Creating a Liveable City - The Role of Ecosystem Services

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Abstract: Ecosystem services include the goods and services derived from the natural environment that benefit humans and contribute to the public good. Relative to services from other forms of capital, ecosystem services are often unaccounted for or undervalued due to their non-market and indirect nature and, therefore, have commonly been highly depleted. This degradation is of particular concern within urban ecosystems, as remaining in-city natural ecosystems, typically located along creeks and rivers, or remaining in scattered pockets throughout the city, offer some of the greatest value social and economic returns per capita for the land area they occupy. In this paper we arrange ecosystem services into three categories: Life-enabling, Life-sustaining and Life-fulfilling in a modification to the categories of the Millennium Ecosystem Assessment. We also identify some additional uniquely city-centric services. Local ecosystem services contribute to the well-being of urban residents and positively affect quality of life, forming an essential element of urban liveability. However, tension between the built and natural environment often challenges the capacity of ecosystems to function and provide their full suite of services. Focusing on Sydney as an example, we show how improved liveability outcomes can be achieved by protecting, improving or re-introducing these services in the local urban context. At a policy level, framing systems-based management objectives that protect, improve and re-discover desirable ecosystem services (as defined by community expectations and needs) will allow for positive, socially-enabling management targets to be defined for Australia's urban centres.

Liveability frameworks and the natural environment

Liveability can be described as a context and situation-dependent statement of individual and collective needs and desires relating to wellbeing and quality of life (WRI and UN, 2005; Chazal, 2010). It is defined by Kielbaso (2008) as "the sum of all things that make life enjoyable, comfortable and meaningful including physical, psychological, economic, aesthetic and recreational benefits" and can be derived from items, processes or imaginaries (Kielbaso, 2008).

The historical use of the word stems from the corporate domain of multi-city and mutli-national organisations. Here, liveability was conceived as a comparative index of urban centres for employees who relocate. An employee directed to move to a less liveable centre was to be compensated with proportional financial or other benefits. Liveability indices that weigh up a number of indicator factors are published by periodicals and regularly produce city rankings across the globe (e.g. Economist Intelligence Unit, 2012). It could be argued, however, that such indices are not representative of the full spectrum of city residents and users but rather present a scope of liveability factors relevant to a limited group of professionals (James, 2013).

A desire for more encompassing frameworks for liveability has become more acute as liveability has gained acceptance not only as an observable condition, but also as a goal of government policies, strategies and interventions. The Australian Government released the National Urban Policy in May 2011 (DIT 2011). The *Our Cities Our Future* document includes three major goals of productivity, sustainability and liveability, with the latter focusing on housing supply and affordability, transport, and some social accessibility elements including recreation opportunities.

The NSW Government has released the draft Metropolitan Strategy for Sydney (NSW DP&I, 2013). The chapter on the Liveable City focuses on similar elements as the federal policy goals pertaining to liveability (albeit, minus the transport outcomes). Interestingly, another chapter on the natural environment observes that the strategy must also "*recognise the positive impact of an attractive, healthy and resilient environment to Sydney's overall quality of life and success*" (p58). However, the

connection between these two elements does not appear to be formally recognised in the document's framework.

As hinted by this draft strategy, the positive impact of the natural environment on liveability (wellbeing) can be demonstrated in Sydney, where remaining in-city natural ecosystems, typically located along creeks and estuaries, or remaining in scattered bushland pockets throughout the city, offer some of the greatest value social and economic returns per capita for the land area they occupy (Crane and Kinzig, 2005). Sydney Harbour itself is attracts 8.1 million domestic and 2.3 million international visitors annually, injecting an estimated $5 billion into Sydney's economy each year (Hoisington, in draft). Clearly there are strong values associated with these natural features.

Waterways and urban water have received some attention in the focus on urban liveability, and inroads have been made in proposed liveability frameworks in the water management sector. The NSW State Government is revising its strategic water planning for Sydney to include "supporting liveable cities" as one of three newly proposed objectives (Metropolitan Water Directorate, 2013) bringing it in to alignment with strong liveability outcomes being championed by urban water planning in Victoria (Victorian Government Ministerial Advisory Council, 2011). In 2012, Catchlove & Ewert examined the factors in the "Liveable Melbourne" framework by Tract (2005) by assessing the liveability of suburbs across Melbourne through a range of indicator factors. They found only three (open space, tree cover, geographic interest) of the 14 factors in this index were influenced by waterways or water management. Finding this inadequate, they proposed an additional two (recreational trails and flooding) be considered in liveability assessments. De Haan et al (2012) observed that liveability is related to community needs and proposed a three-tiered framework based on Alderfer's (1969) Existence Relatedness Growth theory. This framework was used to identify the influence of water and water management on liveability outcomes.

