The Changing Face of Global Urban Forestry

Cecil Konijnendijk van den Bosch

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My talk today

• Urban forestry revisited
• Drivers of change impacting urban forestry
• The changing face of global urban forestry
• Ways forward?
Glowing trees could light up city streets

25 November 2010 by Frank Swain

IMAGINE taking a midnight stroll, your route lit by row upon row of trees glowing a ghostly blue. If work by a team of undergraduates at the University of Cambridge pans out, bioluminescent trees could one day be giving our streets this dreamlike look. The students have taken the first step on this road by developing genetic tools that allow bioluminescence traits to be easily transferred into an organism.

Nature is full of glow-in-the-dark critters, but their shine is feeble - far too weak to read by, for example. To boost this light, the team, who were participating in the annual International Genetically Engineered Machines competition (iGEM), modified genetic material from fireflies and the luminescent marine bacterium *Vibrio fischeri* to boost the production and activity of light-yielding enzymes. They then made further modifications to create genetic components or “BioBricks” that can be inserted into a genome.

The team managed to produce a range of colours by putting these genes into the *Escherichia coli* bacterium. They found that a volume of bacterial culture about the size of a regular wine bottle gave off enough light to read by.

"We didn't end up making bioluminescent trees, which was the inspiration for the project," says team member Thomas Fearnley. "But we've laid the foundation for this type of project to work."

Street lamps with a difference (Image: Theo Sanderson)
Forestry Serving Urbanised Societies

IUFRO European Regional Conference, in collaboration with EFI
Copenhagen, Denmark, August 27-30, 2002

Organised in conjunction with the 9th EFI Annual Conference
Copenhagen, Denmark, August 26, 2002

Organised by:

IUFRO, International
Union of Forest Research Organizations

European Forest Institute

Danish Centre for Forest, Landscape and Planning
Change in focus at this conference

- Global changes and Changing cities
- The quest for green, healthy and competitive cities
- Changes and responses: governance and policy; management; research and innovation; education; community-based approaches
- Designing the urban forests of the future
MA Framework

**Human Well-being and Poverty Reduction**
- Basic material for a good life
- Health
- Good Social Relations
- Security
- Freedom of choice and action

**Indirect Drivers of Change**
- Demographic
- Economic (globalization, trade, market and policy framework)
- Sociopolitical (governance and institutional framework)
- Science and Technology
- Cultural and Religious

**Direct Drivers of Change**
- Changes in land use
- Species introduction or removal
- Technology adaptation and use
- External inputs (e.g., irrigation)
- Resource consumption
- Climate change
- Natural physical and biological drivers (e.g., volcanoes)

http://www.millenniumassessment.org
Demographic drivers of change
Europe’s ageing population

PROJECTED OLD-AGE DEPENDENCY RATIO
Number of persons aged 65 as a percentage of number of persons aged between 15 and 64.

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2060</th>
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<tbody>
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<td>Latvia</td>
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<td>Romania</td>
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<td>36.7</td>
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Source: Eurostat
W. Foo, 24/04/2013
Economic drivers of change
Ecosystem services = benefits people obtain from ecosystems

http://www.millenniumassessment.org
The value of the world’s ecosystem services and natural capital


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*** Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831, USA
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***** Ecological Economics Research and Applications Inc., PO Box 1359, Solomons, Maryland 20680, USA

The services of ecological systems and the natural capital stocks that produce them are critical to the functioning of the Earth’s life-support system. They contribute to human welfare, both directly and indirectly, and therefore represent part of the total economic value of the planet. We have estimated that the current economic value of 17 ecosystem services for 16 biomes, based on published studies and a few original calculations. For the entire biosphere, the value (most of which is outside the market) is estimated to be in the range of US$ 15–54 trillion (1013) per year, with an average of US$ 33 trillion per year. Because of the nature of the uncertainties, this must be considered a minimum estimate. Global gross national product total is around US$ 12 trillion per year.

