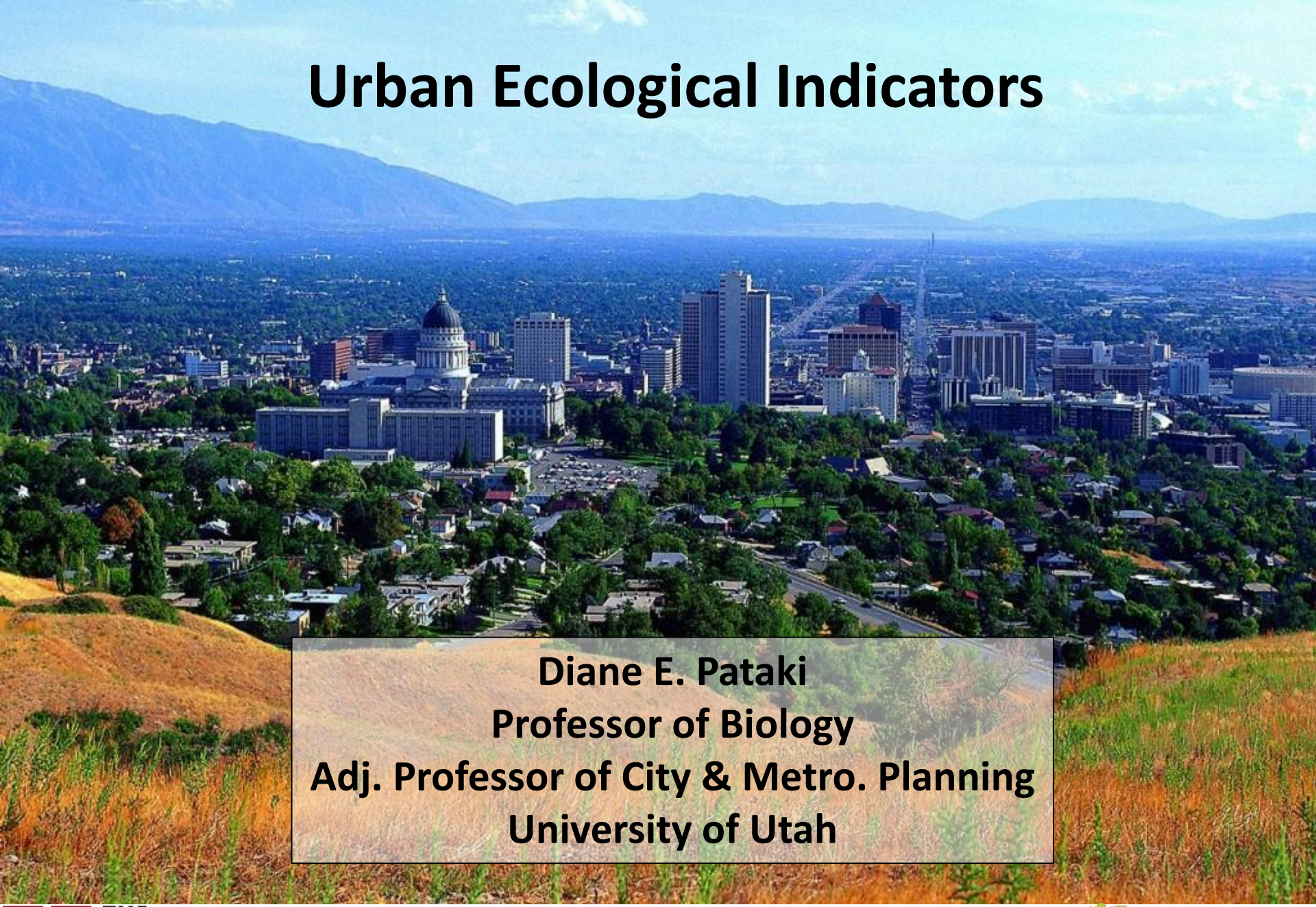
Urban Ecological Indicators



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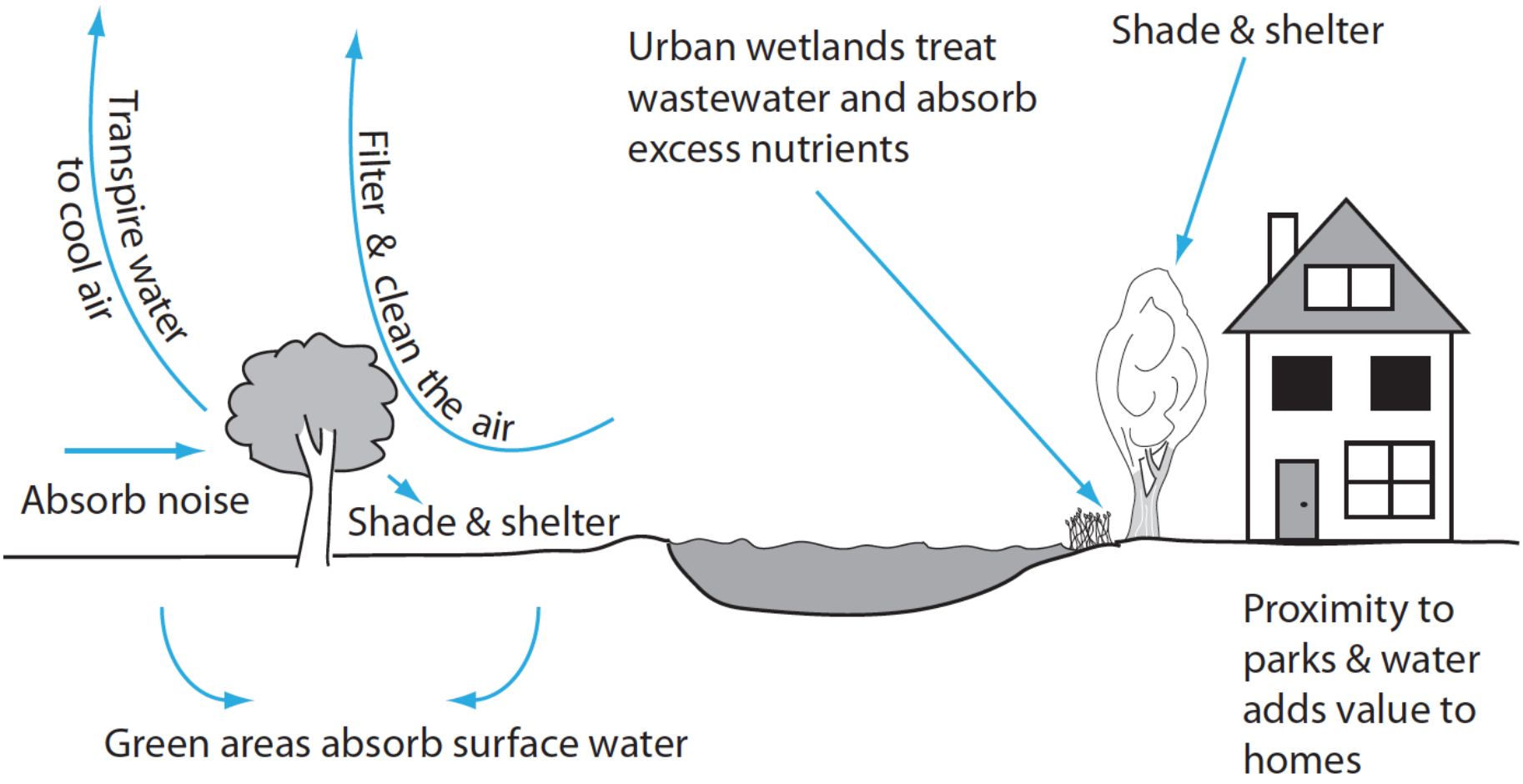
What do we want to measure?

- Environmental impacts
- Non-human biological processes
- Whole ecosystem structure and function

What is the role of the non-built environment in urban sustainability?



aka Ecosystem services

Provisioning Services

