparison with published thresholds of tolerable and acceptable risk, this approach enables the balancing of risk mitigation with the cost of the mitigation measures, not only in monetary terms but to consider also diminution of the tree asset and associated benefits.

Tree hazard assessment and monitoring in Florence

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Trees natural disposition to lose limbs and fall within urban settings generates risks associated to harm and property damage. The municipality, as in the city arborist office, has the duty to monitor the city's tree stock in order to minimize these risks. Tree hazard assessment and monitoring in large tree stocks often result in strongly delayed data feedback. This leaves more immediate options in risk management by using "target localization"

and “frequency” studies in public areas. Tree hazard assessment and monitoring in large tree stocks also require relevant resources, involving highly qualified and trained professionals. Optimization of scarce resources may be obtained by using the following method: i) establishing priorities and acceptable risk levels in order to define tree monitoring frequency; ii) identifying trees that actually need to be assessed. We have created a “Heritage Trees Monitoring Program” aimed at making a more efficient tree monitoring process. It allows for individual tree management by arranging trees in “risk areas”. These areas are designed around the following criteria: 1) vehicular traffic, 2) pedestrian traffic, 3) use of spaces by the public, 4) tree conditions and 5) exposure to atmospheric events. The above criterion has led us to the formation of four “risk areas”, ranging from very high risk to low risk. We have assigned a specific tree hazard assessment monitoring policy to each area. The first phase is being tested on a limited portion of Florentine territory, consisting of 150 hectares of green areas that include 12,000 trees.

Tree stability evaluation: the importance of monitoring programs

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One of the main issues in tree stability evaluation is the redaction of adequate monitoring program. Generally, after tree analysis, arborist indicate the maintenance operations required and the timing for periodical inspection. Field conditions, tree species and biomechanical defects influence planning. Three old trees (*Populus* spp.) located within Golf Club Verona (Sommacampagna, VR, Italy) were monitored periodically from 2010 up to nowadays. In addition to visual assessment, we used sonic tomography to evaluate development of internal defects and planning the maintenance. The aim of this work is to identify a methodology for observing significant difference in tomograms, in order to understand the appropriate interval between instrumental analysis.

Procedures to manage tree risk assessment in extensive green areas

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This handbook has been published in 2011 in Italy with the support and coordination of SIA [Società Italiana di Arboricoltura - International Society

of Arboriculture (ISA) Italy Chapter] and the strong contribution of some important Italian public authorities. It is the result of two years of constant work, discussion and experiences shared of a multidisciplinary group formed by professional consultants, municipal arborists and public technicians with specific experience in tree stability assessment and tree heritage management. In Italy tree stability assessment, with twenty years' experience, is managed with different methods and instruments, basically developed for urban contests; VTA (Visual Tree Assessment) is the most applied method and has got a legal value, it is recognized and common used by public administration and periodically updated beyond international standards by SIA. Italian experience in tree risk assessment is based on urban environment, contest in which every single tree has a particular ornamental and landscape value, situations characterized by an high level of vulnerability, with a tree heritage often strongly conditioned by urban transformation that has damaged tree roots and canopies. All this background justify the necessity to use the best and complete analysis to evaluate tree stability and to attribute for each tree a precise "tendency to failure category". The main result obtained in this work was to provide a formal landmark about tree risk assessment in extensive areas and to indicate the minimum steps for their managers (public or private) to check and reduce the risk. This guideline probably represents a first step of a process, but has a great value coming from the participant experiences shared and from the comparison with some Public Prosecutor's Office who recognized the effort and the rational approach.

Using the ISA Best Management Practice Method for tree risk assessment
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Assessing trees for risk is an important component of managing trees. The International Society of Arboriculture (ISA) has developed a new methodology for assessing tree risk as described in the ISA Best Management Practice (BMP) for tree risk assessment. The methodology involves assessing the likelihood of tree failure, the likelihood of impact and the consequences of impact to determine risk. This talk will outline the methodology and how to it, including a number of example tree assessments. In addition, the Tree Risk Assessment Qualification (TRAQ) program for qualifying arborist in the use of the BMP system will be discussed.

Views from the top: an expedition to the redwood canopy

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The redwood forests of coastal California (USA) are a unique environment, found nowhere else on Earth. These forest giants are also arks of biodiversity, and can teach us many lessons about the lives of trees and other organisms. This talk draws from lessons learned during a climbing expedition with Dr. Steve Sillett, the foremost redwood researcher in the world, during which the team used sonic tomography to assess the level of internal decay in the highest reaches of the redwoods.

From biomechanics to tree-statics

Rinn F. (invited speaker)

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Urban green is more and more appreciated by the general public and, as a consequence, by politics too. However, safety expectations grew up in the same way as the desire to protect natural habitats as long as possible, even in the urban environment. Thus, cities have to provide urban green fulfilling many different and partially antithetic tasks at the same time. For providing natural habitats, carbon sequestration, air quality, and esthetic aspects, the importance of old trees is far bigger than the impact of young trees. But, mature urban trees tend to decay, often due to soil works, past pruning, soil compaction, or other typical urban site conditions. Arborists thus have to be able to assess the risk by urban trees, especially by mature ones. This requires a deep understanding of biomechanics. On one side and in terms of strength loss of the tree as a structure loaded by wind, the location of internal decay is more important than the size of it. On the other side, mature trees need much less remaining shell wall compared to young trees. And, wind load mainly depends on tree height. Thus, wind load reduction is mostly twice as high as the reduction of tree height by pruning (or even more).

R3 TREES: an innovative tool for the integrated management of urban green areas

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We are used to enjoy parks, recreation areas and trees along roads in our cities. Behind this assets there are many activities, which are necessary to keep the places save and enjoyable: regular maintenance works, periodic assessment of trees, monitoring of playgrounds, documentation and accounting of work done. R3 GIS has developed a WebGIS platform to document and manage all activities connected to the maintenance of trees and urban green areas in general. With R3 TREES all information about public greens and their objects (stock of trees, lawn areas, street furniture, pavements, hedges, etc.) can be managed and their maintenance and care (whether lawn cutting jobs, pruning trees, pest control or fertilization) are programmed and documented. R3 TREES is used by municipal administrations as well as by companies and professionals, since it helps to optimise organisational and decision making processes and because it offers a detailed and up-to-date database comprising all aspects of trees and public greens management. Different levels of access permission can be set according to the user's position and function. Interfaces for tablets and smartphones allow you to access and update the database also from the field. In the presentation the innovative management model is described, with examples from Italian and Austrian customers, showing different approaches to monitoring trees and managing urban green areas.

Orebla, a simple model for tree risk assessment

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Analytical methods for tree stability evaluation are based on assumptions that are not supported by empirical evidence, for instance the t/r index or SIA, or are too complex to be used in practical landscape. Here we propose a new method, implemented on Excel® and named Orebla (the inverse of the word tree in Italian), which was developed with the objective of providing an aid in the diagnostic process and useful as a tool to verify the opportunity and the effectiveness of remedial actions. Orebla tries to reproduce the real situation in which the tree lives, by means of a modeling of the shape and dimensions of the various organs, and then use a biomechanical approach for the estimation of some variables significantly correlated with the likelihood of failure. This approach, an advanced tree risk assessment method, does not replace the visual assessment and instrumental techniques currently used, being them the only methods which identify, in different ways, the presence and the extent of structural defects or wood decay. The

modeling analysis, using an estimate of the stresses exerted in specific cases (rough estimate due to the anisotropy of the woody structure, the structural complexity of the tree and the equally complex interaction with the dynamics of the wind), allows identification of the orientation safety factor “real”, by means of the relationship between variables significant from a biomechanical point of view.

Study of Italian stone pine assessment in urban environment

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Tree risk assessment is a diagnostic practice now widespread. Applied in compliance with various operational protocols, it ordinarily consists of a visual analysis, possibly followed by specific investigations using deductive or inductive technical devices. As empirically effective if applied to the most common tree species, it is much less effective on different species of conifers, particularly on *Pinus pinea* (Italian stone pine). The operating protocols currently in use derive from a unique tree mechanical model that, however, cannot be extended to all tree species subjected to evaluation. Interestingly, the anatomy and the morphophysiology of the Italian stone pine have been recently studied suggesting that this species has its own mechanical model which differs significantly from that traditionally used, affecting the reliability of the visual and instrumental analysis. Given this assumption, the population of Italian stone pine in Riccione (RN, Italy) has been studied in order to: 1) define a specific method for the visual analysis of Italian stone pines, 2) classify trees, 3) carry out in-depth analysis using inductive instruments, such as pulling test, in order to relate the external characteristics of pines with the static mechanical behaviour, and 4) implement a database of structural failure of pines to highlight the relationship between their physical characteristics, static mechanical behaviour and susceptibility to structural failure under natural conditions. First results seem to confirm the reliability of the mechanical model developed for Italian stone pine initiating the establishment of a protocol for visual and instrumental stability specific for this pine species.

A protocol for risk assessment of veteran trees

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The aim of the study was to develop and implement a protocol for the risk analysis and assessment of trees in an historical park open to the public. One of the main goals of historic park management plans is the preservation of veteran and “founding” trees. Many of the surviving “founder” trees had undergone inappropriate management practices, which lowered their life expectancy and greatly reduced their biomechanical safety factor. The protocol developed for the assessment of these trees was based on two types of analyses: a biological evaluation of tree health and well-being and a new method for biomechanical evaluation of tree stability. The biological evaluation of tree health is a fundamental step to assess the ability of a veteran tree to react to management practices involving biomass reduction. Specifically, metabolic activity of the root system is evaluated through the measurement of the root starch content which has been shown to be related to tree response to management practices. The protocol has been tested in the evaluation of the veteran “founder” trees of Parco Revedin Bolasco in Castelfranco Veneto (TV, Italy).

Development of a tree risk index associated with ornamental trees inside historic parks. Case study of Villa Lante, Bagnaia (VT), Italy

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Historical gardens and parks are a significant part of cultural heritage. They are considered cultural assets which show the action over nature of human imagination and design. The management of these parks, where a close relationship between vegetation and architectural elements values can be recognized, is a complex task that involves many experts in the field of cultural heritage conservation, arboriculture and silviculture. In this context, one of the most important problem is to assess risk associated to trees next to monuments and pedestrian paths. In this perspective, this work aims to develop a tree risk index based on three factors: the hazard factor [P], the contact factor [K], and the damage factor [D], corresponding to tree failure probability, sensible targets and magnitude of potential damage, respectively. These factors are arised from parameters related to dendrometric attributes, phytosanitary status, proximity to buildings and artifacts, tree aesthetic value. They were derived both from field data and spatial analysis performed in Geographic Information System (GIS) environment. Four risk categories (high, medium-high, medium-low and low) were developed. Tree risk index was tested on 122 trees located in the historical park of Villa Lante in Bagnaia (VT, Italy) an example of

renaissance monumental compendium. Trees next to monuments and artifacts experienced a very high level of risk, whereas a low level of risk is associated to few trees far from monuments and characterized by a good phytosanitary status.

Checktrees.com - collect, update and share data about trees

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An internet portal www.checktrees.com was developed in cooperation of the Forestry Faculty of Mendel University, Brno (CZ) and a private company Safe Trees, Ltd. Aim was to join information sources about trees in urban areas and along roads and publish them in form to be used by tree owners, arboricultural companies and consultants. At present, more than 650,000 trees are introduced in the system, which enables registered users utilize the data for management plans, tree appraisals and various types of surveys. One of crucial areas of interest is an evidence of installed cabling/bracing systems with possibility of their regular revisions. Large part of the portal services are free of charge and available in several languages on various levels of data access. Present experience shows increasing interest of public for the data about trees in their neighborhood and continual use of the system by arborists.

