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The right tree at the right place? Exploring urban foresters' perceptions of assisted migration

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ABSTRACT

Urban trees provide multiple benefits in the form of services to citizens, and urban forests are generally managed in order to maximize those benefits. However, urban environments feature harsh growing conditions for trees, and rapid climate change is now compounding existing stresses. In some cases, the habitat range of tree species is expected to shrink or to shift. To alleviate tree maladaptation and sustain the provision of services, urban foresters could resort to assisted migration (also known as assisted colonization). Assisted migration is an adaptation strategy where species are deliberately relocated out of their historical range in anticipation of future climatic change. The ecological risks and uncertainties it entails, as well as the value-laden dimensions involved in this strategy, have altogether made it a highly debated issue. In order to know if assisted migration is being considered as a management strategy, and to facilitate future policy and decision making, we conducted in-depth interviews with 18 urban foresters from southern Ontario about their practices and perspectives towards assisted migration. We found that although they are generally favourable to a constrained implementation of assisted migration, it is not part of their ongoing management strategies. Opinions are divided on the current need for assisted migration as well as the prevalence of the risks and uncertainties involved. However, respondents agree that trials and experiments need to be undertaken, along with tree inventories and monitoring, but so far efforts are few and scattered across municipalities and actors. Implementing assisted migration will require community involvement, knowledge sharing, leadership from higher levels of government, and coordinated efforts at multiple scales.

1. Introduction

More people now live in urban areas than in rural areas (UNFPA, 2007), and the trend towards urban living is expected to continue. Cities represent the environment where most people experience nature, and where they are exposed to life and natural processes (Dearborn and Kark, 2009; Kowarik, 2011). In particular, urban dwellers benefit from the multiple services provided by forests, including a myriad of ecological, social, and economic services (Bolund and Hunhammar, 1999; Conway and Urbani, 2007; Pickett et al., 2011). Yet the urban landscape is characterized by a high density of people and their infrastructure, which often results in harsh growing conditions for trees (Konijnendijk et al., 2006). These conditions include the urban heat island effect, altered hydrology, altered soil and air quality, low genetic diversity, invasive species, and heavy anthropogenic disturbances (Pickett et al., 2001, 2011; Francis et al., 2011; City of Toronto, 2012).

Rapid climate change is now expected to act as a compounding factor, with changes in temperatures and precipitation patterns causing considerable stress to urban forests. Trees will simultaneously experience increases in extreme weather events, as well as pest and disease outbreaks (McKenney et al., 2009; Winder et al., 2011). Trees may be able to adapt to such changes, but they are generally highly adapted to local conditions and have long generation times, so they are ill-suited to abrupt change (Pedlar et al., 2011; Williams and Dumroese, 2013). Alternatively, populations may migrate in response to rapid climate change, but trees have limited mobility and urban environments tend to be highly fragmented, which inhibits their capacity to migrate (Woodall et al., 2010). While trees migrate at varied rates, they average about 50 km per century, which is too slow to keep pace with the 300 km northward climatic shift projected to occur in Canada within the next 50 years (under a two-degree increase in mean annual temperature, see Aubin et al., 2011). The evidence in fact suggests that the distribution of tree species is already lagging climate change (e.g., Zhu et al., 2011). As a consequence, certain species will become maladapted and local populations could go extinct, affecting the overall health of the urban forest and thus the benefits that derive

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from it. Resource managers must ensure that the urban forest can still provide those important services to citizens.

In response to these challenges, new conservation tools and goals are being considered (Sandler, 2013). Conservation practices have historically been rooted in restoration and preservation, while they are now slowly shifting towards adaptation and resilience (Leech et al., 2011). A prime example is assisted migration (hereafter AM, also known as assisted colonization), which consists of moving and establishing species or populations outside of their historical range to a new location where the climate will be more suitable under expected conditions of climatic change (see Minteer and Collins, 2010; Schwartz et al., 2012). Assisted migration is an adaptation strategy that has been highly debated, partly because it strays from traditional conservation values (e.g., Palmer and Larson, 2014).

Assisted migration does not just concern risks to rare species threatened by climate change. For example, AM in British Columbia, Canada focuses on moving commercially valuable populations of trees to maintain the productivity of forestry operations (Aubin et al., 2011; Ste-Marie et al., 2011; Pedlar et al., 2012; Klenk and Larson 2015). We therefore follow Pedlar et al. (2012) and distinguish species rescue AM from forestry AM. The former is specifically intended to rescue endangered species while the latter seeks to maintain forest productivity and certain ecosystem functions and services. While species rescue AM would typically involve the movement of species well beyond its range, forestry AM mostly consists in the movement of seeds at the northern edge of their range, or slightly beyond it (Leech et al., 2011). Unlike species rescue AM, which remains open to debate, forestry AM has been deemed a key strategy to respond to climate change in the forest sector (Pedlar et al., 2012; Williams and Dumroese, 2013). British Columbia has extensive ongoing trials of AM forestry, Québec and Alberta are changing their seedling policies in preparation for AM applications, and other jurisdictions are preparing by collecting information and setting up decision-making tools (Pedlar et al., 2011, 2012).