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic Resources

Regulating Services

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

Cultural Services

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

Supporting Services

- photosynthesis
- plant growth and allocation
- competition and facilitation

Millenium Ecosystem Assessment 2003

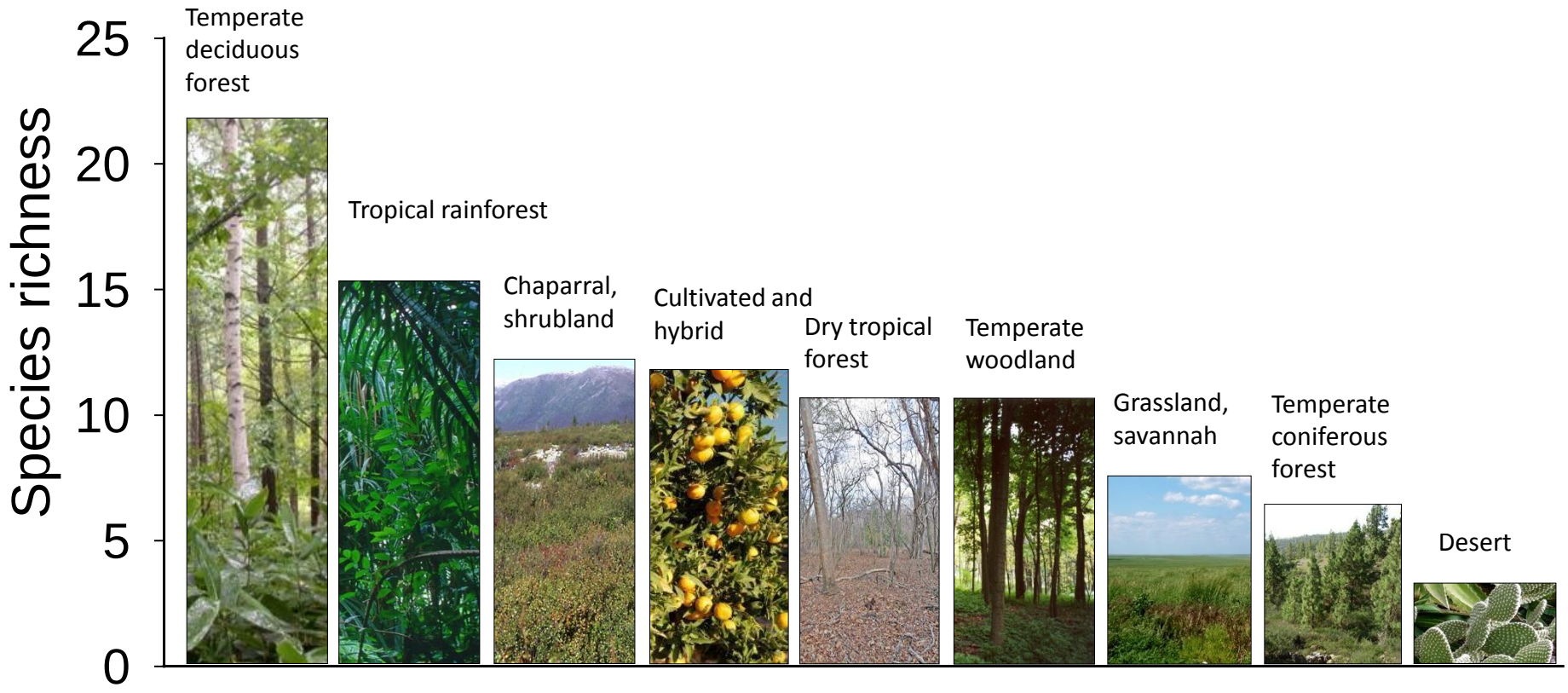
What has been done:

