Urban Nature’s Services Infrastructure: Challenges in Implementation and Ideas of Nature

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Sustainability – The New Role of the City

- Cities now concentrate over 50% of human population
- Biophysical scientists acknowledge ahistorical bias of ecology and artificiality of “pristine state” (Cronon in McDonnell & Pickett 1993)
- Humans are recognized as agents of ecological and planetary geochemical change (Vitousek et al, 1997)
- (Re)Turn to studying cities and urban ecology from ecology in the city to ecology of the city
- Cities are looked at for their capacity to remediate some of their own environmental impacts (Alberti 1996, Rees and Wackernagel 1996, Grimm et al. 2008)
- Cities test beds in which to establish more sustainable ways of living (Hodson and Marvin 2009)
Ecosystem Services – the application of biophysical science to the city

- Ecology: the explicit knowledge for planning the sustainable city (Evans 2009)
- The city as laboratory: Baltimore LTER, Arizona CAP, Portland State University Center for Sustainability, ULTRA Ex and promised ULTRA
- Urban Ecology’s Social-Ecological Systems research program conceives of the city as an integrated system – promoted through coupled bio-social research funding
- Experimental governance toward resilience and sustainability through adaptive learning is the objective
From the Sanitary City of the Twentieth Century to the Sustainable City of the Twenty-first Century

- The scientific discipline of ecology set to play as important a role in shaping the cities of the twenty-first century as the sanitary engineers did in the nineteenth.

- But how is the change effectuated? Sanitary city came with Progressive Era.

- How do the governance institutions evolve and change?

- Does there need to be a more explicit link to a social project? What might it be, where does it fit – or not?
The Nature’s Services
Infrastructure

- Urban Forests “Amenities(?)” or Prerequisites for a Sustainable City? How do we know what is necessary, where and at what scale and intensity? Can we know, How much research will be needed?
- Trees cool heat island
- Mitigate stormwater flows
- Sequester air pollution & CO2
- Encourage walking and improve property values
Low Impact Development

- Stormwater management that emphasizes conservation and the use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial and industrial settings

Washington State University Puget Sound Action Team

- Emphasizes local, decentralized solutions that capitalize on the beneficial services that natural ecosystem functions can offer
BES and CAP

- Big science, many projects and ambitious goals
- Manipulation of residential landscapes in North Desert Village
- Understanding biophysical processes in urban impacts environment(s)
- BES assertion that there should be policy maker, environmental manager, educators, general public stake in outcome of BES understandings.
- BES Patch dynamics to interact with urban design professions and theoretical approach to landscape ecology
  - Explore ecologically based urban designs
- ETC. . . And the policy link?
Portland State University

- $25 million challenge grant from Miller Foundation for research and projects focused on sustainability: Center for Sustainable Processes and Practices
- Portland a living laboratory
- Multidisciplinary research
  - Integration of human societies and natural environment
  - Creating sustainable urban communities
  - Implementing sustainability and mechanisms of change
  - Measuring sustainability
Los Angeles Million Tree Program: Ecosystem Services in Anthropogenic Landscapes
an example of ecosystem service implementation

- City of Los Angeles dominated by anthropogenic landscapes
- Highly impermeable, more than 80% of rainfall runs off to ocean
- More highly diverse vegetation than pre-settlement
- What are the objectives of the use of vegetation and biological processes in an urban area?
- What are the implementation issues?
Our Urban Tree Research

- Implementation of a new program: my emphasis
- Tree functioning in the urban environment, specifically Mediterranean climate (D. Pataki)
- Real estate impacts of canopy cover (J.D. Saphores)
- Urban heat island effect of canopy cover (S. Saatchi)
Million Trees

- Mayor of Los Angeles, candidate promises to make Los Angeles the greenest city in the country: planting a million more trees.

- Already the city has a higher tree canopy than Baltimore, and just a little less than NYC.

- Little evidence that urbanized plain was highly forested, hence an afforestation program.
Economic analysis of canopy cover and land use value shows that there is a relationship between canopy cover and property values, but not for multiple family dwellings in low income neighborhoods. For single family, there is evidence that parcel trees decrease value slightly, but increase with neighborhood trees. J.D. Saphores

There is a correlation between vegetation cover and heat distribution in the city. This is very strong for areas of tree cover and weak for percent areas covered by grass, suggesting that trees contribute substantially to reducing the heat in the city. There has also been an overall increase in surface temperature in the past 30 years over the city, especially in the summer. S. Saatchi
S. Saatchi et al.
Tree species and water use efficiency – D. Pataki

- Trees species vary greatly in water use efficiency.
- Most efficient species were evergreen and from parts of the world where there is high vapor pressure deficits (such as Australia).
- Water requirements of 1 million new trees will depend on species and location
- Could be as low as 1 – 2 million gallons/yr, or as high as 60 million gallons/yr.
- What is the effect on cooling of high vs low water consumption of trees?
Implementation issues -- Whose Job is it to Implement?

- Utility provider since trees lower heat island?
- Sanitation department since trees mitigate stormwater?
- Air pollution district since trees sequester air pollution?
- Health department since trees encourage walking hence improve health?

(LA program started in Public Works. . . But perceived political problems and gets shifted to Mayor’s Office. . .)
And how is tree planting funded?

- Trees – like most nature’s services – mitigate, or help avoid “costs” to health, air pollution, water pollution and run off, urban heat island, among others.

- Avoided costs are not streams of revenue.

- No linkage exists between increased property values and providing a stream of funding to plant more trees, for example.

