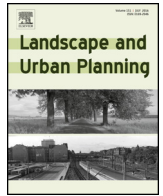




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The role of ecological wisdom in managing for sustainable interdependent urban and natural ecosystems

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HIGHLIGHTS

- Urban sustainability requires ecosystem goods and services, for example, water.
- Natural ecosystems supplying goods and services often are made unsustainable.
- Co-sustainability of urban and natural ecosystems requires urban investments.
- Urban and natural ecosystems may be co-sustainable through ecological wisdom.
- Sustaining natural functions of rivers serving large cities is mostly unsuccessful.

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ABSTRACT

This conceptual paper has two goals. First it reviews aspects of sustainability and resilience and their relationship to management of coupled, interdependent urban and natural ecosystems where the natural ecosystem supplies goods and services to help maintain urban sustainability. Second, it explores whether urban ecosystems and natural ecosystems that help sustain the urban ecosystem can both be sustainable, and whether ecological wisdom could be an overarching tool guiding how these two systems are managed to maintain sustainability of both. In doing this, the concept of ecological wisdom is expanded from a philosophical context to a practical context applicable to 21st century ecosystem management. Using several cases of interrelationships between urban and natural ecosystems, ecological wisdom is conceptually shown to be a preferred management process. The cases also demonstrate that, regardless of management approaches to create sustainable functioning riverine ecosystems modified to supply clean water as goods and services to urban areas for urban sustainability; it is unlikely that these riverine ecosystems will ever be fully functional. As a comprehensive management approach, ecological wisdom conceptually may come closest to creating both sustainable urban ecosystems and sustainable functional riverine ecosystems.

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1. Introduction

Ecological wisdom, a concept as old as humans, is perhaps a useful process for developing management decisions in the 21st century. With that idea as a foundation, this paper builds on the theme of a symposium titled “Ecological Wisdom for Urban Sustainability: Doing Real and Permanent Good in Landscape and Urban Planning” held October 2014 at the School of Architecture and Urban Planning, Chongqing University, Chongqing, China. The symposium emphasized sustainability as essential to landscape and urban planning, including factors that help create urban sustainability, such as ecosystem goods and services. With its emphasis on

achieving sustainability, the symposium focused on management concepts that guide urban and natural ecosystem sustainability such as adaptive management and ecological wisdom. With the theme of the symposium as a foundation, this perspective paper explores whether urban ecosystems and natural ecosystems that produce goods and services to sustain the urban ecosystem can both be sustainable and whether ecological wisdom, an integrator of multidisciplinary information, conceptually could be an overarching process that guides how these two systems are managed to maintain sustainability of both. Building on a discussion of sustainability and resilience, concepts influential to planning and management of social-ecological systems (Xiang, 2014), this paper presents several cases demonstrating the interdependence of coupled urban and natural systems where the natural systems, often highly modified, are sources of goods and services (e.g., clean water)

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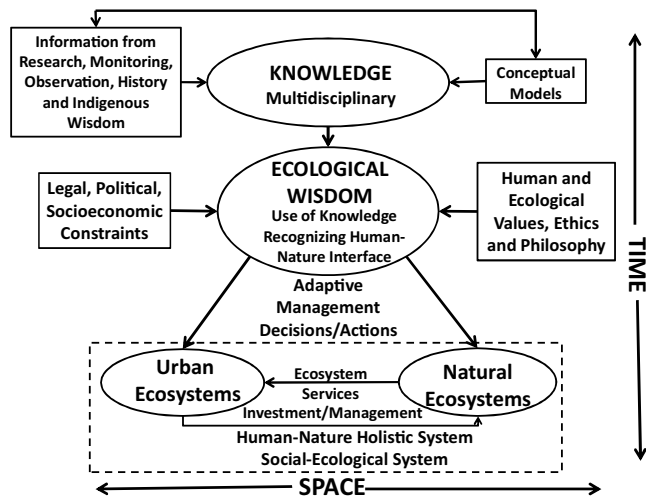


Fig. 1. A conceptual diagram of factors that influence ecological wisdom showing how ecological wisdom as a centric process influences adaptive management that determines the sustainability of urban and natural ecosystems as they interact within an integrated holistic social-ecological system.

that help sustain the urban systems. The paper then explores the role that ecological wisdom might have played in management decisions in the cases if ecological wisdom had been a recognized management tool at the time.