- *Remote sensing and ground inventories of urban forest cover*
- *Some surveys of urban biodiversity*
- *Development of urban ecosystem services valuation tools*

Pataki et al. 2009 *Ecological Complexity v. 6*

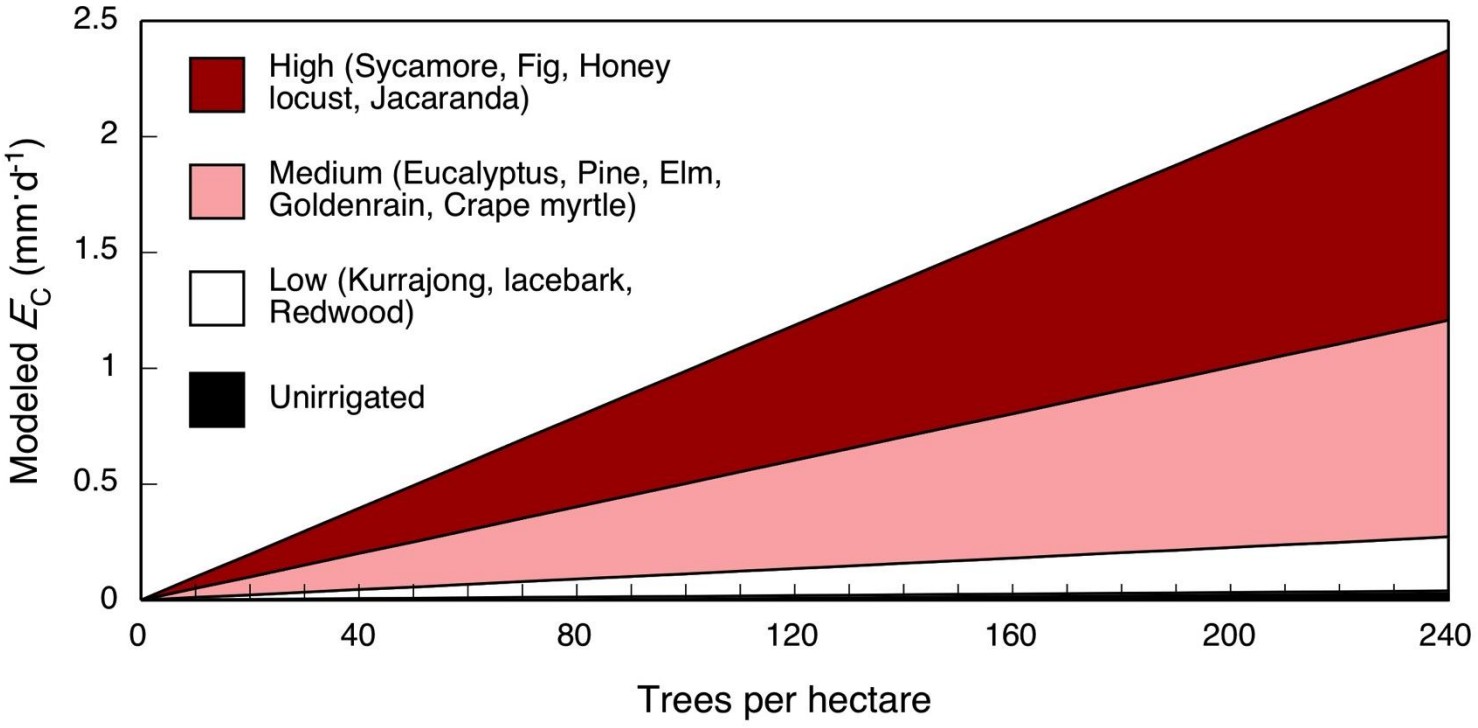
Knowledge gaps:

- *Biodiversity metrics appropriate for urban areas*
- *Relationship between specific aspects of the non-built environment and well-being*
- *Context for quantifying urban ecosystem services*



Clarke et al. 2013 *Landscape and Urban Planning* v116

All species are not alike



Pataki et al. 2011 *Ecol Applications* v21

Nature matters for well-being, but what kind?