The Neto Park renovation project using the digital method - Calenzano (Florence, Italy)

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The Neto, which spans 700 m², is a historic and landscape-style park owned by municipality of Calenzano (FI, Italy), located in the southwestern part of the city of Florence. The project for the purpose of properly preserving the biologic components of the park started in 2012, with a digital method that allowed us to simplify and optimize the services provided for the maintenance of the property. At first we conducted a geo-referenced survey of the entire park, including plants, roads and bodies of water. Later we recorded the Visual Tree Assessment (VTA) profiles for all the arboreal

species and many of the shrubs for a total of 1140 species. For each plant, we collected 70 data, about the health and the planned maintenance services. We were eventually able to collect over 80,000 data. Based on the information we had from the geo-referenced survey and the data we obtained from the VTA profiles, we created, through the use of open-source Geographic Information System (GIS) software, a digital map and a cartographic database that are correlated to one another. The software gives us the opportunity to efficiently manage all the data and achieve a better monitoring of the maintenance services from both a technical and economic aspect. In order to increase the functions of this digital method, we put a barcode label on every plant. Using an optic reader linked to a pc or tablet, we can easily read all the data we have collected about one plant or bush. This system is fast and extremely useful for the technicians who work to maintain the park; it allows them to be constantly informed about the conditions of the plants and act fast if a quick intervention is needed. Furthermore, it allows the registration (in real time) of the cultural practices executed and thus have a database that is constantly updated.

Installing cables did not affect annual radial increment in co-dominant stems of red oaks

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Arborists install cables to support and reduce the risk of failure of co-dominant stems. The adaptive growth hypothesis predicts that doing so will alter radial increments in the stems because their motion will have been restricted. To facilitate the wind-induced motion of cabled stems, cables made of more extensible material have been suggested as an alternative to systems made of steel. Cables made of steel and polypropylene were installed in red oaks (*Quercus rubra*). Trees were harvested after five years and annual radial increment was measured for the previous sixteen years in four directions (incident and orthogonal with the direction of the cable) on five discs removed from two co-dominant stems that were cabled in each tree. We used analysis of variance to determine whether annual radial increment differed among cabling treatments, at different heights in each tree, and with respect to directions of the cable. Annual radial increment did not change in response to the installation of cables with one exception: in the three years following installation, it was greater incident with the cable on two discs immediately proximal and distal to the eye-bolt in each co-dominant stem to which steel cables were attached. The exception appeared

to be due to the formation of wound wood. The results contradict the adaptive growth hypothesis, but this was likely due to cables not restricting wind-induced motion to the extent achieved in previous studies.

Designing special anchoring systems for special trees

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Some trees with high mechanical problems are special and have to be conserved as long and as complete as possible. Giving them a chance to survive and this with safety for the visitors or neighbors. Also the anchoring system needs often to be the most aesthetic or hide possible. The design of this special anchor systems, begins with an analysis of the mechanical properties of the trees and its parts and the aerodynamic needs. Knowing that we are able to design the specific anchor that helps the tree stay long and safe. The exposition will explain the designing and construction process of different anchor system: aerials in compression, aerials in tension, buried anchors, etc., and some more traditional but done in really old or big trees.

The effect of leaves and steel support cables on the dynamic properties of northern red oak (*Quercus rubra*) with co-dominant trunks

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Free vibration testing was performed on ten northern red oak (*Quercus rubra*) sample trees with co-dominant trunks during periods when leaves were and were not present. Five sample trees had steel support cables installed between the co-dominant trunks according to Part 3 of the ANSI A300 standard: Supplemental Support Systems. An accelerometer mounted to the sample tree at the height of the co-dominant union measured the acceleration experienced by the main trunk during the free vibration testing. The damped natural frequencies of the sample trees were determined by performing a power spectral density analysis on the acceleration time history. The damping ratios of the sample trees were determined by envelope curves fit to the acceleration time history. Significant effects were determined by fitting linear mixed effects models to the frequency and damping ratio data. When leaves were not present, trees with steel support

cables had significantly higher damped natural frequencies than trees without steel support cables. When leaves were present there was no significant difference between the damped natural frequencies of trees with and without steel support cables. There was no difference between the damping ratios of trees with and without steel support cables, regardless of leaf condition. Damping ratios when leaves were present were significantly larger than when leaves were not present. The results of our study support previous research efforts demonstrating the important role that leaves and higher order branches play in tree dynamics under the framework of multiple resonance damping. These findings have important implications for practitioners, and future studies should consider the combined effects of cabling and pruning.

Determining strength limits for standing tree stems from bending tests

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Non-destructive tests are essential in urban tree risk assessment. One of the commonly used methods, the pulling test method, relies on wood properties derived from testing small clear samples of green wood. In the past, such data had been suspected to overestimate the strength of intact tree trunks. Here we propose and test a novel method to measure the limit of proportionality directly in large standing trees. Material properties determined in tests on small specimen were not correlated with tree strength derived by testing entire tree stems. Exceeding the proportional in bending tests on entire stems caused local fiber buckling on the compression side. Thus, it is important to test strength thresholds on entire tree stems using the new field method described here in order to improve the credibility of the pulling test method. Furthermore, we show that stiffness measured during non-destructive pulling tests is a good indicator for yield strength in bending for both intact and damaged tree stems. This confirms that pulling tests actually measure data that are relevant for strength assessments.

Determination of the tree safety factor – error source analysis

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Tree safety factor is a useful parameter for characterization of the tree-related risk. First part of the talk deals with the uprooting safety factor

determination based on pulling test. For the correct interpretation of the safety factor we need to know the error of the safety factor. Error sources are the extrapolation of the pulling curve, inclination measurement, force measurement and wind load analysis. The second part of the talk deals with the tree trunk braking safety factor determination, based on acoustic tomography. The possible error sources of the braking safety factor determination are the acoustic tomography test result, the tree trunk geometry determination, the wind load analysis, and the wood material strength. The final tree safety factor is the lowest safety factor among of the uprooting and the braking safety factor. An example of tree safety factor and the related error determination will be presented on a large beech tree.

Interpretation of instrumental data in tree stability evaluation: limitations of tools to obtain scientifically correct results

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Several tools help arborists for tree stability evaluation: electronic drills, sonic tomography, electrical impedance tomography, tensile test. The estimate of parameters such as strength and elasticity provide fundamental information for the analysis of wood mechanical properties. The aim of this work is to compare different methods and tools for tree stability evaluation, and to characterize their peculiarity. The study was performed in a tree-lined road in Bologna (Italy). During the field test survey, 110 *Ulmus* spp. were examined with a preliminary visual analysis, and evaluated using four tree stability tools: two sonic tomographs (Arbotom® and Picus®), electrical impedance tomograph (Treetric®), and impulse hammer. This work will be integrated with tensile test and study of root zone (Root finder®) to outline the trees stability.

Pruning did not affect sway response of large sugar maples

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In the USA, two common pruning types are thinning and reduction. Reduction shortens distal branches in the crown; thinning removes later all branches without altering crown dimensions. Previous work has shown that both pruning types reduced the frequency and wind-induced bending

moment of open-grown trees, but not the damping. Understanding the effect of pruning on these parameters is necessary to investigate the likelihood of wind-induced tree failure. Considering logistic challenges associated with testing full-size, open-grown trees, investigations of pruning have all involved smaller trees. Our objective was to determine whether pruning altered the frequency and damping of large, open-grown trees. We induced a sway response in 8 large sugar maples, and measured axial displacements in the trunk. From the time history of displacements, we calculated the frequency and damping. Next, we pruned 4 trees by approximately 10% of crown height and thinned 4 trees by removing 10% of crown area, which two International Society of Arboriculture (ISA) certified arborists estimated visually. After pruning, we re-tested each tree as described above. We used analysis of variance to determine whether pruning altered frequency and damping and whether its effect was consistent between pruning types. Reduction did not alter frequency or damping; thinning did not alter frequency, but decreased damping. Although limited by a small sample size, this study is the first to investigate the effect of pruning on the sway response of large, open-grown trees. The lack of effect of either type of pruning on frequency and the decrease in damping induced by thinning suggests that pruning mature trees to decrease the likelihood of failure may require more severe pruning. There may be adverse physiological consequences of more severe pruning on older trees.

Results of a 20 year assessment of damage to the roots of street trees in London

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In 1994, an investigation was undertaken into damage to the roots of street trees severed by telecommunications installation in a London Borough. Workers re-opened over 1,100 trenches and arboricultural teams recorded detailed data, including all roots found, measuring: diameter, whether severed, depth and distance from the parent tree. In 2013, 1,068 of the trees were re-inspected and Global Positioning System (GPS)-plotted, losses and tree condition were recorded. The data of the 2013 survey were merged with the 1994 data and the results analyzed. In 1994 damage was categorized and classifications colour-mapped using GPS layers. Trees with no recorded damage or where no roots large enough to measure were found were used as controls. GPS overlays clearly display patterns of tree loss and survival. Data analysis showed that surviving trees had continued to grow in girth

and that differences in percentage losses between damaged and control trees was insignificant. It proved impossible to accurately “filter” out factors which may have led to tree losses – however, these are likely to be constant for both controls and damaged trees. The study is valuable because of the time span and the fact that the trees are mature specimens in an urban situation. The study questions the belief that trees will necessarily fail following extensive root loss.

Assessing the impact of root loss on tree stability

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According to the International Tree Failure Database (ITFD), about 1/3 of all recorded tree failures are related to the root system. The assessment of trunk decay and the impact of trunk decay on the likelihood of tree failure has progressed rapidly in the last decade. Less is known about the impact of root loss on tree stability. This talk will address the impact of root cutting on tree stability. It will provide research results from four sets of root cutting experiments on maple, oak and pine species. Information will be provided on the general implication of this research on the location of both linear root cuts (trenching) and the assessment and impact of cutting individual roots at the root collar.

Effect of aspect ratio and included bark on branch attachment strength

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Branch union failure is a common problem arborists contend with on a regular basis. Previous studies have investigated factors that contribute to branch attachment strength. These factors include branch/trunk diameter ratio (aspect ratio), included bark, and branch attachment angle. It is known that defects such as included bark can negatively impact branch attachment strength. Many studies have found that branches with a small aspect ratio have a stronger union with the trunk, while others suggest that unions with a large aspect ratio (co-dominant stems, or forks) are not an inherent weakness. It remains unclear which of these factors most strongly influences attachment strength, or if significant interactions exist among the factors. A study was performed to investigate the effects of aspect ratio, included bark,

branch attachment angle, branch union morphology, and their interactions, on branch attachment strength. Branches with aspect ratios ranging from 0.3-1.0, with and without visible bark inclusions, were selected from *Acer rubrum* "Florida Flame" and *A. platanoides* trees for destructive analysis. Branches were pulled with an electric winch until failure occurred at the branch-trunk union. Maximum force at failure was used to calculate breaking stress. A secondary purpose of this study was to examine the external morphological characteristics of branch unions to determine the predictability of branch attachment strength based on visibly recognizable characteristics. A better understanding of how these visible characteristics affect attachment strength will help arborists better recognize weak branch unions. This talk will discuss results from this study and explain which characteristics correlate with weak branch unions.

Improving sprout attachment strength for crown restoration of storm damaged trees

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When urban trees are injured in severe storm events, they often respond to this damage by sprouting new branches, often from latent buds. Sprouts replace the branches and foliage lost when the tree was damaged, and may also assist in reducing the spread of discoloration and decay following injury. Although it is believed that at least some sprouts are weaker than normal branches, little empirical evidence exists to support this. Many of the surviving shade trees will require restoration pruning that incorporates sprouting branches as part of the new crown. Arborists have few research-based guidelines on how to craft strong trees from storm-damaged sprouting crowns. Many sprouts originate from ends of damaged branches or heading cuts or grow upright from horizontal limbs, and are necessary for damaged trees to begin restoration. Understanding the strength of attachment of these sprouts is essential to elevate our current understanding of restoration pruning. This talk will cover current recommendations for the care of storm damaged trees, with a focus on crown restoration treatments. Recently completed and ongoing research investigating crown restoration treatments, with support from the TREE Fund, will also be presented.