2. Sustainability and ecological wisdom: their role in management of ecosystems

Sustainability is creation and maintenance of conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations (U.S. Environmental Protection Agency). It is a concept requiring both acceptance of a changing environment and recognition that appropriate manipulation of the environment to do “real and permanent good”, as used in Xiang’s (2014) editorial, is necessary for successful management of social-ecological systems. Using an ever increasing information base and understanding human “needs” and interactions between humans and nature, some planners, managers and scientists have developed guidance for managing social-ecological systems using the concept of ecological wisdom.

In this discussion, and building on Xiang’s (2014, p. 67) description of ecological wisdom as consisting of “evidence-based knowledge, tacit and/or explicit, that originates and evolves from diverse philosophical, cultural, and disciplinary backgrounds and across generations”, this paper treats ecological wisdom as an integrating process that generates information and directives of how social-ecological processes generate flows between components of human and “natural” ecosystems. Consequently, this information may be directed toward useful “outcomes” or “real and permanent good” (Fig. 1). It is a process that is as applicable to the 21st century CE as to the BCE period.

The use of ecological wisdom is undertaken with the long-term goal of developing “management directives” aimed toward sustainability of ecosystems whether they are human-based (e.g., urban ecosystems), or nature-based (e.g., natural ecosystems such as rivers and watersheds). When human ecosystems are dependent on natural ecosystems for goods and services, sustainability of the two types of ecosystems requires they be treated as an integrated holistic system, described as a social-ecological system by Biggs, Schluter, and Schoon (2015) and Walker and Salt (2006), or a coupled human and natural system by the U.S. National Science

Foundation, in which the two parts are interdependent and support each other through supply or maintenance.

Using the concepts of integrated holistic systems (also referred to as coupled human and natural systems, or social-ecological systems), this paper addresses the processes by which both urban and “natural” ecosystems are interdependent and how appropriate management, including ecological wisdom as a management concept, may allow both ecosystems to be sustainable and interactive for long periods of time. In response to Xiang’s (2014, p. 67) question “how can the ideas, principles, strategies, and approaches of ecological wisdom become (more) actionable and practical – efficacious, effective, and efficient – in informing the contemporary practice of landscape and urban planning in the presence of deep urban sustainability challenges?” this paper expands ecological wisdom from a more philosophical context to a practical context applicable to 21st century ecosystem management. In doing this, it builds on the terms ‘ecological’ and “wisdom”: ecological, an adjective from the term ecology, understanding of the interactions between organisms and their environment; wisdom, accumulated philosophic or scientific learning.

Knowledge used in development and application of ecological wisdom is generated by (a) observation over long periods of time, including for example, indigenous wisdom and understanding of ecosystems by experienced managers, (b) history and (c) data from research, monitoring and observation including results from experiments. Additional inputs to ecological wisdom also include modeling, ecological and human values, ecological philosophy and ethics, and constraints from policy, law and socioeconomics. Ecological wisdom, as the integrator of all these inputs, can then guide adaptive management which then is applied to restoration or management of ecosystems whether they are holistic social-ecological systems composed of interactions between urban systems and natural systems, or less complex systems such as small watersheds or rivers (Fig. 1). Lessons learned from the outcome of these restoration and management efforts are then cycled back into improving guidance developed by ecological wisdom.

In this discussion, and in terminology of modern resource management, adaptive management might also be considered a form and/or extension of ecological wisdom where information generated by observation or “experiments” is used in a feedback format to improve present and/or future resource management decisions (e.g., Felson & Pickett, 2005). This “learn by doing” concept has been used for a long time but formalizing it to better direct management processes has become common in resource management since its inception (Walters, 1986).

3. Interconnected systems: the need to link urban and resource sustainability

Every decade more people are becoming urban residents. The global population will approach 8 billion by 2025 (United Nations, 2004). The world urban population is expected to grow from 47 percent of the world population in 2005 to 61 percent by 2030 (Wu, 2008). This expanding urban population creates an increasing demand for resources just to sustain present living conditions. When long-term sustainability of urban areas is considered, resource sustainability and those conditions that influence this sustainability must also be considered.

Resources required for urban sustainability, which includes the socio-economic well being of the population, are many including primary resources of food, shelter and water (Fig. 2). Many of these resources are components of ecosystem goods and services that humans (e.g., urban ecosystems) acquire from surrounding “natural” ecosystems (Bolund & Hunhammar, 1999; Landers & Nahlik, 2013). Primary of these are clean air and sufficient clean

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