- No linkage exists between reduced energy expenditures because of cooling effects of trees and funding to plant trees.
The funding of Million Trees
Los Angeles Million Trees

- Los Angeles is tax restricted.
  - Proposition 13 of 1978 slashed property taxes and redistributed them to the state to reallocate.
  - Proposition 218 requires a 2/3rds majority vote for any new tax increases

- No new revenues exist for new programs
  - The Mayor promises to fund raise from private entities
Implementation becomes opportunistic: program must succeed!

- No new government money (and as it turns out little private money either!)

- A reliance on the private nonprofit sector
  - Creation of a public/private partnership
  - Some participation by “wealthier” city departments
  - Cobbling together of pots of funds
    - Settlement from the Air District to the local municipal utility that in turn provides it to Million Trees LA to pay non profits to plant trees
    - Community Redevelopment Block Grant money
    - State Forestry grants
    - Home Depot and other philanthropic donations
An opportunistic heterarchic system with complex interdependencies and multiple agreements – implications for a city’s new infrastructure, what happens in a system of eroded governmental capacity

• Competition for funds among NGOs – rivalry and distrust
• Lack of transparency and accountability
• Lack of plan and guiding science due to under capacity at level of city – investment in a possibly unhelpful green infrastructure (no city arborists involved in direction, planning or implementation)
• No public information provided about program’s direction, no possibility of public input or participation in overall idea – undermines democratic process of city government, program has lots of skeptics
And what about the other costs?

- Nature’s services infrastructure has costs
  - Water use by trees, unaccounted for in analysis of urban forestry.

  Los Angeles expected to become drier, water is imported from afar, high energy costs in transporting water to the region (except for Owens Valley), and water to be more scarce.

  Residents must agree to have tree, and to water/maintain it for 5 years

  Resident must get permission to plant tree (10 steps)

  Maintenance of trees in public planting strips in Los Angeles is assumed by residents.

  Case of private cost, public benefit, but for sustainability?

  Where is the public project?
And not all parts of the city are created equal

Low income communities of color have the lowest tree canopy cover

They are the most crowded with multiple family units and the least amount of room for more trees

And are the neighborhoods least likely to want more trees
Existing Canopy Cover in LA: Canopy cover tracks with income
A conundrum of complexities

- City governments are a product of twentieth century rational comprehensive planning and the application of engineering and biological science to create healthy and efficient living environments.

- Siloed, specialized departments run by professionals trained in specific disciplines

- Budgets are allocated accordingly

- Ecological services cut across traditional functions and services and avoid costs that are multiple and diffuse

- Will require substantial changes in urban fabric and in property rights and uses
ULTRA EX: Dynamics of Ecosystem Services and their Relationship to Ecohydrology

- What is the institutional framework for water management in Los Angeles?
- What is the magnitude and variability of landscape water use in the city?
- What is the spatial distribution of urban vegetation, how does it relate to landscape water use and sociodemographic differences?
- What ecosystem services are supported by landscape water use and what are some of the costs of such services?
Socio-Ecohydrology

Best management practices
Optimize tradeoffs of ecosystem services and disservices; reduction of risk, vulnerability, and inequity; graduated water pricing; vegetation management

Water management
Institutional frameworks; water delivery; water rates and pricing; importation, treatment, and distribution of water

Ecosystem services
Services provided by outdoor water use and associated vegetation

Urban vegetation and landscape water use
Magnitude and variability in outdoor water use; spatial distribution of vegetation

Chris Boone
ULTRA Ex Challenges

- OK relationship with Department of Water and Power but no guarantee our research will affect policy
- Highly fragmented agency inside
  - Water disconnected from power
- Dominated by power provision issues (solar fights)
- Ancient data collecting system, reluctance to invest in new technologies (e.g. dual metering and other)
- Team needs to build strong relationships with other partners and stakeholders like NGOs and others
Longer term

- What is the magnitude, spatial variability and temporal distribution of ecosystem services in the LA metro region?

- How do urban processes affect ecosystem services in the surrounding watersheds and National Forests?

- Can we optimize tradeoffs between ecosystem services and disservices?

- Which nature’s services ecosystems can, and should be integrated into the urban fabric and by what criteria should they be selected?
Urban Ecological Services

- These may or may not be using system components that are “natural” to place.
- Los Angeles – for example – is characterized by highly biologically diverse, non-native plants, and imported water.
- But trees are biogenic infrastructure: living machines.
- And LIDs use soil life and plants that also are alive.
- Living infrastructure has its own management requirements that are not integrated into current municipal (or other) governmental systems.
Path Forward is Uncharted

Similarly to the early 20th century when the science of communicable disease and sanitation was new, and there needed to be new agencies and infrastructure, the sustainable city of the twenty-first century is facing new challenges of pollution, resource scarcity and the possibility of a new paradigm.

Ecological Services infrastructure will need to be created, be place specific, implemented by new organizational structures, and financed in novel ways
Sustainable Cities in the Twenty-First Century

- For cities to become sustainable into the twenty first century there needs to be a reform of municipal organizational structure and financing of services.
- Residents of cities will face land use change, landscape changes and possibly new responsibilities.
- Avoided costs will have to have a funding stream.
- In a time of budget constraints, of delegitimation of government of outsourcing and reliance on the nonprofit sector, how to maintain the traditional public sphere of accountability, transparency, public participation of government?
Cities offer great potential for reducing environmental impacts using biological services to make them more sustainable

- But there are numbers of questions . . .
  - What does biodiversity mean in an urban context?
  - Are there do’s and don’ts and what do they look like? Who decides?
  - Where will fundamental municipal reform come from that will be needed to realize the new city?

- How are they implemented? Who pays and who benefits?
- How and where does science fit in?
- Is this not a social and political project where there will be new winners and losers? Can it be accomplished without a revitalization of the public sphere and civic engagement?