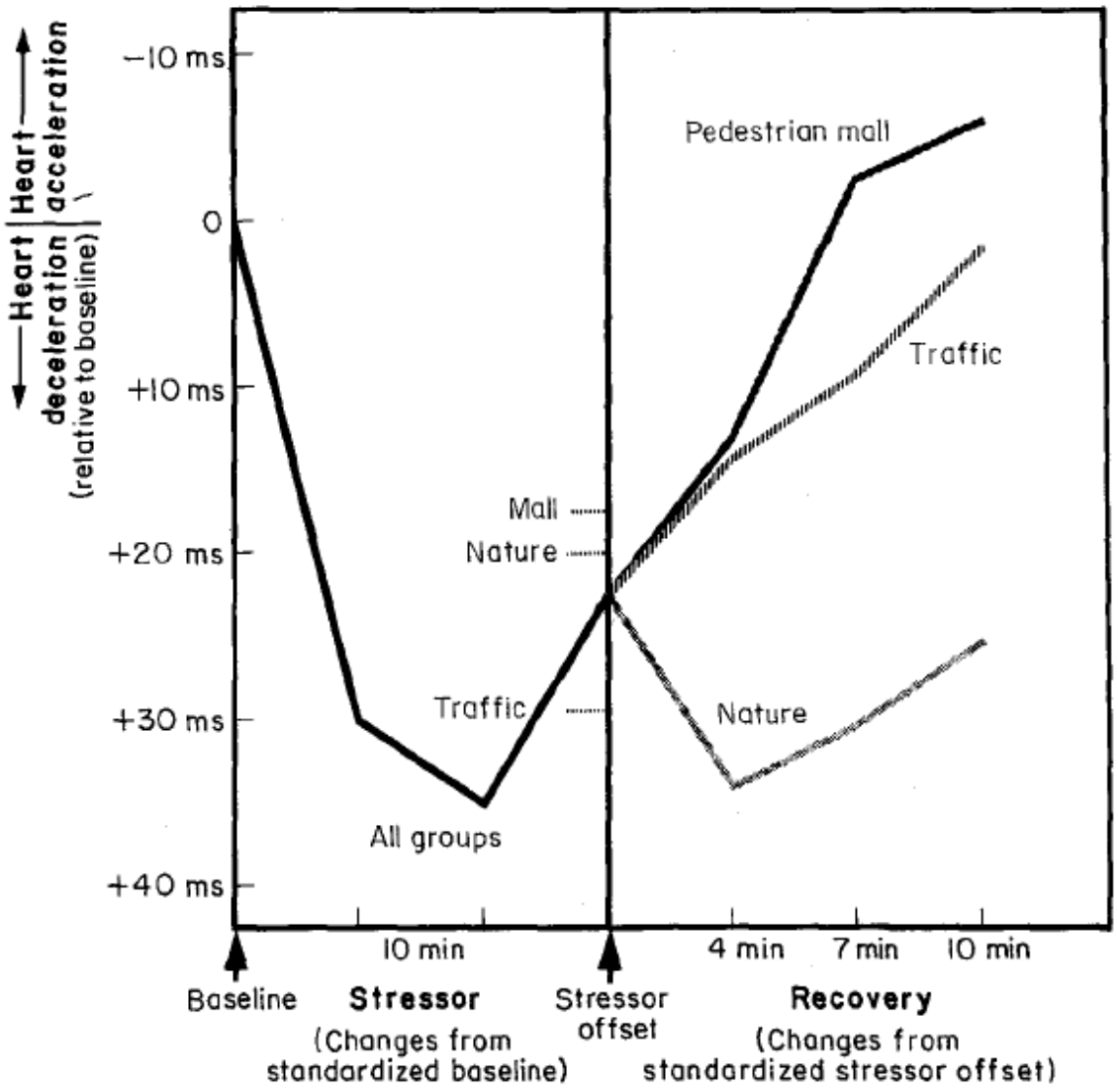
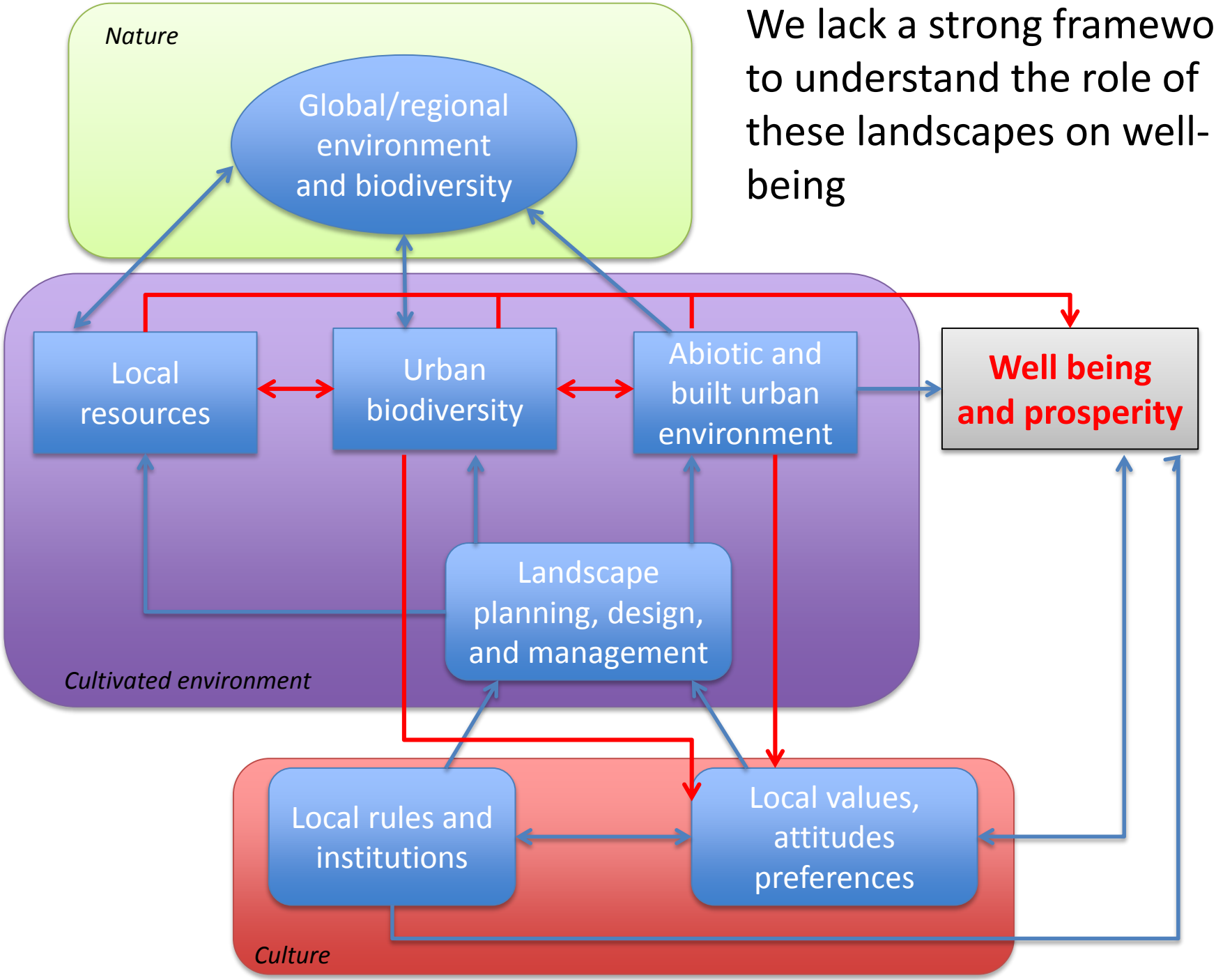


FIGURE 4. Changes in heart period (HP) during stress and recovery.