Residual growth stresses in *Acer pseudoplatanus* and *Tilia cordata* enhance the breaking resistance of tree stems

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Growth stresses occur during cell maturation and can be considered in a technical sense as pre-stresses, increasing the strength of green wood. Pre-stresses occur in all three planes causing a tensional longitudinal pre-stress and compressive tangential and radial stresses in a tree's trunk. In this work the longitudinal pre-stress of 10 *Acer pseudoplatanus* grown in a forest situation at Aberdeen (Scotland) and 36 *Tilia cordata* grown as avenue trees in Munich was investigated. The pre-stress measurements were carried out by using the sawing method and the single hole method for *T. cordata* and using the single hole method only for *A. pseudoplatanus*. The mean elastic modulus (*E*) for *T. cordata* was 4947 N/mm² and for *A. pseudoplatanus* 6522 N/mm². The compressive strength tests carried out with Instron machines were 19.7 N/mm² for *T. cordata* and 25.6 N/mm² for *A. pseudoplatanus*. The highest increase of pre-stress was recorded in the first 20 mm drilling/cutting depth. For *T. cordata* pre-stress was determined with a mean value of 8.3 N/mm² and 3.6 N/mm² for *A. pseudoplatanus*. Therefore, longitudinal pre-stresses increase the breaking safety of *T. cordata* to 40-50% in average. In the stiffer *A. pseudoplatanus*, the pre-stress leads to an increase of the breaking safety of 10-20% only.

Risk assessment of maple trees subjected to wind and decay effects on that risk

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To investigate risk assessment of open grown trees subjected to wind forces, a Finite Element Model (FEM) of a large sugar maple in Belchertown (Massachusetts, USA) was developed. The model was validated with experimental data. A second FEM was developed for another sugar maple growing in Amherst (Massachusetts). The FEMs were used to assess the response of the trees subjected to randomly generated wind samples using

Monte Carlo simulations. Fragility curves were plotted for each tree by comparing the wind-induced bending moments at breast height level to the calculated maximum moment capacity of each stems (from its diameter and wood strength). Fragility curves were plotted for trees with and without leaves, as well as with and without decays cause to 10% and 20% of moment capacity loss. As expected, decayed cross-sections led to greater likelihood of failure for a given mean wind speed. For stems without decay, the likelihood of failure was greater when one tree was in-leaf, but for the other tree, the opposite was true. This was due to greater frontal area of branches on one tree, and it illustrates the counteracting effects of drag and damping on the likelihood of failure.

Wood decay fungi associated with standing and failed conifer and broadleaf trees as detected through molecular assays: inferences on their host preference and their role on tree stability

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In this paper we report the results of a long lasting research based either on the application of Multiplex PCRs previously developed for the detection of the most harmful or widespread wood decay agents of both conifers and broadleaves or on DNA sequencing of the fungal ribosomal ITS region. Molecular diagnosis was performed on DNA extracted directly from wood samples collected since 2006 from both standing and failed trees. A total of 685 broadleaf and 117 conifer standing trees belonging to 13 and 9 species, respectively, were sampled, while failed trees included 39 broadleaves (from 13 species) and 19 conifers (from 6 species). The most frequent fungus detected in standing broadleaves was *Armillaria* spp. (14% of trees), followed by *Ganoderma resinaceum* (5% of trees) and *Perennipora fraxinea* (4% of trees), while in conifers the frequency of *Armillaria* spp. (13% of trees) was higher than that of *Fuscoporia torulosa* (7% of trees) and *Phaeolus schweinitzii* (6% of trees). The frequency of each fungal species greatly varied depending on the host species, suggesting relevant degrees of host preference. The percentage of failed trees colonized by wood destroying fungi differed significantly between conifers and broadleaves (58% vs 85%; Fisher test, $P < 0.05$), suggesting that wood decay fungi may play a more prominent role as factors of tree instability in the case of broadleaves. Exceptions might be represented by *Platanus* spp. (60% of failed trees colonized by wood decay fungi) and *Pinus pinea* (88% of trees colonized). The most frequent fungi associated with tree failures varied based on the host species: *P. schweinitzii* for *P. pinea*, *Armillaria* spp. for *Cedrus* spp. and *Populus nigra*, *Ganoderma*

adspersum for *Aesculus hippocastanum* and *Fagus sylvatica*, and *G. resinaceum* for *Platanus* spp.

SESSION 5 – TREE BENEFITS AND TREE VALUE IN THE URBAN CONTEXT

Assessing urban forest ecosystem services and values in Europe

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Urban trees and forests provide numerous ecosystem services and values for society. These services include improving air and water quality, reducing air temperatures and building energy use, improving human health and comfort, mitigating climate change, and providing for wildlife habitat and biodiversity. To help assess urban forests, their ecosystem services and values, and to help guide urban forest management, a suite of tools called i-Tree (www.itreetools.org) was developed. These tools, though developed to work in the USA, can and have been used globally to assess ecosystem services and values. However, for this model to work outside of the USA, certain local data are required (e.g. information on city location, local air pollution data). This talk will discuss current and future model capabilities, model limitations and how the model can be used to assess urban forests and their ecosystem services and values in Europe.

Rationale for the increased use of evergreen and deciduous conifers in terms of urban ecosystem benefits

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Trees in the urban landscape are key components of Green Infrastructure (GI). GI is the aggregate of plants and green spaces in the urban landscape. This infrastructure serves many functions within the urban area and provides a multitude of benefits which are becoming increasingly more valuable as municipalities look to remediate environmental issues caused by urbanization. The value of the urban forest (UF) is an integral part of securing funding and support for Urban forestry (Uf) initiatives: the higher the value the more support is gained, and the more benefits accrued. The majority of species that make up UF across the USA and Canada are broadleaf deciduous species. Many of the benefits that urban trees provide are attributed to their canopies (i.e. rainwater interceptions, pollution

absorption, wildlife cover, etc.). When these trees drop their leaves during autumn, the benefits of their canopies affectively drop to negligent levels. Especially in regions where rainfall events occur mostly during this leaf-off season, the additional canopy cover afforded by evergreen tree species, in concert with the canopy architecture and density of evergreen conifers specifically, helps maintain the canopy-dependent benefits that a city depends on. This study investigates the role that conifers play in increasing the canopy-dependent ecosystem services of an UF, and the unique role that conifers play in diversifying the UF, which has become a top issue for many municipalities across the USA and Canada due to invasive insect and disease outbreaks.

Vegetal evolution as renewed relationship between nature and mankind. Analysis and development of tangency scenarios between industrial design and vegetation in contemporary cities

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Can the design method be used to investigate the role of vegetation in men every day's life? Industrial design and botanic appear to be opposite at first sight. Despite of this, the tangency between the two areas traces a new perspective for thinking to urban nature. The analysis starts from a collection of case studies, representing how mankind has been approaching trees and vegetation in city so far. From this general "scenario", the design method translates the critical observation into guidelines. These guidelines are intended to help the local authorities, scientists, and committee through the process of designing green areas for the community. The design thinking offers the opportunity to deeply investigate the connections between men, nature and cities, both functionally and emotionally specking. Moreover, this presentation exemplifies the industrial design process applied to three scenarios defined by the guidelines. Each focus wants to portray a different opportunity of thinking to plants and trees, focusing on the underestimate potential. In conclusions, the study underlines the importance of using different analysis method in approaching the green areas element in cities. The design process is confirmed for this purposed because it deepens the needs of the subjects involved and approach the living element in an innovative and appropriate way. It also re-launches the debate towards a new opportunity of thinking about vegetation: more functional and sensitive to contemporary needs.

Sustainable urban regeneration and Green Infrastructure (GI) implementation: competitive gains from tree planting at an economic, environmental and social level

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The research is focused on the role of trees in supporting the implementation of Green Infrastructure (GI) programs. Trees can be used to create energy-efficient open spaces, to better relate the architecture with the surroundings, to encourage the multi-functionality of gardens, and to combine efficient city management with unique landscape design. Planners and architects, when determining the sustainability of a project, tend to focus on the architecture itself, looking at energy efficiency, water efficiency, green materials, and other factors. However, also the environment immediately surrounding the building, i.e. the landscape, plays an important part in the sustainability of a project, and it is often overlooked. Trees belong to the GI broader family and although GI has been studied for more than four decades in all countries, it is still a relatively new EU policy instrument and there is not a significant amount of focused research around it. Until recently the benefits of trees were well known but not well defined or quantified. The research is focused on the role of trees in supporting the development of a green economy and sustainable land, water and city management. This presentation will give an overview of the state of the art, including case study and analytical tools for tree valuation recognition and will outline all aspects that should be developed to enable an effective GI progress in Europe. In particular, global competitive gains from tree planting at an economic, environmental and social level will be explored, and considerations on how multi-functionality can be integrated into methods for quantifying and valuing GI will be developed.

Complementarity of functional traits in urban trees and ecosystem services

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Urban tree diversity is an issue largely debated. The use of uniform planting material from commercial ornamental nurseries and the presence of alien invasive species are factors that depress the diversity. On the other hands gardens and other green infrastructures can act as refuge for endangered

species. Great relevance is attributed to the ecological corridors and the exchange of genetic materials between the urban centers and the surrounding country side. The role of tree diversity to improve of the ecological condition of a city has been explored from many years, however the aspects related to the interaction between functional traits (functional biodiversity) and their importance in providing services and benefits for the urban ecosystem are less know. In this presentation we propose some example how the complementarity in the use of resources between tree species in an urban forest produces beneficial effects on population (ecosystem services). Trees with different superficial and deep rooting systems can keep water from the different layers of soil, and the plants have different stomatal response to the drought stress period. In this way the transpiration rates at the stand level is balanced through the season, so providing a more effective benefit for cooling and climate regulation. The same stomatal behaviour make the plants more effective also in absorbing gaseous pollutants. The coexistence of tree species with different leaf surface characteristics makes the canopy layer more effective in trapping particulate pollutants, whereas a mixture of deciduous, semi-deciduous and evergreen species plays an important role also during the winter season.

Urbanization vs rooting: the city that moves “around” the silent work of the trees

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The city is expanding, colonizing the territory that has always been agricultural, imprisoning trees, rivers and history. Along the left bank of the river Tergola, in the municipality of San Giorgio in Bosco (PD, Italy), rises the villa of the Counts of Cittadella Vigodarzere: hundreds of acres of land and dozens of trees outline the territory. Huge trees, some registered as monumental. In this work a “CONSERVATIVE” intervention of a specimen of *Quercus robur* (circumference at the base 6.30 m; estimated age about 230 years) will be presented.

Cultivations and divisions inside of Tusculum agrarian landscapes, further on archaeology and villas. The role of the vegetation in the course of time

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The park of Tusculum is characterized by archaeological ruins and settlement of villas. These aspects are actually the most searched. Definition of park perimeter is the first step of investigation about a variable subject, through various levels of analysis of physiographic, idrographic and orographic characters. Actual connotation of landscape is not limited to archaeological aspects and villas settlements but involves also characters of landscape and of cultivation techniques and rhythms. Tusculum landscape is characterized by a varied vegetation: it's possible to find the anthropic vegetation both in the villas and in the rural cultures, in the form of local ornamental species, alien ornamental species, ornamental species of fruit trees. On the eastern hillside and partly on the northern side prevails chestnut coppice wood, composed of *Castanea sativa*, *Quercus cerris*, *Q. pubescens*, *Q. robur*, *Carpinus betulus*, *Ostrya carpinifolia*, *Acer opalus*, *Corylus avellana*, *Fraxinus ornus* and the rare *Staphylea pinnata*. In the archaeological area overlooks the pasture, with scattered trees a prevalence of *Quercus ilex*, *Q. pubescens* and *Pinus pinea*. In this talk, a systematic examination of actual landscape is performed, comparing it with ancient design, studies, descriptions, cabrei (1660), catastral maps (1818, 1870, 2007), air photographs, result of a precise inquire, to identify morphologic, chromatic, cultural and landownership modifications in a temporal interval from seventeenth century to present times. The study is conducted backwards, proceeding from actual state of site. The elaboration is not only a knowledge instrument, but especially the best way for planning protection and maintenance, meant to record development and preservation of agrarian landscape.

Valuing and managing veteran trees: the VETree Project

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New in 2014, the objective of the Veteran Tree Network (VETree) is to spread the knowledge about veteran tree management as widely as possible. From England to Romania, from Sweden to Spain, VETree incorporates traditions and best practices from across the continent. Tasks include defining trees of importance for biodiversity or heritage values, and describing the fundamental principles of the biology of old trees, including the importance of the root systems, the aging process, and environmental influences affecting the development of veteran trees, and the habitat within. VETree managers will be able to survey veteran trees in the field, assess their

sustainability, and prepare a simple management plan for veteran trees, including written specifications for their care. VETree will be flexible enough to adapt to and complement existing programs with similar missions in any country. Vocational education is a primary purpose of this project, not only for managers but for technicians whose skills apply to veteran tree management: arborists, ecologists, soil scientists, planners, gardeners, and educators can all expand their understanding and abilities by plugging into the VETree Network.