Because ecosystem services are not fully captured in commercial markets or adequately quantified in terms comparable with economic services and manufactured capital, they are often given too little weight in policy decisions. This neglect may ultimately compromise the sustainability of human and the biosphere. The economics of the Earth would grind to a halt without the services of ecological life-support systems, so in one sense their total value to the economy is infinite. However, it can be instructive to estimate the “incremental” or “marginal” value of ecosystem services (the estimated rate of change of value compared with changes in ecosystem services from their current levels). There have been many studies in the past few decades aimed at estimating the value of a wide variety of ecosystem services. We have gathered together these large (but scattered) amount of information and present it here in a form useful for ecologists, economists, policy makers and the general public. From this synthesis, we have estimated values for ecosystem services per unit area by biome, and then multiplied by the total area of each biome and summed over all services and biomes.

Although we acknowledge that there are many conceptual and empirical problems inherent in producing such an estimate, we think this exercise is essential in order to: (1) make the range of potential values of the services of ecosystems more apparent; (2) establish at least a first approximation of the relative magnitude of global ecosystem services; (3) set up a framework for their further analysis; (4) point out those areas most in need of additional research; and (5) stimulate additional research and debate. Most of the problems and uncertainties we encountered indicate that our estimate represents a minimum value, which would probably increase: (1) with additional effort in studying and valuing a broader range of ecosystem services; (2) with the incorporation of more realistic representations of ecosystem dynamics and interdependence; and (3) as ecosystem services become more stressed and scarce in the future.

Ecosystem functions and ecosystem services

Ecosystem functions refer variously to the habitat, biological or system properties or processes of ecosystems. Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions. For simplicity, we will refer to ecosystem goods and services together as ecosystem services. A large number of functions and services can be identified: reference 5 provides a recent, detailed compendium on describing, measuring and valuing ecosystem services. For the purposes of this analysis we grouped these ecosystem services into 15 major categories. These groups are listed in Table 1. We included only renewable ecosystem services, excluding non-renewable fuels and minerals and the atmosphere. Note that ecosystem services and functions do not necessarily show a one-to-one correspondence. In some cases a single ecosystem service is the product of two or more ecosystem functions whereas in other cases a single ecosystem function contributes to two or more ecosystem services. It is also important to emphasize the interdependent nature of many ecosystem functions. For example, some of the net primary production in an ecosystem ends up as food, the consumption of which generates respiratory products necessary for primary production. Even though these functions and services are interdependent, in many cases they can be added because they represent “joint products” of the ecosystem, which support human
Sociopolitical drivers of change
We are all connected.

From the smallest ant to the tallest tree,
From the birds roaming the skies to the fish swimming in the sea,
Each and every creature is part of the biodiversity family.
LET’S PROTECT OUR FAMILY.
Conserve biodiversity now.

For more information on biodiversity conservation, log on to
www.aseanbiodiversity.org or chm.aseanbiodiversity.org
How Our Health Depends on Biodiversity

Eric Chivian M.D. and Aaron Bernstein M.D., M.P.H.
Cultural and religious drivers of change
Slide courtesy of Kristian Skaarup
Focus on Urban Design
“Retrofitting our cities for happiness”
Soft traffic, shared space
Density and the ’savannah trap’
Importance of biological complexity
MA Framework

Human Well-being and Poverty Reduction
- Basic material for a good life
- Health
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- Freedom of choice and action

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Ecosystem Services

http://www.millenniumassessment.org
Direct drivers of change

- Changes in land use
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- Natural and physical biological drivers
Urbanisation in Europe
2000 - 2006

Change from natural to artificial surface area per 100 km² (10x10 km cells)

- < 0.5 km²
- 0.5 - 1 km²
- 1 - 2 km²
- 2 - 5 km²
- > 5 km²

Urban areas 2000
no data

Source:
(UK is included from version 15)

Christian Fertner
University of Copenhagen
chfe@life.ku.dk
July 2011
Sjöman et al. (2012)

