



Public land managers and sustainable urban vegetation: The case of low-input turfgrasses



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ABSTRACT

In urban ecosystems, public land managers are responsible for making complex decisions about vegetation and the management of public spaces that have ecological, economic, and social consequences. Across the globe, the question is whether to move from commonly used vegetation options that require multiple inputs (e.g. water, fertilizer, pesticides) and intensive management (e.g. mowing, re-seeding) to more sustainable, low-input, low-management vegetation varieties. Little is known about urban public land managers' perceptions and beliefs about low-input turfgrass (e.g. fine fescue species) and their willingness to encourage such environmentally sustainable practices for public lands or support low-input vegetation conversion programs for private residential yards in their cities. We surveyed U.S. public land managers in Minnesota and New Jersey metropolitan areas about their preferences and beliefs regarding low-input turfgrass, specifically cool season fine fescue, and related those beliefs to opportunities for urban environmental sustainability. Overall managers showed favorable views towards low-input turfgrasses suggesting an interest in conversion to more sustainable management. Also, they demonstrated significant support of municipal programs to convert both public and private lands to low-input turfgrasses. Educational attainment and employer type were found to be responsible for most differing viewpoints among managers. This study suggests public land managers may not be a barrier to sustainable vegetation change, but rather important facilitators. More work needs to be done to understand this phenomenon globally and evaluate public land managers' roles in the transition to low-input vegetation as well as capacity to anticipate future challenges for vegetation in the urban ecosystem, more broadly.

1. Introduction

Cities in the United States have the largest percentage of citizens in history (62.7%) and total urban land use is increasing.¹ At the same time, public green space designed to service urban residents is often dominated by turfgrass. As environmental challenges increase in urban areas, it is critical to understand the role public land managers play in the management of urban public green spaces and the extent of their support for programs that promote sustainability in these urban ecosystems. Compared to some national government agencies, cities are more proactive in addressing environmental issues, specifically the promotion of environmental sustainability (Mees, 2017; Castán Broto

and Bulkeley, 2013). A few examples of municipal sustainability efforts include city-wide tree planting (Locke and Grove, 2014), incorporation of recycled material into pavement (Condric and Stephenson, 2015), and more eco-conscious vegetation planning (Schewenius et al., 2014). Despite a promising movement towards sustainability in cities, urbanization continues to put pressure on natural systems. Across multiple nations, city officials and residents are exploring options for more sustainable vegetation to replace high-input turfgrasses with meadows and flower-rich lawns (Ignatieva et al., 2017; Hoyle et al., 2017), prairies (Hitchmough et al., 2017), and native vegetation (Pooya et al., 2013), among others, in order to provide a variety of environmental and social benefits. The challenge for managed urban public lands is the

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¹ <https://www.census.gov/newsroom/press-releases/2015/cb15-33.html>; USDA Economic Research Services last updated 8/28/2017.

prominence of turfgrass which requires high-inputs and maintenance that can have adverse environmental effects such as fertilizer run-off reducing water quality in local water bodies, irrigation demands on water resources, and frequent mowing that produces carbon emissions and high labor requirements.

In the United States, turfgrass covers an estimated 40 million acres, or an area roughly the size of the state of Georgia (based on data from Milesi et al., 2005). While private lawn management has been examined in detail, particularly in relation to who manages, why they manage the way they do, and how private lawns fit into the broader landscape (Larson et al., 2015; Martini et al., 2015; Dahmus and Nelson, 2014; Robbins, 2007), there has been less work done on extensive public turfgrass areas. Primarily, research in this area has focused on the biophysical (e.g. nutrient flows) and maintenance aspects (e.g. mowing and watering schedules) of such spaces (Carey et al., 2012; Young, 2010; Allaire et al., 2008, among others). Only recently have a few studies addressed questions regarding who manages such spaces, and why they manage in the way they do (Ignatieva et al., 2017; Molin and Koniinendiik van den Bosch, 2014). Little is known about urban public land managers' perceptions and beliefs about low-input turfgrass (e.g. fine fescue species) and their willingness to encourage such environmentally sustainable practices for public lands. In the United States these publically owned landscapes are primarily managed in the form of parks, boulevards, sports fields, and golf courses. The prevalence of turfgrass in the publically owned context, coupled with urbanization puts these public green spaces at the forefront of human interaction with nature. The most common turfgrasses used across both public and private green spaces in the northern United States include Kentucky bluegrass (*Poa pratensis* L.), perennial ryegrass (*Lolium perenne* L.), and tall fescue (Watkins et al., 2011). These grasses perform well when maintained properly, however, the necessary level of inputs and maintenance may require greater mowing frequency, water, and fertilizer than desired by most public land managers. For example, Miltner et al., 2005 found that perennial ryegrass performed best at lower mowing heights (which would require more inputs and more frequent mowing). Kentucky bluegrass also needs to be maintained with high input levels (DeBels et al., 2012).