Protection of monumental trees: the implementation of law n. 10, January 14th 2013, and new profiles of collaboration between government and stakeholders

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The law n. 10, January 14th 2013, as well as dictating rules for the development of urban green spaces, goes to strengthen, with its art. 7 dedicated to monumental trees, the existing legislative framework by introducing first of all an univocal legal definition of “monumental tree” valid at national level, and then identifying all the steps necessary to ensure a feedback to the provisions of landscape protection by the legislative decree n. 42, 22th January 2004, and its integrations. It provides that municipalities should ensure to carry out a census of monumental trees located in the area of competence, by forwarding the results to the regions and subsequently to the State Forestry Corps so as to be able to make a national list of monumental trees, to be held regularly updated and published on the website. The law also provides that in the event of default or persistent inertia of the regions, substitutive powers are activated by the Ministry of Agricultural, Food and Forestry Policies. For the implementation of the provisions, the law provided that, within 6 months from the entry into force, by decree of the Ministry of Agricultural, Food and Forestry Policies in consultation with the Ministry of the Environment and Protection of Land and Sea and the Ministry of Heritage and Cultural Activity, the directive principles and criteria for the census must be identified. The presentation will focus the main aspects of the legislative decree, giving prominence to the stated criteria of monumentality and on the basis of which the census will need to be carried out, the operating organization and the relationships that will be established between the parties involved, public and private, to the effects of constraints relating to the protection of the monumental tree.

The Smart Tree initiative and permanent polycyclic plantations in the city of Turin

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Afforestation of urban environments was initially carried out for visual purposes. However, in the last decades the multi-functional role of urban trees has been recognized (e.g. for the improvement of air quality, sequestration of carbon, connectivity to surrounding natural woodlands). The city of Turin has one of the largest network of urban trees in Italy (21 million m², 110,000 trees in the urban area). The city administration has recently carried out many projects to promote urban afforestation; for instance, the initiative “Zero impact construction” of year 2009, aiming at compensating greenhouse gas emissions from construction sites with new tree plantations. Moreover, an increasing amount of citizen donations for investments in tree planting is being collected under the framework of public initiatives. The Smart Tree Project was inaugurated in year 2013, with the aim of rationalizing urban afforestation initiatives from environmental compensation and citizen donations. Each year, one or few plantation projects will be selected, based on their environmental priority and communication potential. The project will be carried out according to participatory standards; citizens will be encouraged to contribute and informed on the project’s objectives, while fund-raising activities will be promoted to increment the investments by third party entities. The planned plantations will be inaugurated each year on International Arbor Day (21st November), and communicated to the public in order to give visibility to all donors and promote the following year’s activities. The efforts of the city administration for urban afforestation will also represent an opportunity to experiment new techniques. Traditionally, urban afforestation was carried out by pure and even-aged plantations. These stands require a lot of tending and are generally visually unattractive and poor in biodiversity. In order to increase the provision of ecosystem services, improve the environmental benefits, and reduce the costs and time required to reach the target tree size, permanent polycyclic plantations have been suggested. In this kind of afforestation, different species and different production cycles can coexist, providing different services and reducing management costs, thanks to the lower tending needs and higher wood production. Polycyclic plantations

have been tested in agricultural land, while application in urban forestry will be tested in the next years. The presentation describes a polycyclic, multi-functional plantation in the city of Turin, and its hypothetical management and development.

Treegrphy (Arborgraphia - Alberografia): a way to appreciate and popularize the existence of our urban trees, a way to enlighten our towns

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People don't have time to know where and how many and what characteristics do have the green spaces existing in town. Traditionally teacher at school explain notions about important Figures and Protagonists of local and national history, carry future citizens in museums, art galleries, do show them movies and documentaries, recommend books (novels, poetry collections, essays) but nature, frequently, is out of cast. So if you are lucky you have a grandfather who teach you about trees, about woods, about the land your eyes are looking at. Our cities today guest a lots of trees, new and old parks and gardens, boulevards, squares, public and private green lungs. A Treegrphy is a way to make a study on the presence of big trees and biodiversity in a specific place: a valley, a reserve, a town, a region; it's a way to put together past and future, to mix botany and poetry, memoirs and awareness, a way to transform the working towns crowd by the species *Homo oeconomicus* in a New Town lived and crossed by *Homo* and *Phoemina radix*.

Georol: a participative approach to input and output data of VTA urban trees census

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Data collected through the VTA (Visual Tree Assessment) within the census of urban trees can generate important information for many entities such as public administration, maintenance, scientific community and citizens. All we need is getting up-to-date reliable data, a smart processing system and sharing information. The very first problem is to collect and update the data, which means finding motivational and financial resources. This is certainly easier for big cities, while small-medium towns find it harder to get even one of them. The second and third problems concern the data processing system and the information sharing. Data are often used within Geographic Information System (GIS) software as they are, only a few people have

access to them, and they are mostly used for the maintenance management. WebGIS software can bring these data outside the single PA office, although they can only be used for statistical purposes without a careful processing. Our goal was to find a solution to the three above mentioned problems and make it accessible to all municipalities and individuals, processing the data to get usable information for governance strategies and sharing this information. Georol is a system designed to combine experience, usability, accessibility and participation of citizens. Through an Android application, an all-in-one tool which works both online and offline, consisting of a database, VTA cards, maps, GPS and camera, citizens duly organized and minimally prepared can collect data for most of the urban trees in a participatory and inexpensive way. The system will calculate through weighted multi-parameter equations its stability value, hazard rating, phytosanitary value, economic value, etc. The system is set as a Software-as-a-Service (SaaS) with the aim of sharing information in real time. Agronomists, users of a higher level, may either intervene in all the steps or simply revise critical situations highlighted by citizens or automatically by Georol.

The influence of forest areas on the Urban Heat Island effect: a case study in Italy

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The aim of this work is to calibrate a surface energy balance model for selected sites (rural, urban park, sites located in canyons of the urban plateau and urban peak) that represent the various microclimates of the urban and peri-urban areas of Milan. The calibration model was developed by taking into account infrared data from the Landsat 8 satellite and soil moisture measurements. Once calibrated the model was applied to specific meteorological time series, describing how peculiar urban patterns interact with different micro-meteorological conditions. The selected meteorological stations belong to the Regional Agency for the Protection of the Environment (ARPA) Lombardy network (Parco Nord, Milano Marche, Milano Zavattari, Milano Brera) and to the Italian Air Force (Milano Linate).

Data gathering, standardization and gap filling have been addressed to obtain a long time series (1981-2013). This time series is crucial for following the evolution of the Urban Heat Island (UHI) through the climate change that affected Europe at the end of the '80s as a result of an abrupt change of the Atlantic circulation (strengthening the Westerlies) that brought about a temperature increase of approximately 1.5°C. Results referred to the whole time series show that, on average, in the urban and peri-urban areas of Milan the heat variable prevails over latent heat from July to August due to lack of freatic water for green (e.g. trees, shrubs and grass) sustainability. On the other hand, the marked inter-yearly variability of the summer Bowen ratio (heat/latent heat) highlights the presence of quite different conditions of urban park suitability. These results show that the modelling approach based on the surface energy balance is useful for both irrigation management and for providing information to park visitors.

The role of bioarchitecture on the carbon sequestration of urban greening: the "Ecovillaggio" case study

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Due to the increasing Green House Gases (GHGs) concentration and the related global warming, the role of vegetation in urban areas is increasingly important. Among the several benefits provided by plants, the removal of carbon dioxide (CO₂) from atmosphere represents a crucial strategy for mitigating climate change and particularly the emissions derived from urbanization processes. Bioarchitecture aims to create a balanced relation between building, environment and vegetation, in order to minimize the ecological footprint of new settlements. The aim of this study is to analyse CO₂ emissions and sequestration concerning the urban greening of a residential area in the Po Valley (Padan Plain - in Montale, Modena, Italy), called "Ecovillaggio", conceived with a bioarchitectural approach. We propose a carbon balance that consider: i) atmospheric carbon sequestration through net photosynthesis, ii) CO₂ avoided emissions thanks to building energy conservation, and iii) CO₂ emissions related to natural processes [e.g. wood decomposition, Volatiles Organic Compounds (VOCs) emission, etc.] and management operations. The budget consist of turf grass, shrub and arboreal components. We evaluated the amount of carbon sequestration through allometric equations and bibliography estimates. The results

showed that adequate landscape design could offset more than 60% of settlement emissions, demonstrating the environmental benefits derived from multi-disciplinary planning.

Environmental benefits derived by urban parks: carbon dioxide (CO₂) lowering and microclimate amelioration

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Over the past decades the anthropogenic greenhouse gas emissions have increased contributing to emphasize the effects of global climate change. A large share of global greenhouse emissions is attributable to cities, accounting for more than 71% of the energy related to global greenhouse gases, which is expected to rise to 76% by 2030. In particular, cities represent a major source of carbon dioxide (CO₂) to the atmosphere due to the anthropogenic emissions originating from road traffic and local heating with natural gas, oil or coal. Nevertheless, there are comparatively large segments of urban areas covered by parks having an important role in the local carbon cycle of the city. The objective of this research was to quantify CO₂ sequestration and temperature lowering capability by urban parks in Rome. The results underline that parks extending over larger areas (Villa Pamphilj and Villa Borghese, 180 and 80 ha, respectively) and characterized by a larger tree coverage (81 and 60 ha, respectively) have a significant role in the surrounding areas than those extending over small areas (Villa Torlonia and Villa Celimontana, 14 and 11 ha, respectively) with a lower tree coverage (7 and 6.6 ha, respectively). Moreover, the air amelioration capability by parks is extended over 300 m in the surrounding areas with a significant decrease of air temperature and CO₂ concentration, on an average, of 4% and 22%, respectively. Thus, the urban heat island can be positively influenced by tree coverage, and both evergreen and deciduous species decrease air temperature through shading and transpiration. More efforts should be made to improve urban strategies, such as increasing tree species and considering that not correct pruning practices can reduce or avoid plants amelioration capability. Understanding the relationship among urban vegetation and air quality can facilitate future urban design enhancing environmental and social benefits.

Analysis of surface temperature under different ground cover and shading condition: a case study in Florence

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It is well known that urban green areas provide several benefits in the surrounding environment, such as the increase of air quality and the improvement of thermal comfort condition for the population during summer heat waves. Furthermore, urban features (parks, building density, impervious surfaces, the sky view factor and so on) can influence micrometeorological variables. The principal aim of the present study was to identify the differences between surface temperature on urban ground, under hedge and tree shadows. The case study was set up in the historical Cascine park in the city of Florence, Italy, from 27th August 2013 to 3rd September 2013. Surface temperature was calculated for different types of ground surfaces during the whole day and in the hottest hours of the day, both in the sun and in the shade. Analysis of variance (ANOVA) and regression analysis were performed to assess the influence of ground cover on the ground surface temperature, measured on different types of pavements. The average temperature difference between built-up and green areas from 11:00 to 15:00 was about 6.4°C. Moreover, the tree shadow effect resulted in a reduction in the average surface temperature of about 6.7°C and 13.9°C for lawn and asphalt respectively, during the hottest hours of the day. The results obtained confirm the effect of surface characteristics on urban microclimate. Thus, urban planners and experts from several disciplines dealing with urban design, should take into account both the type of ground surface and trees for giving a substantial contribution to thermal comfort of citizens.

Urban surface temperature patterns in relation to vegetation within the metropolitan area of Palermo

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Similarly to other Mediterranean coastal towns, beside its closeness to the sea, the town of Palermo presents a number of features that may largely affect Urban Heat Island (UHI) extent. These specific landscape features are the cause of the development of a highly structured UHI, difficult to evaluate by simple ground-based meteorological observations. We report an assessment of the extent and intensity of the UHI across the metropolitan area of Palermo by remotely sensed Land Surface Temperature (LST) MODIS imagery. Both daytime and nighttime data from Aqua satellite overpasses were considered (MODIS Science products MYD11A1 and MYD11A2) and related to vegetational and morphological features across the urban area. Results show a highly variable UHI with a number of “hot spots” and “cool spots” which could be related to specific local features such as the general urban texture and the fraction of vegetation area. Daytime and nighttime UHI presented large differences in the occurrence and distribution of peak temperatures whereas cool areas were located more consistently across the diurnal cycle. We performed the analysis both in standard meteorological conditions and under periods of occurrence of heat waves. Analysis of remotely sensed data was integrated with ground measurements done through a mobile, GPS-based, data logger in several measurement sessions consisting of linear transects through the town both during daytime and nighttime hours. Results obtained were largely consistent with remotely sensed data and showed that mobile sensor data may detect the mitigation effects of relatively small vegetation patches.