The role of vegetation and green space in urban areas, whether in the form of constructed parklands or natural bush remnants, has long been understood to contribute to improved health and wellbeing (e.g. Ulrich et al., 1991; Fan et al., 2011; Ward Thompson et al., 2012; Bell et al., 2008; Maas et al., 2009). However, the value of vegetation and community urban green space is only just beginning to be described in liveability terms. For example, West and Jones (2009) showed that public vegetation and green space were important contributors to liveability in Melbourne.

These frameworks are encouraging, yet there remains a significant lack of consideration of how the natural environment *in its entirety* influences urban liveability. It is a difficult task to identify, and then articulate, how natural elements are being valued at city scales. Yet there are several identifiable proxies for liveability outcomes. Access to open and green space for recreation and relaxation, premium prices paid for property in green, leafy or waterside locations, complaints about polluted inner city waterways, respiratory illnesses on high air pollution days, and gardening popularity are some examples. Clearly, there is a link between a city's liveability and the services that are provided by functioning ecosystems.

While urban centres are renowned for their ability to gorge on the ecosystem services from outside their geographic area (the 'ecological footprint' concept), the framework presented in this paper focuses on providing a pathway that identifies *local* natural ecosystem outputs and their desirability to city populations. We will then go on to argue that full liveability potential can only be achieved by careful management of these local services.

An Ecosystem Services framework for Liveability

While corporate liveability indices typically consider political/social stability, healthcare, culture and environment, education and infrastructure as key constituents of human wellbeing, agencies undertaking natural resource management activities require a broader scope. They must consider a wide range of possible human interventions to manage our impacts on supporting ecosystems. As discussed above, these two approaches are now being considered together, to give a more encompassing view of, and approach to liveability.

Ecosystem services emerged as a framework conceptualising ecological functions, dynamics and interactions (which support all life) in terms of their marginal (in the economic sense) or incremental value to the human economy. Costanza et al (1997) estimates the global value of 17 key ecosystem services at US$16-54 trillion per year compared to (then) global economic output of US$18 trillion.

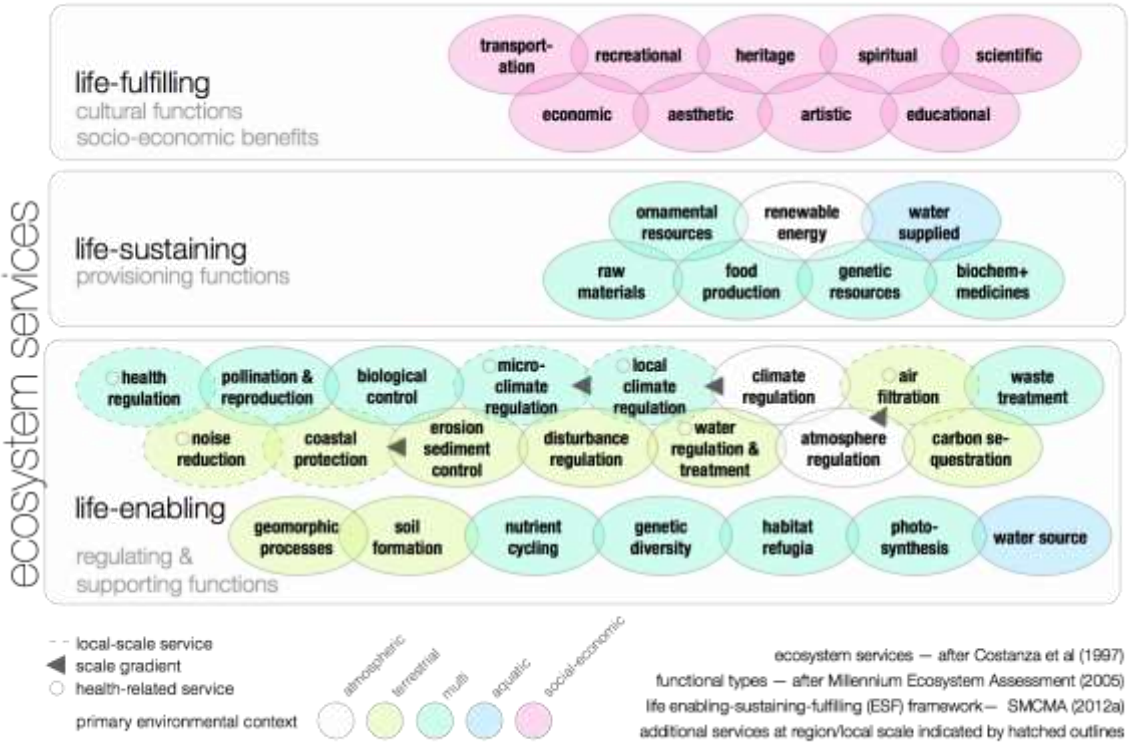
Wong and Brown (2008) propose cities providing ecosystem services as the "2nd Pillar" of their Water Sensitive City manifesto, recognising that knowledge (and management practice) must include an understanding of ecological functions for water management, micro-climate, carbon sinks and food production. This approach focuses on water management but foreshadows a more holistic program that includes all environmental themes, media and ecotypes.