These traditional turfgrass landscapes have numerous environmental sustainability challenges associated with them, including reduced biodiversity, adverse water quality and quantity impacts, and greenhouse gas emissions. Homogenization of urban ecosystems dominated by turfgrass results in decreased biodiversity (flora & fauna) regardless of the location within the country (Wheeler et al., 2017; Lopez and Potter, 2003; McDonald et al., 2008; McKinney, 2006, 2002). Decreased water quality can occur due to overuse of pesticides and herbicides resulting in runoff of these inputs into surface water bodies, that are increasingly used as a primary source for city drinking water as groundwater aquifer supplies are strained (Carey et al., 2013; Winter and Dillon, 2005; Kohler et al., 2004; Cohen et al., 1999). Also, improper use of fertilizer (e.g. fertilizing at the wrong time of the year) and overuse of fertilizer can occur on municipal landscapes such as sports fields and golf courses, contributing to decreased water quality for human uses as well as wildlife (Wu et al., 2015; Carey et al., 2013; King et al., 2007; Winter and Dillon, 2005; Easton and Petrovic, 2004). Water supply problems can be caused by overuse due to high-input turfgrass and other water-thirsty vegetation that are perhaps not appropriate for areas where water resources are scarce (Larson et al., 2013; Larson et al., 2009a,b; Throssell et al., 2009). And finally, fast growing turfgrass species require a high frequency of mowing, increasing fossil fuel use and subsequent emissions (Kong et al., 2014; Bartlett and James, 2011; Allaire et al., 2008). When public land managers desire reduced inputs in a turfgrass stand, there are other species that could be utilized, such as the fine fescues (Watkins et al., 2014). In general, low-input turf requires "little to no supplemental irrigation...no pesticides, and reduced fertility (49.0 kg ha⁻¹ nitrogen or less) (Watkins et al., 2014).

An example of low-input turf varieties, fine fescues include five primary species: hard fescue (*Festuca trachyphylla*), Chewings fescue (*F. rubra* ssp. *commutata*); slender creeping red fescue (*F. rubra* ssp. *longifolia*), strong creeping red fescue (*F. rubra* ssp. *rubra*), and sheep fescue (*F. ovina*). Over the years, low-input turf researchers developed a list of fescue species that do better at a range of mowing heights, 5 cm to 8 cm, particularly sheep fescue and hard fescue (Dernoeden et al., 1994). But Chewings fescues do poorly in heavy wear and traffic areas (Shearman and Beard, 1975). Diesburg et al. (1997) evaluated 12 species across the U.S. north-central region managed with minimal herbicide, 49.0 kg ha⁻¹ nitrogen, and only irrigation during establishment. They found sheep fescue and tall fescue mowed at 7.6 cm were the best-adapted species. This height is suitable for many passive recreation areas across public lands. For a complete review of low-input fescue varieties see Ruemmele et al., 1995. Each of these species has particular strengths and weaknesses; however, they share general aesthetic qualities, and overall have positive traits for lower-input turf management situations such as fewer fertilizer and pesticides applications, drought tolerance, and reduced mowing requirements due to a slow vertical growth rate. With demands for environmentally sustainable options in turfgrasses, the need to understand who is involved in making decisions about using traditional turfgrass vs. low-input varieties becomes essential.

Often decisions about how to balance aesthetics, use, and environmental aspects of turfgrass management fall to public land managers. Managers can be responsible for setting maintenance schedules for public lands, including things such as mowing frequency, fertilizer application timing, and vegetation choices. We know very little about specific sociodemographic and job characteristics of public land managers, what their perceptions are about low-input vegetation, and if they support programs to encourage conversion to low-input, sustainable vegetation throughout turfgrass areas, both public and private. A common supposition is that public land managers maintain the status quo and resist innovative changes in vegetation. Renz et al. (2009, p. 89) pointed out that "with respect to land managers, determining the total population of land managers is even more difficult. The definition of "land manager" is not precise," and with such barriers it is not surprising there are limited studies. In Denmark, green space management is under the control of local authorities who use a hierarchical decision-making process with limited public involvement (Molin and Koniinendiik van den Bosch, 2014). In Sweden, professional stakeholders (e.g. park managers, municipal staff) believe residents want manicured lawns and these managers focus on practical issues such as ease of mowing and the tradition of lawns over many years (Ignatieva et al., 2017). But the Swedish managers recognize there is a growing interest in meadow areas and biodiversity values. In Slovenia, Curk et al. (2016) examined public land management of soccer fields and found that the important influences on turf maintenance and appearance were soil, climate, and the knowledge and motivations of the turfgrass managers.

Conflict can arise due to residents' needs and desires for certain types of green spaces for specific uses (e.g. recreation, leisure) and the influence of those landscapes on existing ecosystems (e.g. poor water quality, loss of biodiversity). Ultimately, public land managers must balance human use & environmental health. Irland and Vincent (1974, p. 182) describe the complex task before public land managers, as being "beset by a bewildering array of conflicts over the use of public lands," a balancing act between several external forces and constrained resources. Hoyle et al. (2017) investigated the feasibility of conversion from turf vegetation to perennial urban meadows in the United Kingdom to increase biodiversity and aesthetics. They found the prioritization of influential factors varied by managerial roles and their personal values. But managers believed implementation might be possible in some cases if local authorities and the public participated in the consultation process. Hammond and Hudson (2007) looked at public golf course managers and found conflicts present in the ways they

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