Gardens without pollen - examples of allergy-free green realizations

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If you observe historical centres of our cities, trees are practically non-existent. When cities became metropolises, many citizens re-discovered the pleasure to have green oasis easily accessible. Paradoxically it is more common an increase of allergies in the cities rather than in the countryside. Allergies are transmitted by inheritance. Predisposing factors that favor the onset are pollution and overexposure to pollen. Pollutants adhere to the surface of the pollen grains. Statistics show that allergies are mainly caused by allergenic species, for the most part spread in specific countries: *Betula* spp. in north Europe, *Ambrosia* spp. and *Carpinus* spp. in the Po Valley, *Graminae* and *Cupressus* spp. in Tuscany, *Parietaria* spp. in south Italy, Palm trees in Africa. High concentrations of pollen, besides increasing the intensity of the symptoms in allergic people, can induce sensitization in healthy people genetically prepared. Which tree is better to plant?

Anemophilous pollens (disseminated by the wind) are issued in big quantities and cause biggest problems, compared to entomophilous pollens, which are carried by insects and therefore more localized. This knowledge allowed us to create gardens with low pollen emissions. We can also create zero-pollen emissions gardens. Dioecious plants are the card to play at this moment. With them we are able to revive our cities without increasing the pollen levels in the air and compensating the emissions of old tree plantings. Some of them are already commonly used, but without distinction of sex. At the time of delivery, the nursery man have to be able to certify the sex of the plants. In the talk some solutions with zero-pollen emissions by using dioecious plants will be illustrated: 4 avenues (*Acer rubrum*, *Eucommia ulmoides*, *Gleditsia triacanthos*, *Pistacia chinensis*), 1 hedge (*Ribes nigrum*), 1 escarpment (*Juniperus pfitzeriana*), 1 containment wall (*Muehlenbeckia complexa*). Also in monoecious and hermaphroditic plants the amount of pollen emitted is variable. It depends on the species, variety, and the single plant. It's possible to select clones low pollen emission for reducing allergies.

***Cupressus sempervirens* and allergy: genetic improvement and plant selection to reduce pollen production**

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Cupressus sempervirens is one of the most common species in the Mediterranean and has been traditionally cultivated mainly as an ornamental tree, becoming a typical feature of urban, peri-urban and rural landscapes. Cypressess release a huge amount of allergenic airborne pollen, and the prevalence of winter pollinosis due to cypress has reached more than 20% in the past decade. As a consequence of global warming, the duration of the pollination period is predicted to extend, and *Cupressaceae* species are becoming established further north. The selection of cypress plants producing null or low amount of pollen (and with a short flowering period) may reduce the effects of allergy on the population and increase the market for cypress plants. A selection of cypress trees based on 1) evaluation of the range of flowering period and of the amount of male flowers and pollen produced and selection of the best genotypes and 2) a biotechnological approach to induce male sterility in *in vitro* cultivated cypress emblings was simultaneously applied. During the winter seasons of 2013 and 2014 (from January to March) weekly evaluations of the number of microsporophylls and their pollen content were conducted on more than 700 *C. sempervirens* var. *stricta* canker-resistant clones. Evaluation involved more

than 2000 15 year old trees growing in experimental fields located in Tuscany and Umbria. Furthermore, based on physiological properties of vegetative reproduction, cuttings of cypress collected from branches without microsporophylls will be grown to evaluate their pollen production over forthcoming years. Somatic embryogenesis is a suitable regeneration *in vitro* method for conifer cloning. We obtained different cell lines of embryogenic calli starting from canker-resistant *C. sempervirens* zygotic embryos. Somatic embryos germination and emblings conversion were achieved in three different lines. These selected cell lines were used for male sterility induction through genetic transformation.

Qualiviva: the quality of the national nursery-floriculture industry through the use and divulgation of varietal plant palettes and procurement specifications for green areas realizations

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Qualiviva is a research project focused on the quality of green areas realizations, open spaces, parks and gardens, funded by the Agricultural, Food and Forestry Policies of Italy. The project is led by the Pistoia Nursery Association in collaboration with the Italian Association of Landscape Architecture, the Institute for Plant Protection (National Research Council), the Landscaping Plants and Nursery Research Unit (Agricultural Research Council), the Department of AgriFood Production and Environmental Sciences (University of Florence), the Minoprio Foundation and the Agricultural School of Monza Park together with Plants and Flowers of Italy Society and Lombardia Nurseryman Consortium. The project was conceived as a result of the awareness that green areas in urban context are essential to bring social and environmental benefits, and are thus capable of improving the quality of life and area, with significant economic impact. The Qualiviva project aims to promote the realization of high-quality green areas by formulating means of supporting landscapers and green industry services and public administration operators. The various partners have worked in groups, selected according to their vicinity and complementary skills, to elaborate a series of "technical plants palettes in urban green areas", a series of "procurement specifications pursuant to national rules", a "disciplinary procedure for the landscape design, realization and maintenance of public green areas" and a "methods for the evaluation of the professional skills of people involved in green areas realization and maintenance". The Landscaping Plants and Nursery Research Unit (Agricultural Research Council) has also realized an innovative and versatile diagnostic method based on the technique of DNA arrays that can be used to analyze both soil

and plant material, and is able to identify simultaneously multiple pathogens related to root collar and root rots and wilting by infected sapwood.

Some native, rare and endemic tree species with ornamental potential in Turkish forests

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Turkey has very rich plant species diversity. There are more than 11,000 plant species and about one third of the species are endemic. Many native tree species in the Turkish forests have not been propagated for the ornamental purposes and urban plantations. The primary objective of this study is to introduce the some native, rare, and endemic ornamental tree taxon found in Turkish forests. The importance of various aspects of urban tree diversity using native tree species is also discussed. The following trees will be presented: *Abies cilicica*, *Acer divergens*, *A. hyrcanum*, *A. monspessulanum* subsp. *microphyllum*, *A. tataricum*, *A. trautvetteri*, *Alnus orientalis*, *Arceuthos drupacea*, *Celtis caucasica*, *C. tournefortii*, *Corylus colurna*, *Fraxinus angustifolia* subsp. *angustifolia*, *F. ornus* subsp. *cilicica*, *Juniperus excelsa*, *J. foetidissima*, *Liquidambar orientalis*, *Malus trilobata*, *Pinus brutia* var. *agrophiotii*, *P. nigra* subsp. *pallasiana* var. *pyramidata*, *Populus euphratica*, *Pterocarya pterocarpa*, *Quercus aucheri*, *Q. brantii*, *Q. libani*, *Q. petraea* subsp. *pinnatiloba*, *Q. pontica*, *Q. vulcanica*, *Salix pentandra*, *Sorbus caucasica* and *Tilia plathaphyllos*.

POSTER ABSTRACTS (in alphabetical order)

SESSION 1 – TREES AND INFRASTRUCTURES AND GREEN INFRASTRUCTURES

1.1 First implementation in Greece of certain international standards regarding tree root systems protection and damage assessment during excavations in public infrastructure works

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We present two first cases of implementation of certain international standards and methods regarding tree root systems during works in public spaces in Greece, where no relevant official regulation or specification or appraisal method exist. In the first case, during excavations for the installation of an underground gas pipe under a pedestrian route, the roots of large *Pinus halepensis* trees were severely cut. Root damage was assessed by the municipality's Urban Green Maintenance Services Department's agronomist. Structural root plate extent and damage were assessed according to indicative dimensions given in the Spanish NTJ 03E:2005 specification. Whole root system damage quantification and tree economic values were calculated with the Spanish "Norma Granada" method. Based on this data a reimbursement request was submitted to the company responsible for the excavations, while municipality procedures were reorganized so that the municipality's agronomist will co-authorize all future pavement excavation permits. The second case concerns excavation works during a public playground renovation project, on a site with large *P. halepensis* trees. According to the plan, extensive excavation works to a depth of 40 cm were programmed to take place very close to the trees. During the project implementation and on behalf of the projects's supervision team, the municipality's Technical Services Department's agronomist evaluated the possibility of slightly modifying the basic architectural plan so that tree root systems would be effectively protected. Two alternative zones were delineated: a) a root protection zone as determined in the UK BS 5837:2012 standard, b) a structural root zone according to NTJ 03E:2005 specification and U.S. ANSI A300-Part.8:2012 standard. The second option was chosen to be implemented, as being the only feasible. These cases highlight the need for specific institutional and legislative provisions regarding the protection of urban tree root systems during project planning and implementation in public places in Greece.

1.2 Trees: colonization strategies in the urban environment

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The idea of a city habitat is linked to the existence of majestic living organisms that break the continuity of the inanimate buildings: the trees. Thanks to their qualities, they are considered as resources from different points of view: the healthcare, aesthetic and economic ones. The space granted to the growth of the trees is far smaller than the original environment from which they were excluded. On the other hand the

plantation of trees in the city allows the local species to enter in the cement cage that is by now prohibit for the majority of the potential nature. Trees as a living organisms have to survive and breed also in the city: it is frequently noted how these needs drive trees to free themselves from the constrictions imposed by men. The florescence of some trees, insignificant for ornamental aims, is completely functional to the consequent production of fruits and seeds, which are scattered in the most uncommon places. The contribution given by this dispersive randomness allows a reflection about the tree as an element of quality: near the buildings, this progeny sometimes bestows an unexpected pleasant natural touch and sometimes represents a critical element. A really objective consideration is not always easy. The decline of some urban areas has become the start for new generations of trees, which have increased the biomass and the local genetic variety. This occurrence could be seen as a renovated synergy between man and environment, but it is connected with the idea of abandon and decline instead. However, the damages to the structures deriving from these circumstances are often relevant. As men cannot choose the place of their birth, trees are at the mercy of the same destiny; but both of them take their roots in the territory and confer to it their character.

1.3 A proposal for the resolution of conflict between trees and urban traffic: the example of Viale de Amicis in Florence

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Since a few years after World War II, in Viale de Amicis (Florence, Italy), the Affrico torrent was covered, transforming it in a long greenway lined with trees planted close to local roads. In that period, very common Italian stone pine (*Pinus pinea*) trees were planted because of their beauty and adaptability to soil and climatic conditions, unfortunately without considering possible future problems. In the last two decades has become evident that *P. pinea* causes an apparently irreconcilable conflict with the traffic because of the well known and common inconveniences caused by this species: damages to concrete paving by radical nodules, roots penetration in underground utilities, etc. In 2013, the rearrangement of the roadway was designed accounting for: 1) the historic significance of this greenway, unique in town, that goes down to Arno river; 2) public safety for traffic; 3) parking demand by citizens, that cannot be set aside. The project included: road section shortening, parking change and rationalisation, for the first time increase of tree sites decreasing asphalt paving and a new cycle

track with incoherent paving. The works were made during the period August 2013-January 2014. The particularity of this project is the increasing surface dedicated to rain water infiltration and gaseous interchange with soil, due to correct biological development of tree root apparatus. Another main goal of the work was to obtain healthy and safe trees urban contest. The poster will show the new layout and the whole cost for the rearrangement of a portion of Viale de Amicis, about 400 m long, realised according to the best arrangement between mobility, parking needs and plant requirements. Moreover, it will be shown the approach to the works executed close by the root system of existing trees. An example of a stretch of suspended pavement will also be provided in order to preserve main roots from anoxia.