Species diversity in parks vs streets

<table>
<thead>
<tr>
<th>City and site situation</th>
<th>Arhus</th>
<th>Copenhagen</th>
<th>Espoo</th>
<th>Gothenburg</th>
<th>Helsinki</th>
<th>Malmo</th>
<th>Oslo</th>
<th>Stockholm</th>
<th>Tampere</th>
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<td>0</td>
<td>24</td>
<td>48</td>
<td>0</td>
<td>29</td>
<td>61</td>
<td>0</td>
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<td>54</td>
<td>0</td>
<td>60</td>
<td>113</td>
<td>196</td>
<td>54</td>
<td>110</td>
<td>0</td>
<td>110</td>
</tr>
</tbody>
</table>

Number of species

- 0 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
Inducing physiological stress recovery with sounds of nature in a virtual reality forest – Results from a pilot study

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E National Research Centre for the Working Environment, 2100 Copenhagen, Denmark

HIGHLIGHTS

• Stress reactions were induced with virtual reality TSST.
• Virtual reality nature facilitated the recovery from stress.
• Nature sounds combined with virtual nature activated the parasympathetic system.
• Experimental studies on human-nature interactions may use virtual techniques.

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Article history:
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Keywords:
TSST
Cortisol
Green environment
Soundcape
Heart rate variability

ABSTRACT

Experimental research on stress recovery in natural environments is limited, as is study of the effect of sounds of nature. After inducing stress by means of a virtual stress test, we explored physiological recovery in two different virtual natural environments (with and without exposure to sounds of nature) and in one control condition. Cardiovascular data and saliva cortisol were collected. Repeated ANOVA measurements indicated parasympathetic activation in the group subjected to sounds of nature in a virtual natural environment, suggesting enhanced stress recovery may occur in such surroundings. The group that recovered in virtual nature without sound and the control group displayed no particular autonomic activation or deactivation. The results demonstrate a potential mechanistic link between nature, the sounds of nature, and stress recovery, and suggest the potential importance of virtual reality as a tool in this research field.
Ecosystem services provided by urban trees

- Air pollutant reduction (O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, PM<sub>10</sub>)
- CO<sub>2</sub> sequestration
- Energy savings & avoided emissions due to shading
- Stormwater runoff reduction
- Aesthetic value (increased market value)

http://theriverwhisperer.blogspot.se/2012/01/ecosystem-services-provided-by-urban.html
Essential urban forests
Resilience

The capacity to recover quickly from difficulties; toughness

http://www.oxforddictionaries.com/definition/english/resilience
Tree Diversity Conference 2014

Our urban forests are under siege from disease, aging canopy, budget constraints and more. Leading experts on creating a vibrant urban canopy from across America will launch this first event of its kind in Colorado.

Continuing Education Credits available for arborists.
Certification with International Society of Arboriculture (ISA)

MORE. TREE. TYPES.

Lindsay Auditorium, Room 281
Sturm Hall, University of Denver

Map and directions to the Lindsay Auditorium and Parking options on campus will be provided to all registrants.

Attendance $60 per person. $35 for registered students. Includes Panera box lunch. Prompt payments made by credit or debit card by logging on to www.paypal.com and clicking on the “Send Someone Money” button. Specify that the payment be made to 2014treediversityconference@gmail.com in the field “Their Email.” Please include the names of all the people you are registering in the comments box on the PayPal form. The charge will show up on your credit card statement as 2014treediversityconference.” Refunds of fees will not be available after 2/28.

Contact Sonia John (soniajoao@aol.com) for details.