Ulrich et al. 1991 *J of Environmental Psychology* v11


wallpaper sumitted by www.wallcoo.com | May 2006

We lack a strong framework to understand the role of these landscapes on well-being

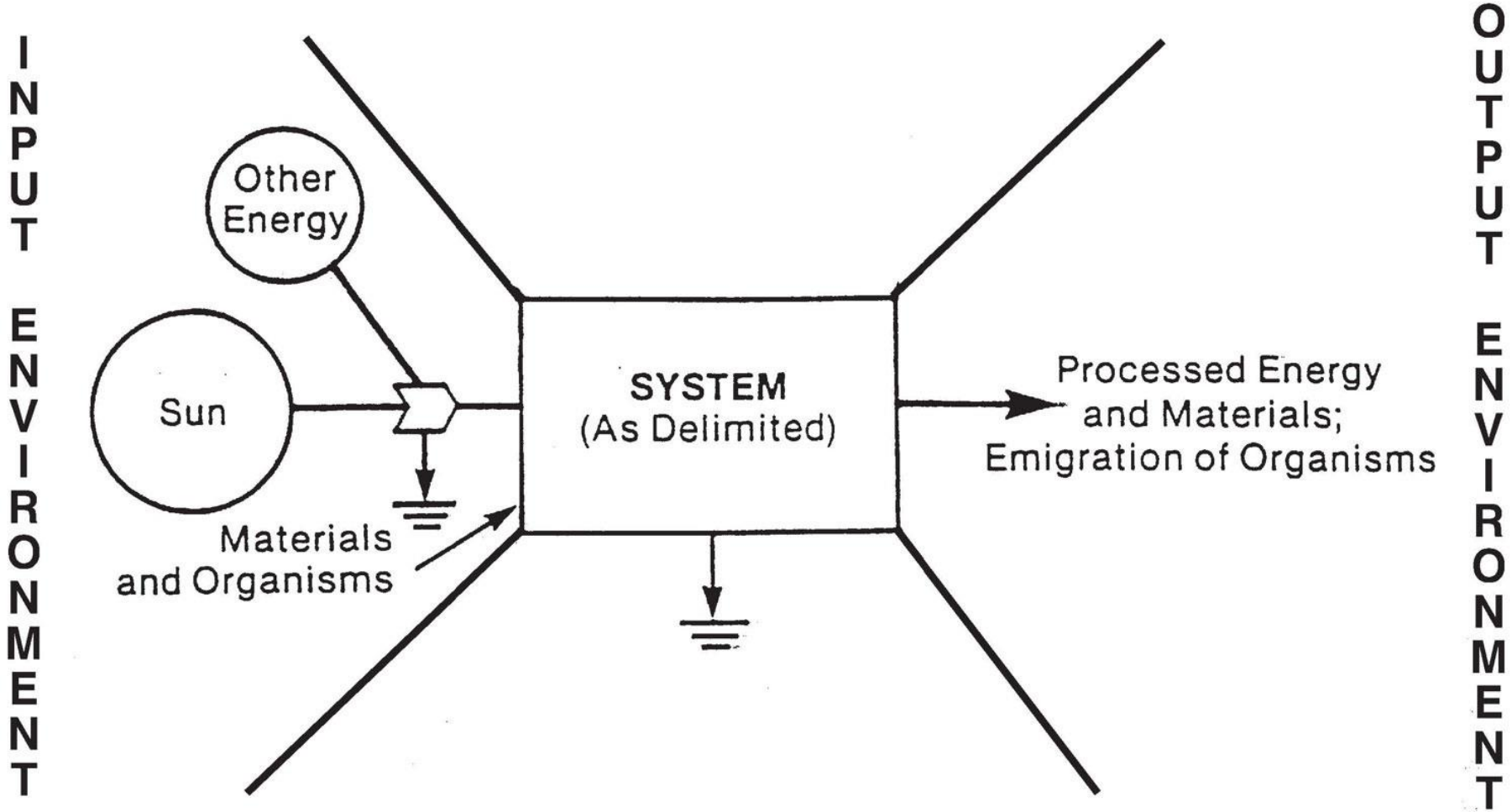


State of knowledge in urban ecosystem services and "disservices"