1.4 Assessing the outcomes of ecological restoration of a high-speed railway in north-western Italy by afforestation

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The building of a high-speed railway in north-western Italy has affected some natural forests and Natura 2000 sites. According to the current regulations, ecosystem stewards have to negotiate measures to “compensate” the ecological damage. Ecological compensation is understood as the set of measures carried out to substitute the habitats, ecological values and functions that remain definitively damaged or lost. Compensation measures are usually determined by a combination of administrative goals set by the competent authorities, availability of suitable sites, and other criteria. The purpose of this poster was to assess the outcome of 18 already completed afforestation projects along the high-speed railway in Piedmont (Italy), and to compare the current vegetation development with the expected goals. Most of the compensation projects were unsuccessful (e.g. very slow growth rate, very high tree mortality). This was due both to questionable planting techniques (e.g. tree species selection, poor or no soil preparation), and to the lack of adequate management (e.g. thinning) and monitoring in the following years. According to our results, we advocate the need to rethink a comprehensive approach to afforestation practices for ecological compensation, in term of spatial distribution of the projects, planting methods, tree species selection and ecological goals.

1.5 Ragusa-Catania motorway connection, 4 lanes modernization of S.S. 514 “di Chiaromonte” and S.S. 194 “Ragusana”: an example of landscape coherence

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The 70 km motorway connection known as “Ragusa-Catania”, object of a deep modernization, is located in an area of regional interest for the high landscape value. This kind of intervention needs an analytic process of the landscape-naturalistic heritage before the planning phase. The analytic process has to consider the environmental conditionings and the planning inputs, which have to be organized in a ranking-associative structure. Climatic conditions, geomorphological structure, lithological and pedological characterization, structure of the natural and ecological network elements, anthropic system (agriculture, architecture, etc.), vegetation canopy, soil and building colour palettes, all these factors contribute in forming the mental map from which to start in order to define the different environmental frameworks of the landscape: the Ibleo upland, the olive tree groves, the Lentini lowland citrus groves. The identification of the goals and functions for the green intervention in the infrastructural plan, and the recognition of the mitigation and compensation measures, contribute to complete the map too. The project identifies macro-categories for the intervention, finalized to reach the objects. Each of them will be developed in accord with the optimization activities of the infrastructure. Finally, an alphanumeric algorithm was created to identify the detailing intervention. The algorithm composition was defined applying one or more typological intervention according the involved landscape. The typological intervention follows the landscape context whose preparatory studies identified the main traits about vegetation, use of materials and tones, proposal of morphological forms, etc. In this way, it was possible to suggest different interventions about: grass cover structure, restoring of the natural aspect by hedgerows and tree rows, development of the natural systems of trees and shrubs, increasing of the ecological network and the rural value. All the interventions have been contextualized according the landscape background. Therefore, 1926 specimens will be removed and replaced with 24,700 trees and 219,120 shrubs, for a total cost of 11.175.210,00 Euros (€).

SESSION 2 – MANAGEMENT OF DISEASED, INFESTED AND DECLINING TREES

2.1 Unmanned aerial vehicle, “drone”, as new tools for the urban trees monitoring

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The urban forests are very important features in the mosaic of the city for their multi-functional benefits and for psychophysical advantage provided to dwellers that can relax and socialize. However the urban trees often are placed in difficult vegetative situations, where the space to develop the roots or the branches is poor. Several pruning operations are commonly performed in few years and big cuts to the branches can be preliminary pathways to a new infection by decay pathogens that decrease the stability of the tree. In the last twenty years, Visual Tree Assessment (VTA) method was applied as standard way to monitor static safety of the trees. In lots of cases, tree climbers or lift platforms are necessary to assess the condition of upper parts of a tree, increasing hazards or costs of the silvicultural operations. Recently the possibility to use an Unmanned Aerial Vehicle (UAV), commonly known as drone, equipped by video/photo camera has been proposed to minimize the hazards and the costs, restricting the use of a climber or platforms just to the necessary cases. The UAV can fly around a tree for all its height and monitor the conditions of trunk, of branches or leaves in real time. It's able to perform stationary flying to get best visual analysis to the operator as detect the presence of decay fungi or signs of weakness for parts of the crown. Recently it has been possible to fly over the canopy in a private park in Florence, using a hexacopter equipped by motorized high resolution camera, to evaluate the conditions of the crown of big tree (*Sophora japonica*). The drone was useful in addressing tree climber to the best choice in pruning operations. Attempts are in progress to evaluate benefits and disadvantages of these new work tools.

2.2 VOCs (Volatile Organic Compounds) released by fungal tree pathogens, a new tool for disease diagnostics?

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Secondary metabolites of plants play vital multiple biological and ecological functions in communication between plants and different organisms. Mostly they have an important role in the chemical defense against biotic agents such as insects, pathogens, mammalian herbivores but also in protecting wounds. Recent research showed that Volatiles Organic Compounds (VOCs) produced by forest trees have inhibitory effects on mycelial growth of fungal plant pathogens related with root rot diseases or tracheomycosis. Similarly chemical volatiles obtained by saprophytic fungi have antifungal inhibitory effect on competitive pathogens that may affect trees. Furthermore, the chemical composition of VOCs released by both saprobiontic and pathogenic fungi can be used also in helping taxonomical identification as it has been observed by using Maldi-Tof method. Generally it is not easy to demonstrate the functions for these substances in field or in laboratory experiments; however, it is known that several fungal species produce characteristics VOCs. Aim of this work is to provide evidence on how and to which biogenic VOCs may be employed in fungal characterization by using models species well known as fungal pathogens. *In vitro* tests will provide information necessary in helping to diminish time of species identification particularly in case of mix of mycelia obtained after isolation from samples collected in the field.

2.3 Monitoring, detection and management of *Ceratocystis platani* in urban contest

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Ceratocystis platani, a fungal pathogen responsible of the canker stain of plane trees, was introduced into Europe during World War II. The fungus colonizes the host through wounds or root anastomoses between neighboring trees and it's able to survive in the sawdust, produced during sanitary operations. *Platanus* is an important species of parks and boulevards in Florence and since the '60s, some died or infected plants are registered every year. To ascertain risk of fungal spreading the sawdust obtained after cutting infected trees was tested. Traps by Whatman filters wetted in Tris-EDTA (TE) buffer were placed on streetlight the day before

sanitation cuts and removed the day after, to collect the airborne inoculum. Fungal DNA was extracted from the pellet by using the E.Z.N.A.[®] Plant DNA kit and presence of *C. platani*, was detected by Real Time qPCR by using a TaqMan MGB probe. The DNA was quantified in all traps within 100 m from the felled trees and often within 200 m, beyond this distance samplings were negative. At the same time historical data on the presence of *C. platani* in the city of Florence, were compared with those collected during a monitoring performed in 2012. To evaluate the possible increasing of the disease the city was divided into four parts using Arno river as longitudinal boundary. The presence of disease on plane trees was identified and data collected. After comparison with the 2012 monitoring data, values increased from 8.3 up to 13 km² in length and from 2.6 up to 4 km² of area. The western part of the city also resulted affected. As main consequence is suggested to accompany eradication operations with intensification in reducing contaminated sawdust that may infect trees after pruning operations or by accidentally wounds.

2.4 Fusarium wilt and pink rot of palms in the city of Genoa: incidence and attempts of management

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Phoenix canariensis is used extensively as a landscape ornamental in coastal areas of Italy. In 2010, symptoms of wilt and dieback were observed on *P. canariensis* in the city of Genoa (Italy). Leaves of 28 symptomatic and asymptomatic palms from 8 urban sites were sampled. Isolations were attempted from sections of petioles by transferring small pieces of tissue, after flame-sterilization, on standard growth medium and subsequent incubation at 24±2°C for one week. Two different fungal pathogens were isolated: the Fusarium wilt agent *Fusarium oxysporum* f.sp. *canariensis* and the pink rot fungus *Nalanthamala vermoesenii*. Fungi were identified on the basis of their macroscopic and microscopic features using taxonomic guides and standard procedures. Identification of *F. oxysporum* at the formae specialis level was achieved through a PCR-based assay by using the taxon-specific primers HK66 and HK67. When isolations failed, PCR was conducted on fungal DNA extracted directly from the petiole tissues. Since chlamydospores of *F. oxysporum* f.sp. *canariensis* can survive for long periods in the soil, the same PCR assay was used to detect the pathogen directly from soil samples collected around palms. *Fusarium oxysporum* f.sp.

canariensis was isolated from petiole tissues of 9 palms (32% incidence) and in soil samples from 9 palms (5 of them also positive to isolations); *N. vermoesenii* was isolated from 6 palms (21% incidence). Only one palm was colonized by both pathogens. In a subsample of infected palms, the effectiveness of two fungicides, i.e. thiabendazole and thiophanate-methyl, was tested. The first treatment was applied through trunk-injections using the recently patented BITE, and the second through soil drenches. Preliminary observations suggest thiophanate-methyl soil treatments may be effective in reducing disease severity.

2.5 Can emissions from a novel green manure control pathogens in relation to Specific Replant Disease on *Sorbus aucuparia*?

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Specific Replant Disease (SRD) is a persistent problem that affects the propagation and cultivation of broadleaf trees, especially those being cultivated in nurseries, on a local level across the United Kingdom, and also globally. This disease is of unknown aetiology, although studies have indicated that it is caused by a build-up of an array of pathogens, which are potentially species-specific. Literature suggests that *Pythium ultimum*, *Rhizoctonia solani*, *Fusarium oxysporum* and *Cylindrocarpon destructans* have involvement in this disease. Trees particularly prone are those in the *Rosaceae* family, and therefore as a result the green industries face financial implications when rosaceous fruit and ornamental trees fail to produce an adequate yield or grow to their full potential. Broad spectrum fumigant methyl bromide was previously used as a successful treatment; however its use was revoked in 1993. With the pursuit for an alternative control measure currently being undertaken, it is proposed, that the antimicrobial properties of a Novel Green Manure (NGM) has the potential to treat SRD. The current research being undertaken investigates the response of, the above mentioned, pathogens to volatiles released from the NGM *in vitro* with microbial studies undertaken in triplicate aseptically. Preliminary results indicate that the growth rates of pathogens are significantly ($P < 0.05$) reduced during exposure to volatile emissions in a closed environment. This response to NGM appeared to be fungistatic after growth of pathogens resumed as normal after re-planting onto fresh agar. These results need to be

considered on a wider scale, where soil microbial interactions may affect the response to the NGM. Further research needs to be undertaken, including solid phase micro-extraction and microbial inhibition studies.

2.6 Presence of *Sydowia polyspora* on *Pinus halepensis* in urban areas

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Pinus halepensis is a pine native to the Mediterranean region that is generally located from sea level up to an altitude of 200 m. In July 2012, after some days of heavy rains, extensive leaf yellowing and scorching were observed on the foliage of two specimens of *P. halepensis* in a public park of Alassio municipality (SV, Italy). Diseased needles showed chlorotic and reddish brown colored areas that were randomly distributed among healthy needles. In order to isolate the potential pathogen, diseased needle tissues were surface sterilized and plated onto Potato Dextrose Agar (PDA) amended with streptomycin sulfate. After 7 to 10 days, a brown to dark green mycelium slowly developed on the PDA. From the mycelium, single cell conidia were produced. The Internal Transcribed Spacer (ITS) region of rDNA was amplified using primers ITS1f/ITS4 and sequenced. A BLAST search yielded 100% of maximum identity with *Sydowia polyspora* for ITS1f and ITS4. Pathogenicity was confirmed by inoculating 15 3 year old plants of *P. halepensis* grown singly in pots and maintained in greenhouse. Twelve of 15 plants were wounded by gently rubbing needles together. Five non-inoculated plants, with wounded and non-wounded branches, were kept as controls. A suspension of *S. polyspora* conidia was applied on the needles with a soft paint brush. After inoculation, plants were covered with polythene bags for 5 days and kept at an average temperature of 14.5°C. The inoculation trial was repeated once. All inoculated plants, both wounded and non-wounded, developed leaf yellowing and browning, while control plants remained symptomless. *Sydowia polyspora* was re-isolated from the needles of inoculated plants according to the procedure already described. *Sydowia polyspora* is associated with Current Season Needle Necrosis (CSNN) on various conifer species and *P. halepensis* was reported in Spain to be a susceptible host. To our knowledge, this is the first report of *S. polyspora* on *P. halepensis* in Italy. Control of the pathogen with fungicides was ineffective on fir species, while application of very high rates of calcium chloride during shoot elongation was able to reduce the severity of CSNN. In forest areas, municipality gardens, and parks, effective management strategies have not yet been developed, while stress induced by severe drought and rainy

periods may enhance disease appearance and severity.

