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Ecosystem services in urban land use planning policies: A case study of Ontario municipalities

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ABSTRACT

Land use plans are widely used to guide urban development, which in turn can impact the magnitude, diversity and spatial distribution of ecosystem services that occur within urban areas. However, few studies have assessed whether ecosystem services have been included in land use plans. The purpose of this paper is to present a case study of the ten most populous municipalities in Ontario, Canada, to determine whether and how ecosystem services have been incorporated in each of their land use plans. Through a review of official plans, we found that municipalities have adopted varying approaches in their consideration of ecosystem services, with several municipalities explicitly adopting an ecosystem-based approach to planning. While the term, ecosystem services, is rarely used, we found that all official plans made reference to a variety of specific ecosystem services, with several cultural and supporting services most frequently identified. There is opportunity to enhance the inclusion of other types of ecosystem services, including provisioning and regulating services, in all of the official plans examined. Our case study also highlights the importance of incorporating a working definition of ecosystem services in policy documents that help guide municipalities and urban planners, adopting a broader focus on a greater variety of ecosystem services, and delineating clearer linkages between specific service providing units and associated ecosystem services.

1. Introduction

Cities are complex social-ecological systems where ecological processes and human influences intertwine (Alberti et al., 2003; Gómez-Baggethun and Barton, 2013). As the world's population is becoming increasingly urban (United Nations, 2014), there is growing recognition that urban ecosystems provide critical benefits for human well-being. These benefits, which are derived from ecological functions and processes, are known as ecosystem services (Bolund and Hunhammar, 1999). Ecosystem services are comprised of nature's provision of goods, such as food and fresh water, as well as benefits, such as aesthetic value, cultural heritage significance, mental health benefits and support for active and passive recreation, among many others (Bolund and Hunhammar, 1999; Millennium Ecosystem Assessment, 2005; Gómez-Baggethun and Barton, 2013). With the rapid expansion of ecosystem services research over the past decade (Haase et al., 2014), the ecosystem services concept has been recognized as a useful tool to identify and communicate the benefits and values of nature, especially in urban areas (e.g. Gómez-Baggethun and Barton, 2013; Andersson et al., 2014; Woodruff and BenDor, 2016).

The provision of ecosystem services is dependent upon healthy ecological systems (Kremen, 2005; Millennium Ecosystem Assessment, 2005). However, approximately 60 percent of the ecosystem services examined in the Millennium Ecosystem Assessment (2005) were considered degraded or used unsustainably. Urbanization is a key driver that poses many challenges to the health of ecosystem services through the removal of natural land cover, increases in the amount of impervious surfaces, concentration of people, and increases in waste discharge and nutrient loading (Millennium Ecosystem Assessment, 2005; Alberti, 2005; Tratalos et al., 2007). There is also a plethora of urban ecosystem services that exist within cities that are facing many localized pressures, such as high levels of pollution, limited growth space, and high levels of human disturbance (Grimm et al., 2008). These stressors present challenges to the provision of essential, life-supporting ecosystem services that will be required to meet the demands of our growing population (Kremen, 2005; Millennium Ecosystem Assessment, 2005).

While urban planning may lead to land use changes and development that can result in negative impacts on natural systems, it can also contribute to their protection and associated benefits (Gómez-

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Baggethun and Barton, 2013; Cortinovis and Geneletti, 2018). Land use planning policies, such as Canada's municipal official plans (similar to comprehensive plans in the United States), help guide how planning authorities regulate urban development, which in turn may help protect and enhance ecosystem services in urban areas. For example, urban planning policies may provide direction and support for urban heat island mitigation, stormwater management, and the provision of recreational open spaces.

Over the past few decades, a growing body of literature has emerged, calling for the integration of ecosystem services into land use planning (e.g. Gómez-Baggethun and Barton, 2013; Jansson, 2013; Andersson et al., 2014; Holzinger et al., 2015; Woodruff and BenDor, 2016; BenDor et al., 2017). There has also been a small but growing body of studies investigating if ecosystem services have actually been incorporated into urban planning policies, and how they are being integrated (e.g. Piwowarczyk et al., 2013; Wilkinson et al., 2013; Kabisch et al., 2015; Hansen et al., 2015; Mascarenhas et al., 2015; Rall et al., 2015; Woodruff and BenDor, 2016; Cortinovis and Geneletti, 2018). These studies have helped to address the limited empirical assessment of planning policies. This paper seeks to contribute to these efforts by presenting a case study of the ten most populous municipalities in Ontario, Canada. A review of their local and regional official plans has been conducted to answer the following questions: (1) to what extent have ecosystem services and other related concepts been incorporated in municipal land use planning policies in Ontario, (2) what types of ecosystem services are represented in these plans, and (3) is there variation in approaches across different municipalities?

The Province of Ontario offers a unique case study as each municipality is required by provincial legislation to adopt an official plan, which offers an opportunity to compare and examine how municipalities have interpreted provincial policies and adapted these polices to suit their local contexts. Furthermore, in recent years the provincial government has been actively encouraging increased intensification and the concept of smart growth, while also promoting environmental conservation and sustainable development (Government of Ontario, 2014). These provincial policies help shape a planning context that is simultaneously supportive of urban growth and ecosystem protection. Understanding the planning policies that set the framework for development is a first step to identifying potential ways to advance the management of ecosystem services in urban areas for the mutual benefit of a healthier environment and human population.