The Millennium Ecosystem Assessment (2005) discusses provision, consumption and degradation of ecosystem services (and their natural capital base) in relative terms, rather than economic. The MEA broadly group these into supporting, regulating, provisioning and cultural services. Supporting services include basic ecosystem building blocks and processes: geomorphic, soil formation, water source, nutrient cycling, photosynthesis, genetic diversity and habitat/refugia. Regulating services include functions moderating climate, disturbance, erosion, pollination/reproduction, as well as air and water filtration, regulation of water flows, and carbon sequestration. Provisioning services include material products provided by ecosystems: raw materials, energy, food and fibre, genetic and ornamental resources. Cultural services are minimally delineated by Costanza et al (1997), but are discursively elaborated by the MEA to include diversity, spiritual/religious, knowledge/education, inspirational, aesthetic and recreational values.

Our framework adapts and extends the MEA's global approach by identifying regional and local scale services (for a total of 38 identified service items – see table 1). For example we've expanded the 'climate regulation' function identified in the MEA framework by adding 'local climate regulation' (to consider benefits from onshore breezes or forest cooling/transpiration) and 'micro-climate regulation' (to consider benefits from street trees or local creeks and wetlands). This matches the scale of likely interventions required to maintain/enhance ecosystem service provision, implement protective zoning for bushland pockets at city or local government scale (Sydney has ~42 local government jurisdictions), or implement guidelines for water-sensitive urban design or street planting at precinct-, street- or property- scales.

To more explicitly align the services framework with needs of humans and other species, we re-conceptualise the broad groupings presented in the MEA framework as *life-enabling* (including regulating and supporting services); *life-sustaining* (provisioning services); and *life-fulfilling* (cultural services) (Figure 1). The approach parallels Maslow (1943) and Alderfer (1969) but while theses psychologically-focussed frameworks delineate a single-existence base-layer and multiple social-to-personal levels, we draw the distinction between the services that make life conditions possible, those that sustain and provision life, and those that fulfil cultural/personal development aspirations as appropriate to multi-disciplinary natural resource management and urban planning.

Figure 1. The Life Enabling-Sustaining-Fulfilling (ESF) ecosystem services framework.



We also modify service descriptors in the cultural domain by adding economic (direct profit-taking, asset values, etc) and transport service items, and specifying recreation, heritage, spiritual, artistic, aesthetic, scientific and educational items to span the range of human experiences and values that ecosystem services support. Descriptors in the cultural domain are particularly heterogeneous and overlapping, and align to social/cultural values supported or derived from natural environments, ecosystems and species. We locate all services within overlapping aquatic, terrestrial and cultural domains, the first two spanning biomes from oceans to mountains and the latter spanning human activity from primary to quinary economic sectors.

This approach has allowed us to use the ecosystem services framework to understand and assess urban liveability by taking full account of the impact of present or absent ecosystem services. Assessing liveability in this way emphasises the physical environment of a city and places focus on how people connect with those spaces and services.

Table 1: Examples of the ecosystems services as categorised by the ESF framework.

Local Ecosystem Service	Examples of contribution to urban liveability
Life Enabling	
Atmosphere and climate regulation; and Carbon sequestration	Tree plots (minimum 10 tree/ha) and forest fragments have been shown to be effective carbon sinks (Strohbach et al., 2012), however the rates are dependent on the dynamics and management of the vegetation (Hein, 2011).
Photosynthesis	Vegetation and functioning ecosystems are responsible for the production of oxygen and reduction in carbon dioxide.
Soil formation	Soil supports plant and animal life, filter water and provide nutrients and raw materials. Soils and landscapes are necessary for the construction of buildings and associated infrastructure such as roads, bridges and transport corridors. Soil is used in urban gardening and localised food production,
Nutrient cycling	Functioning ecosystems break down and make nutrients available. Urban examples include worm farming and composting, backyard gardens.

