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Conceptualising a biophilic services model for urban areas

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ABSTRACT

The recent United Nations Framework Convention on Climate Change Conference of the Parties ('COP 21') indicated that world leaders are now actively exploring solutions to address the consequences of global warming. One area of consideration is the built environment. A number of challenges have emerged due to the current design of most major cities. The notion of Biophilic Urbanism refers to the use of natural elements as purposeful design features in urban landscapes in order to address climate change issues in rapidly growing economies.

Five case studies and twenty six interviews were conducted to interrogate examples of successful biophilic cities – Portland, Chicago, Toronto, Berlin and Singapore. This investigation was conducted to capture the method of economic enquiry used to inform Biophilic Urbanism. Findings indicated the explicit or implicit use of ecological knowledge in decision making.

We present an extension to the theory of ecosystem services in the form of 'biophilic services', which we propose play an influential role in informing decisions regarding whether to incorporate biophilic urbanism in city environments. We also present the underlying logic that appears to be informing biophilic urbanism. The existing Ecosystem Services model for decision making is adapted to provide a decision making flow for biophilic urbanism. Not only do the components of the model (i.e. 'Pressure', 'Context of Value', 'Biophilic Services' and 'Valuation') accommodate the iterative, snowballing dynamism necessary within biophilic-related decisions; the model also highlights the significant role of each component in informing the final decision.

We conclude from this study a number of opportunities for governments, as well as for other stakeholders involved in the decision making process, to use economics in a holistic way to strengthen the case for biophilic urbanism.

1. Introduction

There is an urgent need for all countries around the world to engage in addressing climate change mitigation and adaptation. Global greenhouse gas reduction targets were produced at the 2015 United Nations Framework Convention on Climate Change Conference of the Parties ('COP 21'). This includes, for the first time, requirements that all parties report regularly on their emissions and implementation efforts, and undergo international review (Centre for Climate and Energy Solutions, 2015). The built environment is a major focus area in plans to reduce greenhouse gas emissions, and is also acutely vulnerable to the impacts of climate change (Grimm et al., 2008; Smith et al., 2010). The current design of most major cities contributes to both mitigation and adaptation challenges, exacerbated by increased urbanisation and population pressures. This includes increased congestion, rising fossil-fuel based energy consumption and concrete-laden construction techniques, in addition to rising urban heat island effects, particulate pollution, health implications (Beatley, 2011, 2012).

Within this complex and multidisciplinary problem context, and moving beyond the prevalence of *ad hoc* and incremental sustainability improvements that have been made to date, step-change collaborative efforts are required to find rapid and transformational solutions (Reeve et al., 2015; Hargroves et al., 2016). Complex problems often require a multidisciplinary approach to comprehensively address an issue. According to the United Nations (UN) report by the Department of Economic and Social Affairs (2013), sustainable development requires ambitious and collaborative efforts to systematically reduce inequality, encourage the protection of natural assets, and strengthen economic governance. This

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is further highlighted in the UN Sustainable Development Goals (SDG), which presents a comprehensive agenda suggesting the need for collaborative efforts (United Nations, 2015).

Linking sustainability, design and ecology, the notion of biophilic urbanism presents a unique opportunity to create sustainable and liveable cities to promote enhanced well-being (Beatley, 2011; Desha et al., 2016). Biophilic urbanism represents the idea of integration of urban nature into cities and proffers a design principle to inform intentional and functional use of natural or "biophilic" elements, such as city and pocket parks, linear green space, and green roofs and walls in the built environment (Beatley, 2011). The term biophilic urbanism stems from E. O. Wilson's physiological principle of *biophilia,* which suggests that there is an innate bond between living systems and humans (Wilson, 1984). This intrinsic bond refers to the subconscious connections that human beings seek with the rest of life. Similarly, Ulrich et al. (1991) described the restorative influence of nature on human beings' well-being derived from the psycho-evolutionary theory. Following a stressor, this theory explains that exposure to nature creates a shift in feelings towards a more emotionally positive state, positive changes in activity in various physiological systems, and even moderately high levels of sustained attention. This theory further exemplifies that human beings are innately aesthetically attracted to natural content.