2.7 Detection of *Armillaria* spp. in soil and plant tissues in ornamental trees in urban areas: three year of survey in western Liguria

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Armillaria spp. are important root rot pathogens affecting different species of standing trees and shrubs in urban and gardens areas. Disruption of root integrity can lead to sudden fall of plants with consequent severe stability risks posed to people's safety and potential damages towards facilities and goods. In recent years an increasing number of tree collapses has been reported to be caused by this disease in some municipalities of western Riviera (Liguria, Italy). The disease remains undetected until symptomatic plants are observed, by which time *Armillaria* spp. may be widely spread both in soil and within the plant. On this basis, starting from 2010, the Center for Agricultural Experimentation and Assistance (CERSAA) carried out surveys on ornamental species (trees and shrubs) in order to detect the presence of *Armillaria* spp. in soil, wood and root samples of ornamental trees and shrubs through a PCR-based method developed for an early detection and identification of the fungus. The genomic DNA was extracted from homogenized samples (soil or plant tissues) using NucleoSpin® Soil kit; Internal Transcribed Spacer (ITS) region was selectively amplified by nested PCR. The first reaction was carried out with fungal universal primers ITS1f and ITS4. In the second reaction, 1 µL of the first reaction product was amplified with the universal forward primer ITS3 and the taxon-specific primer ARMI2R as reported in the literature. With regards to main ornamental genera or species considered (*Cedrus* spp., *Citrus* spp., *Cupressus* spp., *Eriobotrya japonica*, *Pinus* spp., *Pittosporum tobira*, *Platanus x acerifolia*, *Populus nigra*, *Prunus laurocerasus*, *Rhynchospermum* sp., *Schinus molle*, *Tilia* spp. and *Viburnum tinus*), 54 samples were collected in 15 municipalities including 22 wood/root samples and 32 soil samples. Among the former ones, 15 resulted positive for *Armillaria* spp., 23 among the latter ones. Biomolecular assays can play a key role in support to Visual Tree Assessment (VTA) for the identification of hazardous ornamental trees in urban areas and lead to specific management practices in case the presence of *Armillaria* spp. is detected in soil or plant tissues. On shrubs such analysis provides useful epidemiological indications regarding the presence and spread of *Armillaria* spp. in urban areas, parks and gardens.

2.8 “La valutazione fitosanitaria degli alberi monumentali - criteri di rilevamento”. Handbook for the evaluation and management of ancient trees

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As part of a wide-ranging action to preserve its heritage of trees and plants, the Regional Government in Emilia-Romagna promulgated the regional law n. 2, January 24th 1977, which ratified the obligation to preserve and to protect monumental trees in its jurisdiction area. A survey to list the tree species of great scientific and monumental value was carried out in the years following the enactment of the law. 646 specimens, either individual, in groups, in rows or in the woods, were identified as subject to protection. Any interventions aimed at maintaining good vegetal conditions and pest management of these specimens must be authorized by the Regional Plant Protection Service only after a careful analysis and evaluation made by phytosanitary inspectors. The handbook provides a brief overview of the most common plant health problems identified to date in the region. It had been originally written for a special survey on monumental trees, but it circulated widely afterwards within the scope of a major communication project. The layout of the handbook resembles a “check list” form, very similar to the one used by phytosanitary inspectors during their regular activity to monitor monumental trees. The handbook deals with a complex topic with simple and explanatory texts, a useful glossary for non-experts, and more than 200 drawings and photos (mostly of protected trees). It brings attention to the preservation of ancient trees, for which the liability of public bodies is essential to ensure proper care and steady management. The handbook has been published thanks to the resources made available by the Plant Protection Service of the Emilia-Romagna region and is distributed free of charge. Its content, images, artwork, drawings, layout, as well as its publication are the result of the expertise and joint efforts of the authors and other co-workers.

2.9 The regional project for biological control of the Chinese gall wasp *Dryocosmus kuriphilus* in Emilia-Romagna

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Dryocosmus kuriphilus (Chinese gall wasp) was detected in the chestnut (*Castanea* spp.) woods of Emilia-Romagna in 2008. The pest spread rapidly and endangered the fragile economy of mountain areas, for which the growth of chestnut trees is an important resource. The Regional Government in Emilia-Romagna took immediate action, and invested resources and energy to develop a biological pest control strategy. This strategy was based on the introduction of *Torymus sinensis*, which is the natural enemy of the Chinese gall wasp. The regional biological control project started in 2009. It was coordinated by the Regional Plant Protection Service and under the scientific responsibility of the University of Turin, which was the first one in Italy to have acquired expertise on this topic. An open-pit field multiplication site was established, where the natural enemy of the gall wasp rapidly established. In 2010 the Plant Protection Service started the release of the parasitoid in open field. 12 additional releases were made in 2011, one of them with parasitoids collected from the regional multiplication site. The management of the parasitoids that were reared in the multiplication area was assigned to the University of Modena and Reggio Emilia in 2012. Thanks to the parasitoids collected from the multiplication site, it was possible to make 38 releases on top of the 24 already planned with material provided by the University of Turin. Additional releases of the parasitoid were carried out in the western part of the region as the gall wasp colonized new areas and reached a sufficient population density. 152 releases were completed in 2013, 57 of these were projects led by “Local Action Groups (LAGs)” with the resources from the “Plan for the Development of Rural Areas (PSR)”; other 3 releases were carried out in the Republic of San Marino. We present the results of the distribution of the releases in the region.

SESSION 3 – TREE MANAGEMENT IN A GLOBAL CHANGE SCENARIO

3.1 The renewal of city trees. Models of reorganization

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In many Italian cities the problem of the decay of trees rows, because of their phytosanitary conditions and of anthropic damage, is getting more and more serious. Causes are very often due to the different conditions of plantation sites (insufficient living space, scarcity of exploratory soil, anthropic damage). The renewal of felled trees by planting new individuals replacing the eliminated ones often neither solves the problem, nor changes their health and well-being state, since the conditions of conflict and

suffering still exist. In such cases failure is inevitable. Therefore, the intervention of reorganization adopted in the streets and parks of the city of Padua are aimed at removing some structural problems and at achieving several objectives: i) the need to ensure greater biodiversity in the tree population, introducing new species and varieties suited to the urban environment, selected according to the concept of resistance in the urban ecosystem and not restricted to the concept of native species; ii) the spread of free or semi-free forms of growing; iii) the realization of plantation sites ensuring the physical protection of trees; iv) the improvement of soil conditions and in particular of permeability; v) the elimination of conflicts with the surrounding facilities and with other plants; vi) landscape redevelopment (pedestrian areas, green squares, etc.). It is needed a wider restructuring plan which, while providing technical solutions to guarantee the future development of trees, allows to manage the various stages of felling, by giving citizens the necessary information to understand the choices made. Public opinion is more and more sensitive to environmental issues and even the most ambitious interventions may fail because of the lack of a proper information plan and concerted action. Here we are presenting a protocol and some examples which allow to find a new approach to the management of trees in the city.

3.2 SMARTurban – a monitor system for green areas planning

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Over 50% of world population lives in urban areas and this percentage is supposed to increase in the future. Moreover, changes in the city affect the environment both locally and globally. That's the reason why urban planners and managers need tools to evaluate the performance of the present state as well as the future development of cities in terms of comfort and quality of life. The SMARTurban (a monitor system for green areas planning) project (Project cofinanced by the Regional Government of Tuscany and the European Regional Development Fund) aims at creating an innovative system for the design of urban spaces. The project involves the

implementation of a software able to determine the variations of thermal comfort and the level of CO₂ and main air pollutants induced by the project layout and plant choice. Four essential steps are considered for setting up and implementing the system. The first one is relative to the analysis and to the implementation of biometeorological indices for the estimation of thermal comfort, environment indicators and the realization of a database for cataloging the element's characteristics typical of urban areas (vegetation and materials). The following step involves the system design by studying and developing all the algorithms necessary to the implementation of the subsystems for the analysis of the chosen indicators. In addition, this phase involves the setup of specific case studies for collecting data series. The third step deals with the system tests for the development of the prototype. The last one involves the creation of pilot sites for the simulations based on data collected and performed in specific pilot sites for the validation of the system. SMARTurban software permits to schedule a sustainable design, from small urban spaces to large area, thus offering designers and public administrations an innovative, scalable and scientifically reliable environmental monitoring.

3.3 Volatile Organic Compounds emitted from urban and peri-urban vegetation

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Urban forest management strategies to help improve air quality in future scenarios have to consider the plant capability of producing Biogenic Volatile Organic Compounds (BVOCs), that may profoundly influence the chemical and physical properties of the atmosphere. BVOC emissions lead to the formation of secondary chemical species that can enhance tropospheric ozone and have also the global effect of increasing the lifetime of methane (CH₄). Upon reaction, BVOCs can also generate carbonaceous aerosols whose impacts may include feedback mechanisms in the earth radiation balance. BVOCs also modulate plant tolerance to heat, pollutants, oxidative stress and abiotic stresses, and affects plant-plant and plant-insect interactions. Urban vegetation is often characterized by the presence of exotic species interspersed with natural vegetation. When considering exotic and newly introduced plants, the urban biodiversity is even higher than that of natural communities. Furthermore, biotic and abiotic stresses to which the

urban vegetation is exposed are often specific and not common in natural environments. A screening of BVOC emissions by the mixed stand constituting urban forests is therefore required if emissions are to be reliably predicted. Furthermore, emission of BVOCs increase exponentially with temperature. Ozone formation is also temperature-dependent. Consequently, a major way to decrease both the production of ozone and the emission of BVOCs is to reduce urban temperatures and the effect of the Urban Heat Island (UHI). Thus, urban forestry may have a high impact on atmospheric composition, air quality, environment, and quality of life in urban areas. Monitoring the emission rates simultaneously with measurements of air quality, plant physiology and micrometeorology on urban forests, will allow detailed quantitative information on the inventory of BVOC emissions by urban vegetation to be compiled. This information will make it possible to propose an innovative management of urban vegetation in cities characterized by heavy emissions of anthropogenic pollutants, aiming at the abatement of BVOC emissions through the introduction or selection of low-BVOC emitting genotypes in urban areas subjected to pollution episodes and in the new afforestation areas covering peri-urban parks, green belts and green corridors.

3.4 Planning for change - urban forest management planning as a foundation for success

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This poster examines a successful model for Urban Forest Management (UFM) planning based on the application of key criteria and indicators. A strategic planning framework used in the preparation of UFM plans for numerous Canadian municipalities will be outlined and presented as a model applicable to communities of any size that are interested in sustainably managing their urban forest resources. The poster also discusses how a refined set of Criteria and Indicators (C & I) for success in sustainable UFM can be successfully applied as tools to improve UFM planning. Through a series of practical case studies, the poster demonstrates how municipal arborists and urban foresters can apply C & I to evaluate UFM in their own communities, and use the same to set strategic and operational objectives to optimize management in the face of a changing global climate and increasing stresses on urban trees.

4.1 Trees and citizens: why don't people trust tree risk assessment?

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Since 2000, the city of Padua has been concerned with citizens safety by providing a systematic process for assessing street trees risk. In these last years the selective cutting of trees has always been performed after evaluating the likelihood of failure, supported by experienced arborists who have applied different procedures and used different inspection tools. Despite the great effort made to identify hazard trees, citizens often take position against the felling programs and simply do not trust the evidences given by tree risk assessment. By describing some typical situations, the poster examines the reasons that may hide behind this distrust, and try to suggest solutions.

4.2 Monumental trees: pilot project for the preservation of biodiversity

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The historical avenue “Viale Carlo Emanuele”, at the entrance of the protected area La Mandria Regional Park (TO, Italy), represents, with its ancient decayed oaks, a wealth of history, nature and landscape. This heritage is constantly monitored by the Park and has to be protected and safeguarded in order to ensure its survival as long as possible. On these old oaks a great biodiversity can be found: an example is *Osmoderma eremita*, a rare beetle included in Annexes II and IV of the Habitats Directive 92/43/EEC and defined as priority species. However, these oaks are also characterized by large cavities and deep decay, becoming a potential danger for Park's users. To avoid felling, the avenue was closed in autumn 2012, but some trees are still very close to busy roads and it was determined to preserve such trees, avoiding drastic pruning to maintain as long as possible their vitality. Magneti Marelli S.p.A., that has two plants near the Park, sponsors a pilot project for the preservation of six oaks and then biodiversity. A team of engineers and forestry doctors designed the intervention, considering anchors to direct (the eventual) tree's fall in secure

areas. The pole's dimensions and positions were calculated in order to withstand winds of 117 km/h. For each tree four iron poles (120 mm diameter and 5 m long) were placed in the ground about 12 m away and another one at about 0.5 m from the collar. The exact location of the pole near the base was determined using Ground-Penetrating Radar (GPR) surveys in order to identify the lower root density area. A team of arborists positioned the steel ropes connecting stems and poles. This kind of work represents a new approach for preserve important trees, even with different properties, without using concrete.