Genetic diversity	Increasing biodiversity has been linked with an increase in property value (Tyrväinen, 1997).
Habitat/refugia	Provision of natural environments allow greater biomass and diversity of species, fertilise home and market gardens and provide enjoyable spaces.
Water source	Water may be harvested from urban areas in rainwater tanks or from stormwater re-use schemes. This can allow sustainable water use for gardens and landscaping (Wong & Brown 2008).
Primary production and photosynthesis	Functioning ecosystems allow for backyard and rooftop gardening projects, market gardens, green roofs and walls.
Biological control	Higher levels of biodiversity and connections through corridors and nodes allow resilience to shocks. Biological control of weeds is common in some urban areas.
Pollination and reproduction	Natural pollinators such as insects and birds are necessary in urban spaces for primary production such as home and market gardens.
Waste treatment	Purifies and reduces water and waste treatment costs. Natural wetlands have been found to lower the costs of energy consumption associated with sewage and wastewater treatment (Ewel et al., 1998).
Disturbance regulation (ie shock resilience) including include flood, tsunami, cyclone, storm surge, prolonged drought	Indian villages physically buffered by mangrove wetlands were found to have suffered significantly fewer deaths from the 1999 Orissa super cyclone than those with negligible or non-existent coastal mangrove zones (Das and Vincent, 2009). Provision of natural retention areas and permeable, vegetated areas (as opposed to impervious surfaces) reduces stormwater runoff and peak flood discharge (Bolund and Hunhammar, 1999; Farber et al., 2002).
Coastal protection	Vegetation is an essential element to provide stability to coastal environments by buffering the coastal zone against storms and rising tides.
Erosion and sedimentation control	Riparian vegetation and wetlands act as sediment traps, digest organic wastes from runoff, and play an important role in heavy metal uptake and biofiltration (Johnston et al., 2011; Matagi et al., 1998).
Water purification	Pollutants are taken up and filtered out of stormwater and streams by natural based systems such as wetlands and biofiltration systems (Hatt et al, 2009).
Water flow regulation	Natural porous areas and wetland systems buffer the flow of stormwater from urban areas and reduce the impact on downstream receiving environments (Wong et al., 2012)
Air filtration	Trees within Chicago were found to provide more than USD $9 million of air quality improvement over the course of the 1991 year (McPherson et al., 1997), helping to reduce associated health and amenity impacts.
Micro- (ie at neighbourhood/ streetscape scale) and local-(ie at city/place scale) climate regulation	Trees and natural wind breaks lead to a reduction of urban wind funnelling, promoting more comfortable living conditions by slowing wind speed and impacts (Bolund and Hunhammar, 1999). Natural areas lead to a reduction of the heat Island effect through evaporative cooling from water bodies within urban areas; heat reflection and uptake by water bodies. In decreasing order of cooling effect, trees, water, and swales (reeds and young eucalypts), were found to be temperature- regulating agents in the medium-density, medium-rise residential Victoria Park precinct, Sydney (Samuels et al., 2010).
Noise regulation	Appropriately designed street trees, vegetation strips and fragments, riparian corridors and natural ground cover have been shown to absorb and buffer urban noise pollution (Bolund and Hunhammar, 1999).
Life Sustaining	
Food production	Adequate food is essential to sustain life and can be provided in urban areas through home and market gardens.
Water supply	Adequate water supply is essential to sustain life and can be provided in urban areas as through stormwater harvesting and water recycling.
Raw materials	Raw materials promote comfortable living conditions (e.g. fibre for clothing, building materials) and contribute to economic growth through sale and trade. Supply of land for urban, commercial and rural development.