Extending the principle of biophilia and the psycho-evolutionary theory to city design, biophilic urbanism proposes the incorporation of intentional natural design features across cities, neighbourhoods and buildings to offer daily exposure to natural systems (Beatley, 2011). Biophilic urbanism understands that human beings are a part of the ecosystem and focuses how cities should be designed to protect each resident at the individual level. This suggests a holistic approach in the way cities are designed to create socially optimal outcomes. Given that the globe's top 600 cities are projected to account for about 60 per cent of global GDP in 2025, opportunity exists for biophilic urbanism as a means to address the plethora of urban-related problems noted above, while improving productivity and increasing biodiversity in our urban environments (Dobbs et al., 2011).

There are a number of emerging factors conducive to successfully embracing biophilic urbanism, observed globally in cities that have integrated nature within their built environments (Newman et al., 2012; Reeve, 2014; el-Baghdadi, 2016). This includes the need for economic understanding of the decision making process for integration. Existing literature on the economics of biophilic urbanism has started to create links between natural design features (i.e. biophilic elements) and its monetary impacts on various sectors of the economy (for example Terrapin Bright Green, 2012; Bilsborough, 2014). This provides a starting point; however the decision making process and systematic economic understanding of biophilic urbanism remains poorly understood (el-Baghdadi et al., 2014).

Within this context, the objective of this study is to uncover a clear method of economic enquiry that could overcome barriers to decision making related to uncertainties about capital and operational costs of biophilic elements. In doing so, this study facilitates understanding of the decision making process that appears to be employed by stakeholders. This paper also offers a better understanding of the functionality of biophilic elements, further exemplifying their significant potential in the built environment.In Section 2, the research methods are presented, which includes a systematic literature review, case study research, and semi-structured interviews. These methods are used to reveal examples of the successful implementation of biophilic elements. This section also explains the data analysis process and results are presented in Section 3. Subsequently, we discuss how the ecosystem services approach can be used to derive 'biophilic services', which can enhance well-being. These biophilic services: encompass various conditions and processes; can be characterised as direct or indirect; can be conceived as implicit or explicit; and can be treated as qualitative or quantitative.To ground the conceptual model in existing theory, we adapt the framework for an integrated assessment of ecosystem and landscape services by De Groot et al. (2002). This framework links ecosystems and landscape to services, values, trade off instruments, planning tools, and financing mechanisms, presenting the conceptual flow to ecosystem services assessment to assist with decision making. We also adapt the Ecosystem Services Decision cascade presented by Apitz (2013), which suggests a three-part iterative conceptual framework to assist in evaluating, justifying and optimising decisions.

In all, we adapt these two frameworks to present a conceptual 'Biophilic Decision Model' that captures the pressure, decision context, and biophilic service selection and evaluation of biophilic elements to be used in a given scenario. We conclude by acknowledging the explicit and implicit role of ecology in the decision making process of biophilic urbanism. We highlight opportunities for biophilic urbanism by formally recognising 'biophilic services' in decision-making.

2. Materials and methods

This study builds upon a research project that analysed biophilic urbanism in response to climate change with the Sustainable Built Environment National Research Centre (Newman et al., 2012). Specifically, the research project presented a synthesis of biophilic urbanism literature, distilling the economic and policy considerations. This study extends upon the economic component of the SBEnrc work to shed further light on the decision making process that informs the integration of urban nature into cities.

Drawing on additional review and interviews undertaken by the first author, this study involved a literature review of biophilic urbanism. Subsequently, five comprehensive case studies of cities with example application of biophilic elements were generated. The example cities – Portland, Chicago, Toronto, Berlin, and Singapore – were selected from the literature based on application of various biophilic elements (preferably successful), invocation of discussion and new ideas, and geographically dispersal to capture various contexts in terms of climate, government and community (Newman et al., 2012). We chose to explore multiple case studies, with each providing an example of a particular biophilic element, to collectively inform comprehensive attempt to green a city i.e. biophilic urbanism.

The case study research investigation protocol involved a series of questions that were used in each of the five cities to qualitatively investigate and produce consistent, comparable case study data. Government reports and academic studies were reviewed to address the series of questions. Identified gaps in the case studies were addressed through semi-structured interviews with a total of 26 participants. Interview participants were selected based on their role (government and academic) and involvement in the (relevant/respective) project. Aware of a number of various contextual factors in each of the cities, we used the case study research to add colour and weight to the hypothesised relationships articulated in the conceptual model. Analysis of the case study and interview data included:

- Data preparation: Organising the data in chronological order; coding the data; then clustering the data into meaningful categories to highlight emerging trends, themes and gaps.
- Chronological interpretations: Collected data were presented in a simple timeline narrative of each city portraying the uptake of biophilic element(s). This generated a clear narrative of each of