2. Ecosystem services and land use planning

The Millennium Ecosystem Assessment (2005) has helped to mainstream the concept of ecosystem services in both the natural and social sciences. The assessment identified four categories of ecosystem services: (1) provisioning, including food, fibre, fuel, wood, natural medicines, and pharmaceuticals; (2) regulating, including climate moderation, erosion regulation, and water purification; (3) cultural, including spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences; and (4) supporting, including photosynthesis, pollination, habitat, nutrient cycling, and hydrological cycling (Millennium Ecosystem Assessment, 2005).

While the Millennium Ecosystem Assessment's (2005) definitions and classification scheme are the most commonly adopted framework in ecosystem services research, alternative definitions and classifications have since been proposed to help operationalize the concept (Fisher et al., 2009; Schröter et al., 2014). In particular, two interrelated ideas have emerged through the literature that have helped to refine the ecosystem services concept. These include: 1) the criterion that ecosystem services must have connections to human well-being, and 2) the need to separate *means* and *ends* in recognition of differences in meaning among terms that are closely associated with ecosystem services, including structure, function, and process.

First, ecosystem services can flow from ecological structures, processes, or functions, but must have some connection to human well-being (Fisher and Turner, 2008; Fisher et al., 2009; de Groot et al., 2010; Haines-Young and Potschin, 2010; Hansen and Pauleit, 2014). For example, trees provide natural shade that can help reduce surface and air temperatures but without human beneficiaries, the shade provided by trees would just be a natural function rather than a service. Fundamentally, the ecosystem services concept is an anthropocentric one, which carries the objective of advancing ecosystem services to achieve greater sustainability, and human health and well-being (Millennium Ecosystem Assessment, 2005; Costanza et al., 2007; Haines-Young and Potschin, 2010).

While the ecosystem services concept has been criticized for its anthropocentricism, the concept is not limited to promoting the instrumental values of nature as it also recognizes values that are inherent to the existence of nature (e.g. spiritual value; Schröter et al., 2014). Furthermore, the anthropocentric framing of ecosystem services provides additional arguments for the protection of the environment that can be more effective, particularly in urban areas, than arguments calling for human action to protect the environment for the environment's sake (Schröter et al., 2014). Recognizing the benefits and values of ecological systems can then provide rationales for their protection from the harmful effects of development (Schröter et al., 2014; Woodruff and BenDor, 2016).

Second, the need to separate *means* and *ends* was first raised by Wallace (2007) and has subsequently been adopted by several authors (e.g. Fisher and Turner, 2008; Fisher et al., 2009; Burkhard et al., 2012). *Means* refer to the processes through which the services are achieved, while *ends* refer to the services themselves (Wallace, 2007). It has been recognized that this delineation is necessary to help facilitate the implementation of ecosystem services research (Fisher and Turner, 2008).

This study has adopted this conception of ecosystem services proposed by Fisher and colleagues (2008; 2009) to help differentiate between terms associated with means (ecosystem structure, functions and processes) on the one hand, and ends (ecosystem services) on the other hand. *Structure* refers to the physical biotic and abiotic elements that are part of ecosystems (e.g. woodlands, wetlands, and trees; Haines-Young and Potschin, 2010). These physical components have also been referred to as service providing units in ecosystem services research and land use planning practice (Kremen, 2005; Haase et al., 2014). *Functions* are the naturally-occurring capacities of an ecosystem and its components (e.g. soil enables the infiltration of rainwater into the ground; Haines-Young and Potschin, 2010). Finally, ecosystem *processes* are complex interactions among biotic and abiotic elements of ecosystems (e.g. nutrient cycling, and predation; Wallace, 2007; Haines-Young and Potschin, 2010). Together, these three components underpin the provision of ecosystem services (i.e., ends), that can contribute to people's health and well-being (Haines-Young and Potschin, 2010).

2.1. Integrating ecosystem services in land use planning

Land use planning offers many opportunities to incorporate the ecosystem services concept in the urban development process (Albert et al., 2014, 2016; Woodruff and BenDor, 2016). Land use plans often serve as mechanisms to guide development, which in turn can affect the health, diversity, and spatial distribution of ecosystem services (Albert et al., 2014; Cortinovis and Geneletti, 2018). Specifically, ecosystem service provisioning can be integrated into policies and plans, as well as the development approvals process, to help avoid negative impacts on service providing units, enhance their provision of ecosystem services, and weigh the benefits and drawbacks of different development options (Jansson, 2013; Mascarenhas et al., 2014; Woodruff and BenDor, 2016). Using an ecosystem framework in comprehensive planning can provide a robust approach to facilitate sustainable urban development (Brauman et al., 2007; Grêt-Regamey et al., 2013; Biggs et al., 2015). Ideally the planning process translates community goals into land use