Medicines and bio-chemicals	Medicinal supplies can ease discomfort, pain and sustain life.
Genetic resources	Provides diversity of raw materials available such as building materials, food and fibre crops.
Ornamental resources	Ornamental resources are visually appealing, can also lead to having aesthetic life- fulfilling functions by promoting more enjoyable living conditions.
Solar and wind energy; Hydro and tidal energy	Renewable energy is increasingly seen as an important alternate energy source with rising awareness of the adverse impacts of fossil fuel consumption on the anthropogenically enhanced greenhouse effect (Climate and Health Alliance and The Climate Institute, 2012).
Life Fulfilling	
Aesthetic	Enables enjoyment of scenery and provides a resource for outdoor activities, which has psychological and physical health benefits. Vegetation can provide screening value and privacy (Tyrväinen, 1997) and may increase property value: the proximity of properties to areas of perceived natural beauty (particularly wooded areas, water courses and high proportions of forested land) has been found to have a positive influence on property values (Luttik, 2000; Tyrväinen, 1997).There is evidence that land value and house prices increase when near healthy natural areas such as rivers and bays (Anning and Dominey-Howes, 2009; Anning, 2011; Phaneuf et al., 2008).
Spiritual and Cultural Heritage functions	Natural areas facilitate physical and spiritual connection with past and present cultural features, rituals and histories. Various natural areas across Sydney are considered to be of high cultural significance to indigenous landholders. Connection with natural areas enhances spiritual enrichment and provides a sense of peace (Chiesura, 2004). Nature is commonly perceived as important in providing sense of continuity and harmony and in enhancing our understanding of our place in the universe - expressed through personal ethics (de Groot et al., 2002).
Artistic and inspirational functions	Functioning ecosystems inspires literature, film, photography music, dance, fashion, advertising and host of other artistic pursuits (de Groot et al., 2002). It promotes contemplation (Chiesura, 2004), can increase mental awareness (Hernández and Hidalgo, 2005), and is thought to enhance learning and cognitive development (de Groot et al., 2002). Natural areas are used for excursions (e.g. stream watch) and to inspire/provide a medium for scientific research (de Groot et al., 2002).
Education functions	Provides examples of diverse landscapes, vegetation, water resources and biodiversity for all levels of education as well as raising awareness in communities. Natural areas are used for excursions (e.g. stream watch) and to inspire/provide a medium for scientific research (de Groot et al., 2002).
Recreational and tourism functions	Provides opportunities for a host of recreational pursuits that are important for entertainment and may encourage the formation of social ties (Chiesura, 2004; Spartz and Shaw, 2011). These include (but are not limited to): bushwalking/bird watching; recreational fishing/hunting; swimming/ snorkelling/diving/kayaking/surfing/sailing exercise May promote economic growth through ecotourism and generates revenue from access, facility or equipment fees.
Science and research functions	Opportunities for study and research of ecosystems and derived materials (including genetic materials)
Economic functions	Economic benefits from ecosystem services. Includes economic surplus derived from primary and relevant secondary production.as well as ecosystem services provided to tertiary/quaternary/quinary sectors, including tourism, education, research. Eg Mahoudi et al (2012) found that properties in Adelaide were increased in value with proximity to parkland.

Transportation functions	In the 2010 financial year, approximately 14 million trips were taken by ferry in the Sydney Metropolitan Area (Transport for NSW, 2012). Enhances mobility and accessibility via private boat transport.

Creating a Liveable City: Sydney - a case study

Sydney is now Australia's biggest city with a population of 4.26 million. This is predicted to increase to 5.62 million by 2031 (NSW Government, 2012; SMCMA, 2012a). Sydney is considered to be one of the most liveable cities in the world, ranking 7th in the Economist Intelligence Unit in its annual liveability assessment (Economist Intelligence Unit, 2012). However, we argue that this does not take into account the true representation of Sydney's liveability. Sydney is a function of its people, infrastructure, cultural connections, governance, community groups, employment sector and health, safety and wellbeing services. It is also fundamentally linked to its location, landscape, supporting environment and its people. This surrounding natural environment provides fresh water, food, air, helps regulate local climate and provides space to recreate, socialise and learn.

Method:

In order to draw links between ecosystem services, values and liveability, we assessed the extent to which Sydney residents valued the above-identified ecosystem services provided by the city. The city was broken up into local government areas (LGAs) to provide both a simple categorising framework and a means of assessing spatial heterogeneity in opinion. Each of these local governments have undertaken extensive surveys in the preparation of Community Strategic Plans.

We undertook an analysis of the values and priorities identified in the Community Strategic Plans of 38 local governments in Sydney. From these values, we were able to extract and infer the relevant ecosystem services that they related to and to determine the ecosystem services that were considered important to local communities.

To augment the data collected from this analysis, a survey of over 1000 people from various locations and backgrounds in Sydney was also undertaken (SMCMA 2012b). This survey asked people what they thought was important to their local areas. They were asked what they considered was important generally as well as environmentally, economically and socially. This data was then also analysed for reference to ecosystem services as identified above.

Results:

The results of this analysis showed that ecosystem services provided locally are of high importance to the community. As shown in Figure 2 there was a clear value placed on of Aesthetics; Water regulation and treatment; Recreational; Habitat refugia; Genetic diversity; Economic; and Cultural heritage ecosystem services according them more importance than the other ecosystem services. These frequently valued ecosystem services were from the Life-enabling and Life-fulfilling categories and show a strong interaction with the social and economic wellbeing of the city.