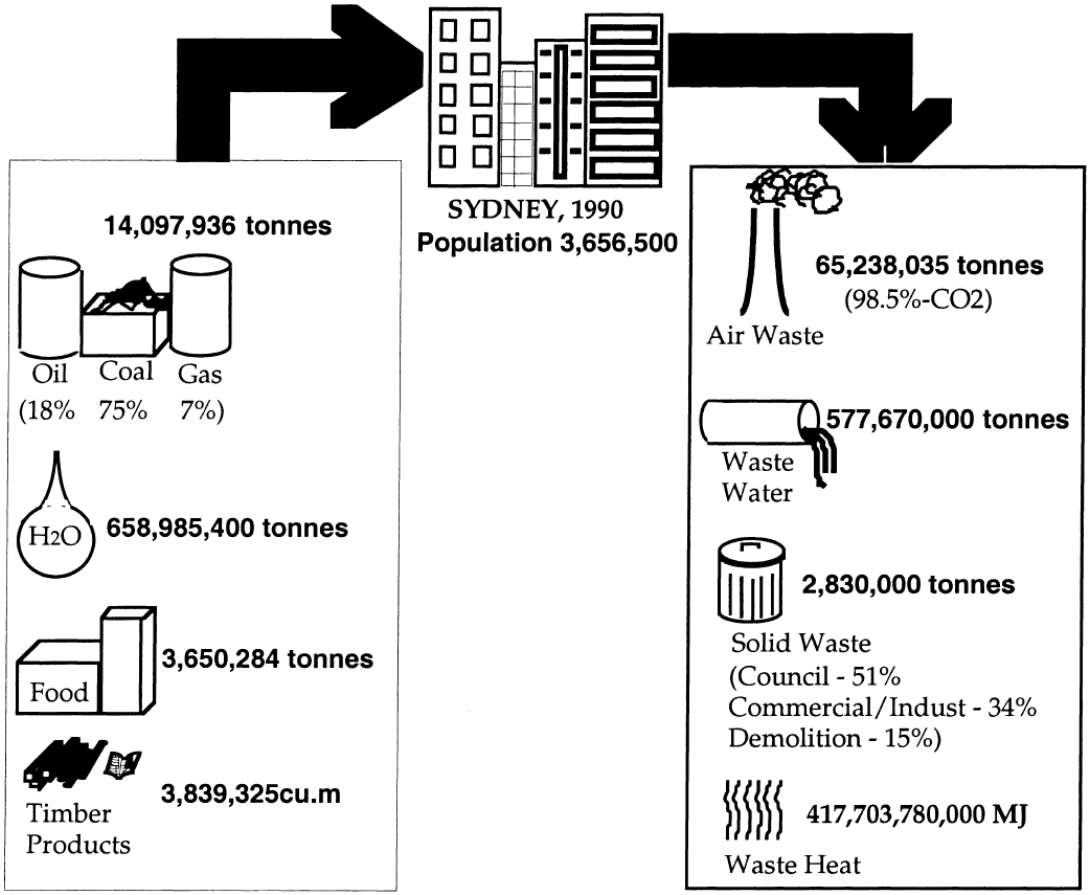
Ecosystem service	*Potential magnitude*	*Current level of uncertainty*
C sequestration	Low	Low
Net GHG emissions	Moderate	High
Local cooling	High	Moderate
Stormwater mitigation	High	Moderate
Water-quality mitigation	High	High
Air-quality mitigation	Low	High
General human health	Moderate	Moderate
Ecosystem disservice	*Potential magnitude*	*Current level of uncertainty*
Water use	High	Moderate
Net GHG emissions	Moderate	High
Source of allergens	High	Low
VOC emissions	Moderate	Moderate

Pataki et al. 2011 *Frontiers in Ecology and the Environment* v.9

Whole ecosystem mass and energy lows: urban metabolism, ecological footprints, and LCA



Mass and Energy Inputs and Outputs: Urban metabolism



Notes:
Waste water data do not include stormwater
Timber products and food data derived from national per capita data

Newman 1999 *Landscape and Urban Planning* v.44

Limitations include:

- *"black box" approach*
- *Lack of available data*
- *Variable and uncertain system boundaries*