4.3 The Italian stone pine (*Pinus pinea*) in the city of Rome: presence, problems and management

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The presence and distribution of the Italian stone pine (*Pinus pinea*) within the city of Rome, resulting from the census performed by the Capitoline Administration, are analysed: approximately 17,000 specimens along the tree-lined roads, out of a total of 150,000 trees of different species present. The main problems (both anthropic and natural) which may compromise the correct development of the species are highlighted along with the consequent risks for its stability. Data were reported and analyzed relating to more severe falls in the last years together with damage and accidents caused. Several possible management activities for risk-containment are presented.

4.4 Decay in urban trees: measuring the invisible

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In order to quantify the amount of decay within a standing tree, numerous devices have been produced. The Resistograph (RST) resembles an electric drill with a built-in self-contained unit attached to the top that houses the drilling needle and graphic printout paper. It works on the principle that decayed wood will not resist the needle which is set at a constant speed. The Picus Sonic Tomograph (PST) is based on sound-wave technology, up to 12 transducers are attached to the tree stem, and the travel time between each point is recorded when tapped with a hammer. A colour tomogram image is produced mapping the internal condition of the wood. This literature review will examine how these devices have been tested in recent years, providing

an insight into their efficiency as well as highlighting any limiting factors. Both devices are suitable for informing the user that decay is present or not within a tree. The RST is able to produce results quickly and gives an accurate measurement of decay. The PST provides a visual diagnosis of stem condition at point of testing but can exaggerate cracks and abnormalities. When tested on trees with substantial decay the PST is very effective in representing this onto the corresponding tomogram. The review has provoked the following thoughts, the devices do not have to be used in isolation, the PST may be used to provide an analysis of cross-section status, pinpointing where best to drill with the RST to confirm the extent of suspected decay.

4.5 A new approach to investigate internal tissues of date palm tree (*Phoenix dactylifera*)

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The date palm (*Phoenix dactylifera*) is an important economic resource for many nations worldwide, with particular reference to the Kingdom of Saudi Arabia and North African countries. In addition to the production of dates, this palm species is used as an ornamental tree in many parts of the world. In Italy, date palm is present from Liguria Region to Sicily Island, in parks and gardens. Considering the presence of many insect pests and fungal pathogens, and the difficulties to detect infected tissues at early stage, a new approach has been applied to study internal palm tissue health. As part of a wider project on date palms, funded by the company Sabic, the use of radar technology has been applied for a totally non invasive evaluation. TreeRadarUnit™ (TRU), already used in the USA and Europe for decay detection on deciduous trees, has been used on palm trees. TRU works with a 900 MHz frequency antenna (dimensions 50x25x15 cm) turning around the trunk. The rather large size of this antenna can hinder measurements on small palms (diameter) or on palms with long petioles. Part of the project was therefore dedicated to the identification and setting of another antenna, smaller in size. It was chosen a 2000 MHz frequency antenna, generally used on concrete, with small dimensions (10x10 cm), handy and easy to use. This antenna, after a new accurate setting, has been connected to TRU in order to scan the palms. TRU measurements, with both antennas, have been carried

out on adult palm trees on the entire trunk section, also at multiple levels. The results resemble a tomography in which it is possible to detect tissue discontinuities, such as the presence of decays and galleries. This tool could be used also to evaluate palm stability in urban areas.

SESSION 5 – TREE BENEFITS AND TREE VALUE IN THE URBAN CONTEXT

5.1 Citrus germplasm as an heritage of the historical rural landscape of Cannero Riviera (VB), Italy

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The rural landscape of Piedmont is rich in historical evidence of traditional agricultural techniques and agro-systems which must be maintained and preserved. In Cannero Riviera (VB, Italy) there is an historical tradition of citriculture since the seventeenth century, thanks to a suitable microclimate due to the influence of the Lake Maggiore. The culture, introduced from Tuscany and Liguria, is a peculiar trait of the landscape and characterizes the local agro-ecosystems. The orange grows at the northern distribution range of the genus *Citrus* in Europe, endure cold winter and they are a precious germplasm to be preserved. The study aims to carry on the chemical, morphobiological and qualitative traits of these genotypes. Fifteen accessions of *Citrus sinensis* were grouped into three morphological traits (IPGRI Descriptor for *Citrus*): pigmented, navel and common oranges. Fruit from five plants of each accession were analyzed for the following parameters: Titratable Acidity (TA), pH, Total Soluble Solids (TSS), Total Phenolic Content (TPC), antioxidant activity, vitamin C, hesperidin and narirutin contents. Spectrophotometric (Ferric Reducing Antioxidant Power and Folin-Ciocalteu methods) and HPLC techniques were used. The antioxidant activity tested on orange juice ranged from 8.50 to 18.60 mmol Fe²⁺/kg_{FW}; the TPC values ranged from 81.10 to 160.80 mg_{GAE}/100 g_{FW} and the vitamin C content from 32.90 to 72.01 mg/100 ml. Hesperidin content ranged from 15.60 to 36.90 mg/100 mL and narirutin from 14.67 to 35.20 mg/100 mL. The Analysis of Variance (ANOVA) and HSD Tukey multiple range showed statistical differences between the three groups. The results showed that Cannero oranges have reasonable qualitative characteristics and good nutritional properties. Besides the production, this germplasm is the core symbol and a great resource of the historical rural landscape of Cannero Riviera.

5.2 Floating gardens and floating rafts. Planning without use of soil in agricultural and river landscapes

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Human intervention on the environment should always consider the respect, the protection and the preservation of nature. The use of bioengineering method provides to build solutions in harmony with the environmental requirements, which have the ability to get closer to natural developments of the landscape. The union between water and ground has allowed in the past, and currently permits, the develop sustainable agriculture through the use of forms of cultivation without the use of soil. Today, the opportunity to place directly on the water the floating structures, is an historical recovery of some agricultural and natural ancient environments. The floating gardens are floating structures on which vegetation grows. The main purpose of the floating gardens is to create habitats, purify water and improve landscape. The floating structure creates, near the shore, an artificial ecosystem through utilization of water surface instead of occupying the shoreline space. Since the floating structure uses floating platforms to support vegetation, it can move up and down with the fluctuation of water level, and also it can be move from place to place. There are five key-points that should be taken in good consideration to design a floating garden such as the stability, the durability, the landscape, the cost-effectiveness and the easily-construction. The floating structure is composed by the vegetation, a platform and a fixing system-anchor. Besides, according to their platform structure, the floating gardens are classified into two types, the dry type and the wet type. The cost and the size of a floating garden varies from the different type of structures, but transportability, workability, and durability must be always taken into account. After the installation of the floating structure it is necessary to conduct the monitoring for about 3-5 years to take mastering the change of surrounding environment and evaluating effects of the structure.

5.3 Tree risk management and biodiversity conservation: the case of Viale dei Roveri (oak tree avenue) at La Mandria, natural park in urban contest in NW Italy

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An avenue of centenary pedunculata oaks (*Quercus robur*) constitutes the main access to La Mandria Natural Park and the Borgo Castello (TO, Italy); it is an interesting cultural heritage site. The trees have not only historical and aesthetic interest, but also a great naturalistic importance, hosting a rich biodiversity, among which the saproxylic beetle *Osmoderma eremita*, a priority species under the Habitats Directive 92/43/EEC. Being most of the oaks senescent and scarcely vigorous, actions were undertaken during the last ten years, aimed at preserving public safety without compromising conservation. Risk was assessed using the Visual Tree Assessment (VTA) method; several trees were pruned and/or consolidated with specific ropes. Dead oaks were reduced to the trunk, as “totems” and, when possible, moved in a safe area using a mechanical tree transplanter, in order to maintain verticality, important for saproxylic communities. Last tree evaluations described a quick and progressive worsening of the general situation. Maintaining the avenue open to public access would have required even drastic pruning or felling of several oaks. Therefore, the park authority decided to stop pruning and cutting, believing it was more significant to conserve the remaining vitality of the oaks, as veteran and monumental trees, habitat for *O. eremita* and its community. Public safety was guaranteed by closing definitively the transit, transforming the avenue in an “open air natural museum”, and building a new dual approach to the park, both for pedestrian/bikers and for vehicles. Everything was possible also thanks to the contribution of Magneti Marelli S.p.A. (which main factory borders the park) that financed scientific researches on the *Osmoderma* by the Polytechnic of Turin and the project and building of ground anchorage for the oaks planted at the ends of the avenue.

5.4 Ecological and economical values of urban trees for a sustainable management: a case study in Trentino

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A sustainable management of urban trees, aimed at concealing both their economical and ecological values, should be the target of the choices of urban administrations. Difficulties arise because there are few attempts to quantify these values and to apply them in practical examples, trying to harmonize a correct management (pruning and substitution rate) of trees

with the landscape and their ecological role. In this work we evaluated the ecological compensation of a mature and even senescent tree line with different methods. We considered an *Aesculus hippocastanum* line, located in Trento (Italy) and planted in 1887. The 86 trees were pruned several times, topped in the 60's and suffered several windthrown; nevertheless, they have become a beautiful landscape component, but with huge management costs due mainly to recurrent pruning and several risks for evident rot problems. The ornamental importance of these kind of trees is well understandable and the replacement values can be calculated with mathematical systems, but their role as CO₂ sink is unpaired by ageing process and wood degradation and not well measurable. Alternatives able to conserve the tree importance as CO₂ sink, such as new plantations and solar power plants, were therefore considered. Even if several difficulties arose for the estimation of these ecological values and many criticisms are evident in all of these approaches, the best solution either for economical and ecological factors resulted to be a gradual substitution of single or groups of trees. In this way, also the landscape role and the risk control could be enhanced. But, of course, these strategies do not take into account the emotional impact on citizens. Because of the several lacks of data on these topics, the need of new research works is emphasized and suggested.

5.5 Rivalta, the knight's move in chess, why reconstruct a garden, hypothesis of reconstruction of the garden of the Ducal Palace in Rivalta of Reggio Emilia

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For a long time the municipality of Reggio Emilia has had the restoration of the remains of the Ducal Palace in Rivalta in its programs, supported by local residents, who have an admirable dedication to this complex. The focus of their attention has always been the eighteenth century garden, both for its extraordinary dimension and for the complexity of its structure, even if today only the external fence is still visible. But how useful can a garden be? The history of man has proved gardens have always played a fundamental role, for their cultural and representative characters and other very important aspects, which are eminently environmental and ecological. There are countless cases of gardens designed in the most difficult moments: symbolic and sacred founding acts of people who put their highest

aspirations of hope right in the trees. In 2008 the urge for a restoration started to be claimed with two different objectives: a scientifically precise renewal and at the same time an effective, economically and environmentally sound project of management and development. The outcome would certainly be a driving social and economic development, which would allow Reggio Emilia to further increase its prestige and its competitiveness in the international context confirmed by its candidacy as European Green Capital 2016. The project sets out the restoration as an anastylosis of the vegetation, reconstructed through an iconographic and documentary research, at the same time, it carries out a process of analysis of the environmental benefits for the region and the community. The garden of the Palace of Rivalta is a cultural heritage which can have also a high productive value. It is the crisis itself which should suggest the idea of a reconstruction of the ancient vegetation of the garden, it would be like the knight's move in chess. In a moment when many of the usual development pathways seem to be very difficult to follow, it would appear as an initiative that has the character of uniqueness and originality, which could act on the collective imagination as an idea of beauty and a sign of hope. It would be able to speak to those who live and know these places, but not only, because it could quickly find agreement, support and interest in a much wider public, which for the moment is elsewhere, but which could soon be at Rivalta.

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