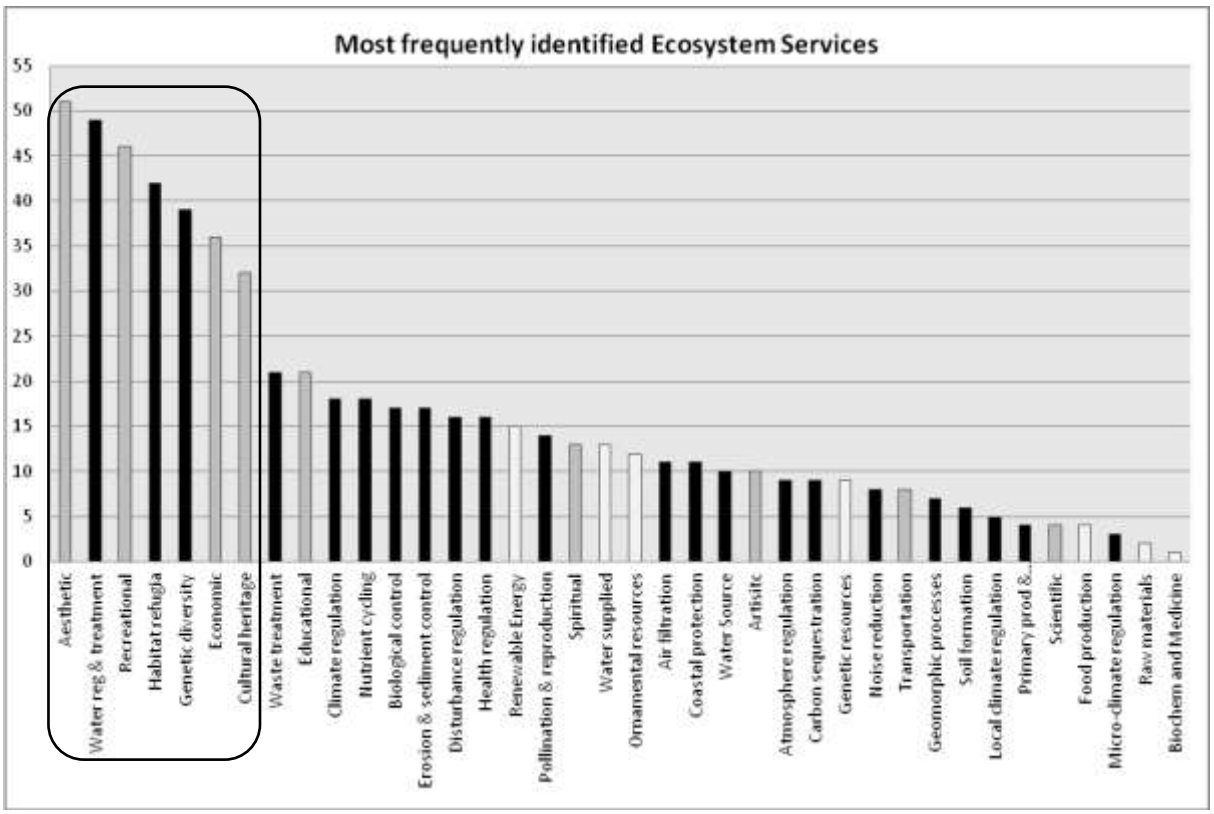


Figure 2 - Most frequently valued ecosystem services in Sydney

Discussion:

Our analysis shows that the 'natural' aspects of the city are valued by Sydney's community equally, if not to a greater extent, than traditional measures of liveability. A clear link between the city's natural resources and the cultural, health and aesthetic aspects of community wellbeing, often included in traditional measures of liveability was demonstrated.

Much of the natural environment of Sydney has been modified and as a result the natural environment of the city is no longer able to provide the full suite of ecosystem services required to maintain full functionality. This means that Sydney relies on ecosystem services that originate from external sources, such as regional NSW, other states and international suppliers. Reliance on externally sourced ecosystem services threatens the long term resilience of the city and makes it vulnerable to external shocks such as natural disasters. The liveability of the city and the wellbeing of the people within it are reduced (Folke et al., 2004; Walker et al., 2004; Gunderson et al., 2006).

Making urban centres in NSW more liveable and protecting our natural environments are both goals of the NSW 2021 State Plan (NSW Government, 2011). For Sydney, this could means increasing its resilience and liveability by focussing on the amount and quality of ecosystem services produced and provided within the city. This involves having an understanding of the interactions and interdependencies of the human and natural environment, and appreciating that their health is intrinsically linked in an urban environment.