http://www.energyatlas.ucla.edu

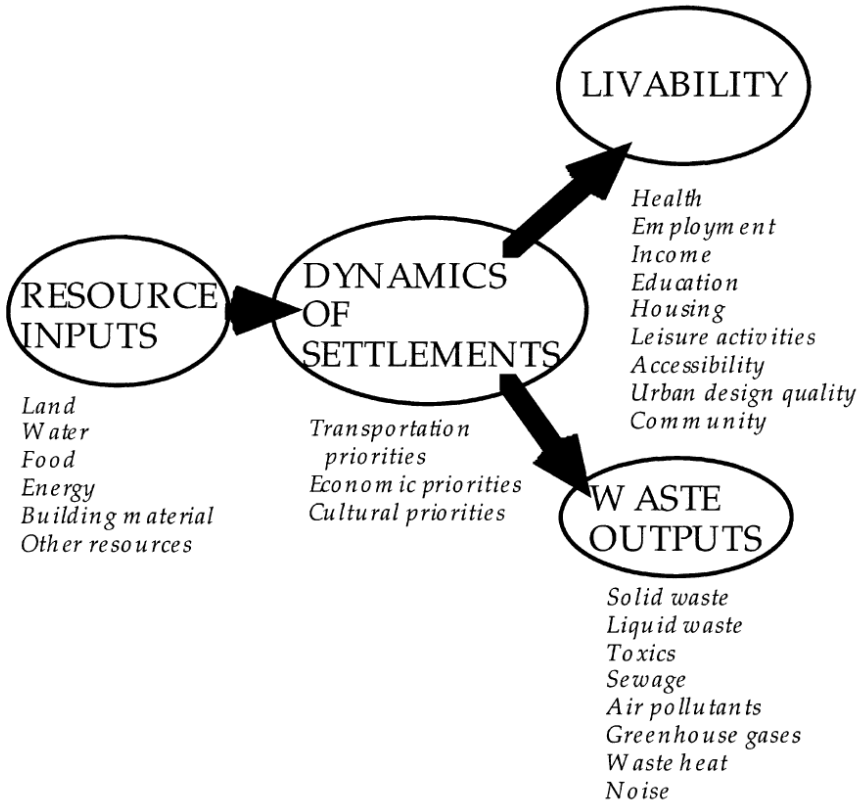


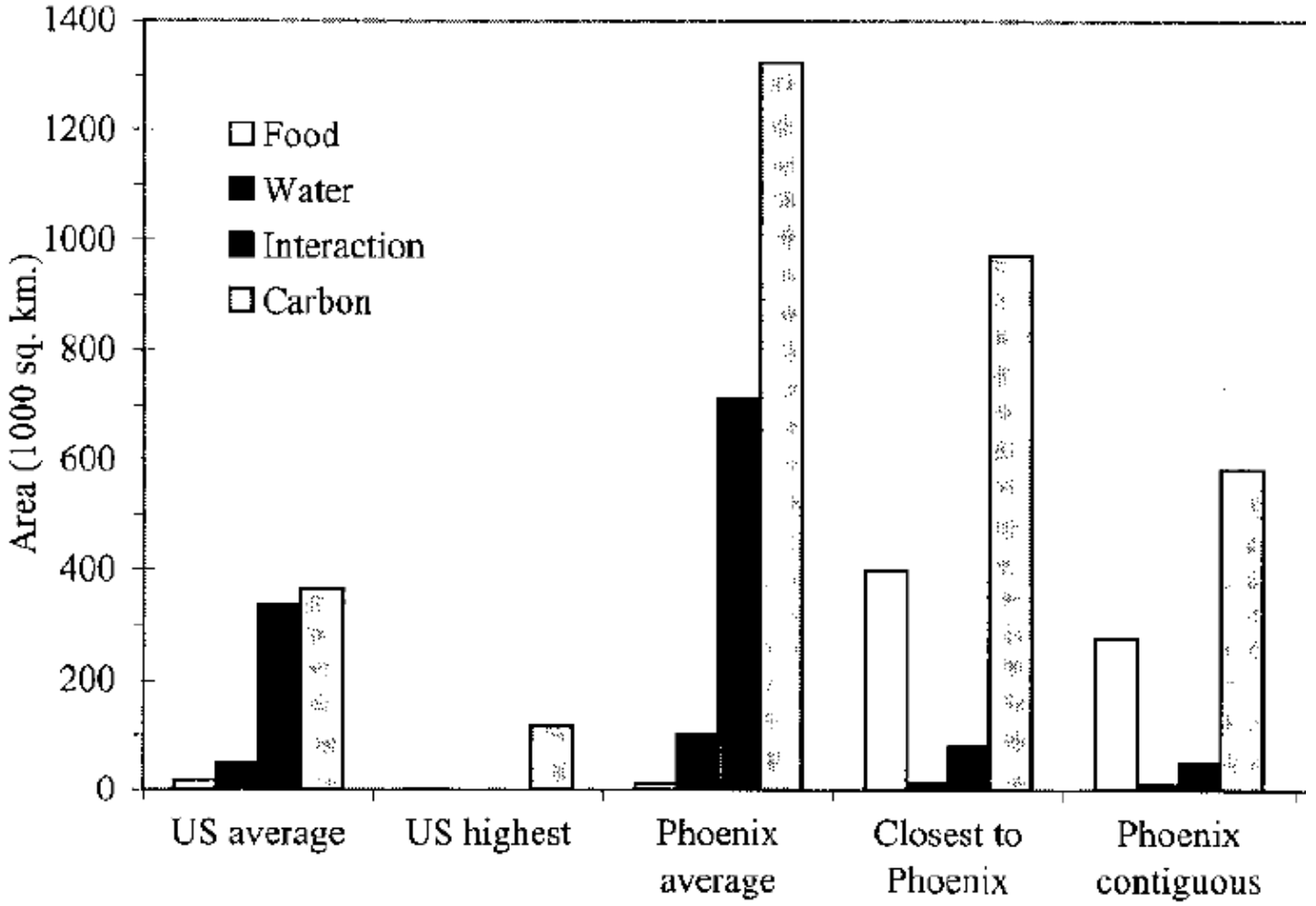
Fig. 1. Extended metabolism model of human settlements.

Newman 1999 *Landscape and Urban Planning* v.44

Ecological footprints attempt to account for remote resource extraction and impacts

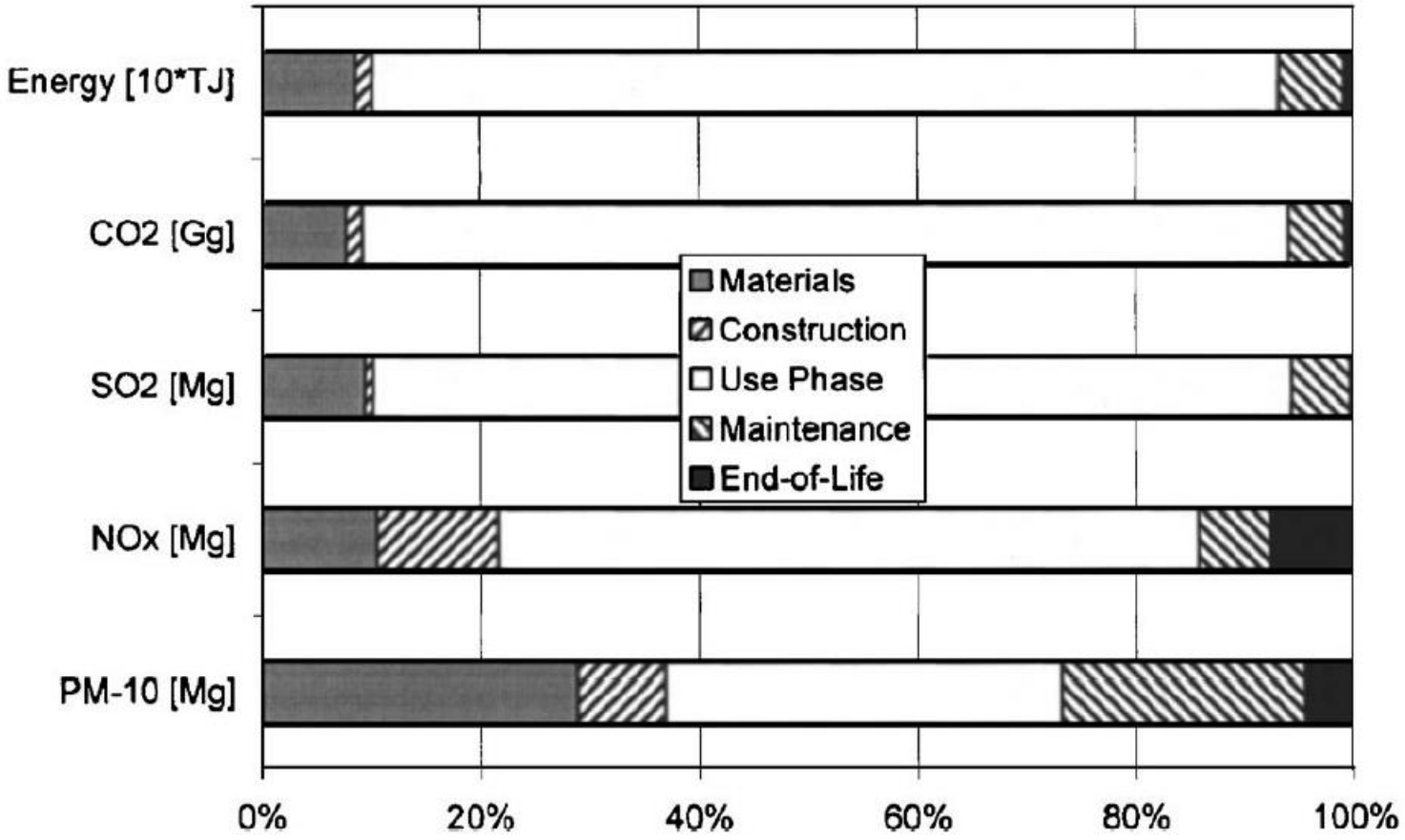
Wackernagel et al. 1999 *Ecological Economics* v. 29