To date, however, urban forests have received little attention within the AM literature (Yang, 2009; Woodall et al., 2010). Urban forests could benefit from both forms of AM, both to help sustain ecosystem services and to contribute to the rescue of threatened species. Urban foresters could integrate tree populations and species from the south or assist their northward movement if they are at risk. Yet Yang (2009) has found that despite projected climate change impacts, urban foresters in the Philadelphia region would most likely continue to plant the same tree species. Woodall et al. (2010) similarly conclude that the potential for AM in urban areas is constrained and ambivalent. Nonetheless, climate impacts are experienced at the local scale (Measham et al., 2011), so urban foresters are encouraged to experiment and see which species do best under current climate conditions and to assess their viability under changing conditions (Wieditz and Penney, (2007); Williams and Dumroese, 2013; Trees Ontario, n.d.). Moreover, urban foresters receive mixed recommendations about current planting practices, with some documents putting a strong emphasis on planting native, ideally locally-sourced species, whereas others explicitly mention AM or discuss species movement and migration (Colombo et al., 2008; Trees Ontario, n.d.; City of Toronto, 2012). To the extent that urban foresters retain the former emphasis (e.g., in traditional 'restoration' projects), it is important to draw attention to the potential for AM in the urban context—both to aid species conservation and to maintain or improve function.

This research in southern Ontario, Canada aims to explore how urban foresters perceive AM and the extent to which it is being considered in the management of the urban forest. We sought to answer two main questions:

(1) How favourable are urban foresters to AM, and which preferred goals and underlying values guide their position?; and
(2) To what extent are urban foresters integrating adaptation strategies in their planning and management?

By assessing the place that adaptation strategies hold in current management and planning, this research can provide guidance for policy making and help to advance the dialogue about AM.

2. Methods

Our main purpose was to investigate the perceptions and planting practices of urban foresters in the context of climate change adaptation. For this exploratory study, we used a qualitative interview-based approach to obtain in-depth analysis of experiences (e.g., Hay, 2010), rather than seeking a quantitative and representative sample. We focused on the perspective of urban foresters, as opposed to arborists, because of their extensive knowledge with the phenomenon under study (Marshall and Rossman, 1995). Within municipal forestry, urban foresters, arborists and even park managers will share responsibility for implementing urban forestry management plans. However, urban foresters work at a larger, systemic scale and are trained to understand and analyze ecosystem functioning (Schwab, 2009), so they have a greater influence on tree-related policies and urban forest management plans. We did not seek participants on the basis of their educational background, as it was clear in the beginning of the research that the term "urban forester" can incorporate a variety of educational background and experiences. We instead sought professionals who identified as urban foresters, either from their training or their work responsibilities and experience.

We used purposive sampling towards our objectives (Hay, 2010), first seeking respondents through a preliminary internet search of urban forestry organizations in southern Ontario, particularly around Toronto and the Greater Toronto Area (GTA). We focused on southern Ontario because it contains the "Carolinian" Life Zone, which harbours a high proportion of Canada's rare species (Parks Canada, 2009) and is thus pertinent to considerations of species rescue AM. We focused on the GTA because of Toronto's recent adoption of an urban forest management plan (City of Toronto, 2012) and the possible impacts it may have on surrounding municipalities. We expanded our respondents through snowball sampling, by asking each respondent to provide the names of other potential informants. Finally, we obtained additional participants through a recruitment email to the Canadian Urban Forest Network mailing list. Although our study is focused in this region, it has implications for thinking about the challenges of applying AM in urban areas elsewhere.

We utilized in-depth, semi-structured interviews in this research, with ethics clearance from the Office of Research Ethics at the University of Waterloo (which granted anonymity to respondents). The interview questions were modified from AM frameworks and key questions in the literature (e.g., McLachlan et al., 2007; Richardson et al., 2009). The questions were divided into two main categories (see Appendix A for our questionnaire). The first concerned urban forestry goals and the drivers of species selection, while the second concerned the acceptability and feasibility of AM. Since AM is a relatively new concept that could be unfamiliar to potential participants, the main interview questions focused on the underlying concepts of AM and climate change adaptation rather than technical aspects of the definition of AM. The interviews were recorded, transcribed verbatim, and then the transcripts were coded using a grounded approach (Gibbs, 2007; though our codes ultimately reflect the literature on acceptability and feasibility).