Applying the data to the site scale:

Having identified that ecosystem services are in demand across the city, work can progress to identify how best to maximise these elements and increase liveability. Sydney Metropolitan Catchment Management Authority (2012a) proposed several generic social-ecological systems operating in Sydney that could then be managed depending on the ecosystem services identified as desirable by local communities. One system identified was a High Density Urban System, defined as "areas of Sydney where the urban form dominates the landscape with little recognisable remnant landscape features evident".

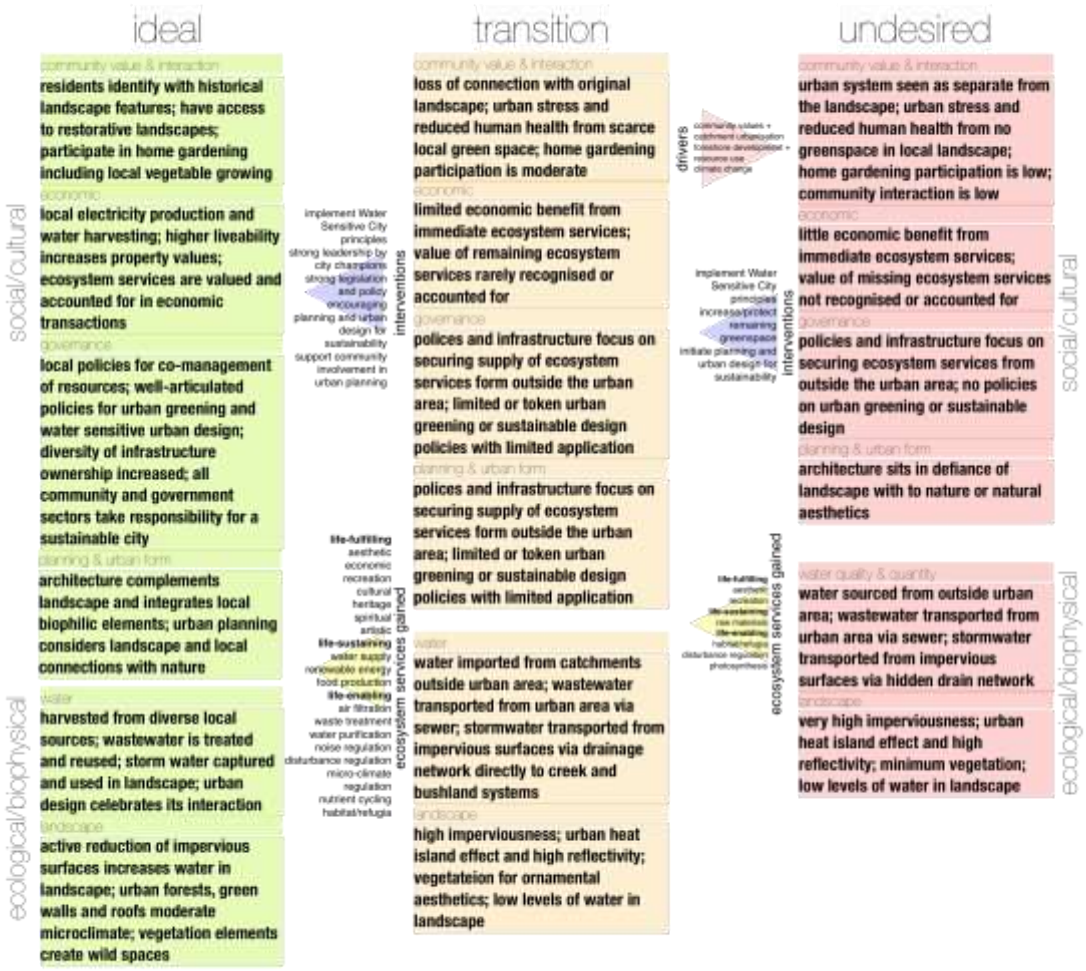
Although High Density Urban systems, which dominate the Sydney region, often showed less value to the community for their ecosystem services, restoring the ability of this system to provide a range of ecosystem services was desired by the community and was seen as enabling the system to provide

the life-fulfilling aspects that are valued. The traditional approaches to restoration generally do not include tools to improve the ability of highly modified ecosystems. However, the ESF framework is not restricted to paradigms of “restoration” to pristine outcomes.

Natural resource management strategies must commence with the identification of the full suite of services that impact liveability. The focus then needs to be on restoring key ecosystem services that will have the greatest benefit to the liveability of the area and wellbeing of the community.