EF calculations are highly sensitive to assumptions



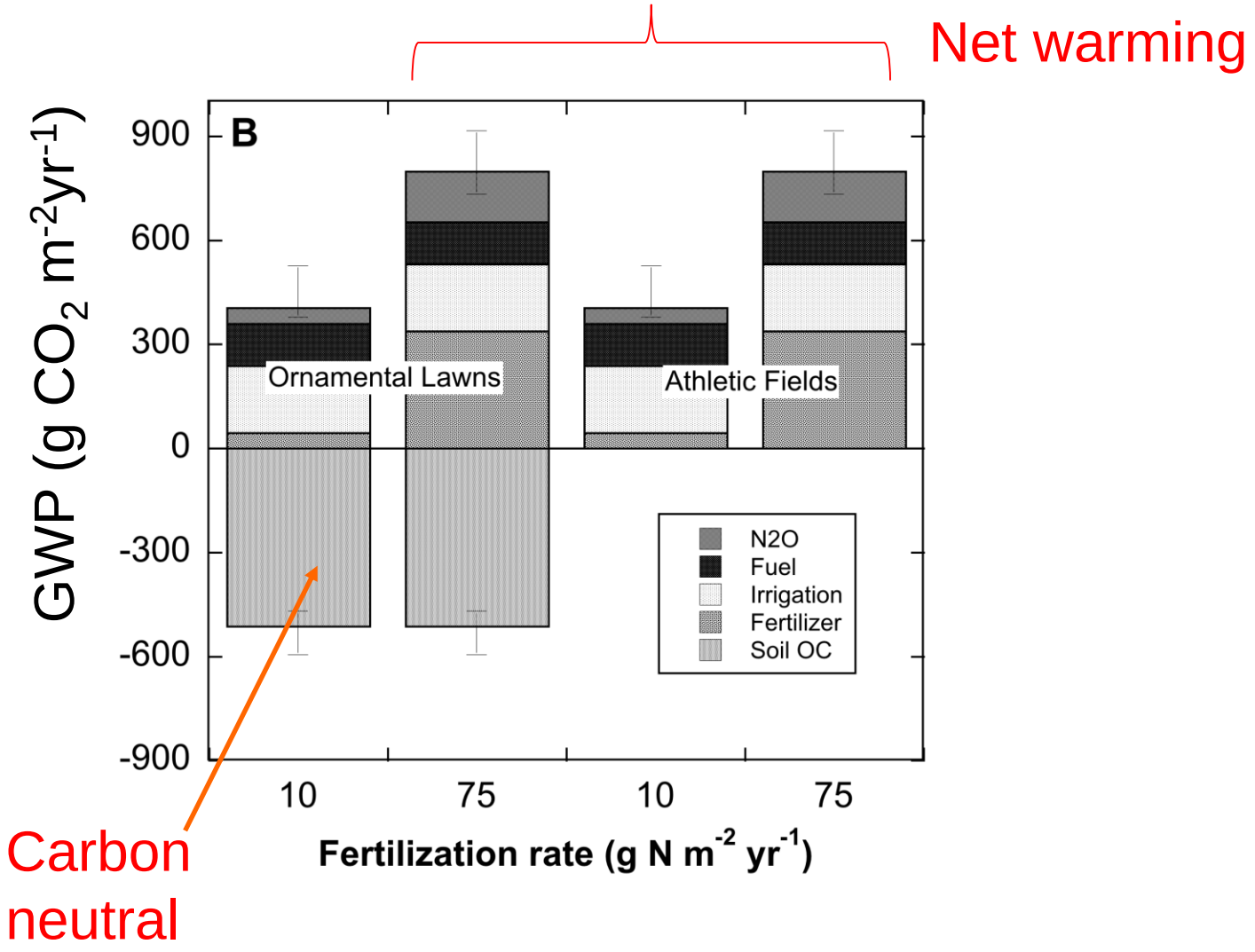
Luck et al. 2001 *Ecosystems* v4

These should be integrated with full life cycle accounting



Junila et al. 2006 *Journal of Infrastructure Systems* v12

Including the non-built environment



Townsend-Small and Czimczik 2010 *Geophysical Research Letters* v37

Urban Ecological Indicators

What has worked?

- High resolution vegetation mapping coupled with ground inventories
- Studies of costs and benefits of specific aspects of the non-built environment
- Placing ecological processes in an urban metabolism context

Knowledge gaps

- Biodiversity/inventory metrics appropriate for cultivated ecosystems
- Studies linking specific aspects of the non-built environment to human well-being
- Methods and datasets appropriate for integrating urban metabolism, ecological footprints, and LCA