Friday, March 7, 2014

Time: 9AM-4:30PM

Presented by
The University of Denver Chester M Alter Arboretum &
Denver Botanic Gardens

Committee: Rob Davis, Denver City Forester; Sonia John;
Panayoti Kelaidis, Denver Botanic Gardens; Martin Quigley, D.U.
Urban Tree Diversity congress
Alnarp, Sweden, June 2014

• Diversity is desirable
• Long-term thinking – build on ‘future tree species’
• Awareness raising
• Diversity starting from the nursery
• Linking planning, design, establishment, maintenance
• Native versus Exotic (or: non-debate?)
• Tree diversity, People diversity
• Need to challenge ourselves and step away from ‘business as usual’
• Good practices exist across the globe
MELBOURNE'S URBAN FOREST

60,000 COUNCIL TREES
$650m AMENITY VALUE
22% CANOPY COVER

LOW DIVERSITY
Just three species - plane, elm and red river gum make up more than 35% of Melbourne's trees

AGEING
Some of our grandest trees are nearing the end of their lives

HIGH VULNERABILITY

Fitzroy Gardens now

CITY OF MELBOURNE EXPECTS TO LOSE

- 27% of trees in 10 years
- 44% of trees in 20 years

CHALLENGES

Pests & Disease
Myrtle rust could affect almost 45% of Melbourne's trees

Climate change
Victoria's temperatures are predicted to increase into the future
Victoria has recorded five of its ten hottest years since 1999**

Increasing Population & Density

THE FUTURE

OUR VISION
The City of Melbourne's urban forest will be resilient, healthy and diverse and will contribute to the health and wellbeing of our community and to the creation of a liveable city.

URBAN FOREST STRATEGY TARGETS
1. Increase canopy cover - 40 per cent by 2040.
2. Increase diversity - no more than 5% of one tree species, 10% one genus, 20% one family.
3. Improve vegetation health - 90 per cent of tree population healthy by 2040.
4. Improve soil moisture.
5. Improve biodiversity.
6. Inform and consult with the community.

CITY OF MELBOURNE

Slide courtesy of Ian Shears, City of Melbourne
What is Green Infrastructure?

Green Infrastructure can be broadly defined as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings.

More specifically GI, being a spatial structure providing benefits from nature to people, aims to enhance nature’s ability to deliver multiple valuable ecosystem goods and services, such as clean air or water.
Welcome!

We need nature in our lives more than ever today, and as more of us are living in cities it must be urban nature. Biophilic Cities are cities that contain abundant nature; they are cities that care about, seek to protect, restore and grow this nature, and that strive to foster deep connections and daily contact with the natural world. Nature is not something optional, but absolutely essential to living a happy, healthy and meaningful life. This site is devoted to understanding how cities can become more biophilic, more full of nature, and to telling the stories of the places and people working to creatively build these urban-nature connections.
Comanagement
(e.g., comanagement/ CBNRM, forests, fisheries, water)

Public-private partnerships
(e.g., concessionary arrangements, logging, mining)

Private-social partnerships
(e.g., payments for ecosystem services, certification, carbon sequestration, ecotourism)

State

Community

Market

Slide courtesy of Bas Arts
Combining abilities, creating synergies, enhancing performances.
Biocultural Diversity

“(…) the diversity of life in all of its manifestations: biological, cultural, and linguistic, which are interrelated (and likely coevolved) within a complex socio-ecological adaptive system” (Maffi & Woodley, 2010)

- Human valuations and uses of nature
- Biocultural expressions – focus on concepts, physical elements
- Public ecology, transdisciplinary inquiry – social learning, connecting professionals, people and places
Nature & Creativity

How and why nature enhances human creativity

Trine Plambech, LAK 10054
Supervisor Prof. Cecil C. Konijnendijk
Master Thesis in Landscape Architecture, September 2012
Forest & Landscape, Faculty of Science, University of Copenhagen
Nature and the creative process

Source: Plambech (2012). Adapted from Mikkelsen (2009)
Parks and Public Spaces  Sustainable and healthy mobility  People friendly public realm  OpenStreets Programs

http://www.8-80cities.org
Reduced health inequalities in green areas (Mitchell & Popham, 2008)

"Effect of exposure to natural environment on health inequalities: an observational population study"
Recreation use of urban forests: An inter-area comparison

Arne Arnberger*
Perspective

- Urban forestry has become global – but is also at a crossroads
- Urban forestry with resilience, biocultural diversity and ecosystem services in mind
- Urban forestry as contributor to e.g., urban resilience, green infrastructure
- Finding the essence of urban forestry