For this High Density Urban System, one of the key management actions identified following analysis of values (and lost or missing ecosystem services) was implementing the principles of Water Sensitive Cities (Wong & Brown 2009). As shown in Figure 3 below, this will provide an increase in the ability of the High Density Urban System to provide a range of Ecosystem Services across the *life-enabling*, *life-sustaining* and *life-fulfilling* spectrum, including water treatment, regulation, provision and source services, aesthetics, temperature regulation and habitat services.

Figure 3 Management options for High Density Urban System



Discussion:

Improving the ability of the city to provide ecosystem services to the community is a clear desire of the survey respondents. Improving the ability of people to understand and appreciate the links between environment and a liveable city is important if true liveability is to be an outcome of city planning and management. This involves having an understanding of the interactions and interdependencies between the human and natural environment, and appreciating that their health is intrinsically linked in an urban environment.

This valuing of ecosystem services has implications for the management of cities and the natural and semi-natural spaces in them. Ecosystem services are not currently used to define management goals when designing cities, or as yet even incorporated into improving liveability. While ecosystem services may at times be used to justify environmental restoration activities in urban areas, the primary goal is often the restoration of the bushland to its pre-disturbance state (Standish et al, 2012; SER, 2004). Although admirable, this is not always a realistic goal in cities due to the extent of disturbance, cost and ongoing significant impacts from the urban areas. We suggest that by improving the ability of natural areas to provide key ecosystem services in response to community needs and values, significant improvements in liveability will be achieved in urban areas. An additional outcome will be an improvement in the resilience of the natural environment.

The concept of city management through the support of ecosystem services could be challenged with alternate frameworks that 'balance' the inherent values of life outside of a utilitarian lens. Although anthropocentric in nature, ecosystem services and the "liveability" concept do support the continued existence of life itself. Functioning life enabling and sustaining services will therefore lead to more complex ecosystem function that, in itself, can be identified as having a value to the population. These non-use or existence values will still be identified by the framework. Indeed, though scale and place-specific, willingness to pay studies in urban areas regularly report landscape naturalness and accessibility to natural areas as very valuable to urban dwellers (e.g. Tyrväinen, 2001; Jim and Chen, 2006; Salazar and Menéndez, 2007; Tameko et al., 2011). This aligns well with the second pillar of the water sensitive cities paradigm which is to ensure "provision of ecosystem services for the built *and natural* environment" (Wong and Brown, 2009, emphasis added).

To progress our understanding of the relationships between ecosystem services and urban communities and inform future management to maintain and maximise liveability, rigorous valuation needs to be undertaken. As previously discussed, many Australian urban centres currently enjoy many identified services that could be easily lost. Work by Duncan and Morrison (2013-15) currently underway in South Western Sydney examines preference values of urban waterways through hedonic (property value) and recreational survey techniques. Similarly, Anning (2011) calculated the recreational value of Sydney's Beaches. Such research is commendable and mirrors other programs being under taken by the NSW government and researchers organisations.

It is clear that there is significant complexity in how the liveability of a city is influenced by the natural features within its boundaries. Ecosystem services afforded by the natural environment provide benefits to urban populations, while being threatened by the intrusive nature of urbanisation. Urban landscape managers need to address this tension if they are to ensure liveability is maintained or improved. The issues are complex, and as Grove (2009) points out, desirability or the perceived value of local ecosystem services can vary over time and between differing social groups. The value accorded to ecosystem services can be influenced by other interacting factors such as crime rates that reduce the desirability of naturalised landscapes or recent localised histories (e.g. bushfires).

Conclusion:

While the connection of ecosystem services to the urban centres is not a new concept, a full suite of services can only be gained by the restoration, maintenance or re-discovery of *local* ecosystem services. We argue that by incorporating our ecosystem services assessment into more traditional liveability measures we will see a truer reflection of a city's liveability and a greater understanding of the wellbeing of its people.

The presented ecosystem services approach represents a dramatic shift in the way in which liveability measures are assessed and described. We have demonstrated that desire for urban ecosystem services can easily be identified from both existing planning documentation and from unique surveys.

It is unlikely that this approach will be adopted as the sole means of assessing liveability across the disciplines. However, by incorporating an ecosystem services approach into other measures of liveability, a more holistic and representative measure can be achieved. This will ultimately result in a better valuing and understanding of the natural environment in urban areas and a greater effort to protect and restore ecological function. Without such a framework, liveability is likely to decline.

If the opportunity to integrate ecosystem services into better planning outcomes is not taken, these unique, highly cherished natural elements of Australian cities will be lost or never fully realised.

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