Proposal Outline

*Positionality*  
One’s positionality refers to the space they occupy in relation to their research (Alcoff 1988). Discussing and acknowledging positionality is a widely accepted and encouraged part of scholarship for many disciplines, mainly in the social sciences (England 1994). Natural science has so far gotten away without this important practice because of the belief that our research is “objective.” However, my training and approach to the natural sciences is directly informed by my privilege, worldview, and experiences. As such, I believe that by outlining my biases and approach, I give context and credibility to the work I will do and provide a critical step in reproducible and transparent research. I am approaching this research as a descendent of white settler-colonial Europeans who grew up on the traditional and unceded homelands of the Haudenosaunee, Anishinaabe, and Attiwonderonk Peoples. My privilege as a cisgender, white, settler researcher directly informs the questions I ask and the science I produce. My training and approach to natural science is informed by a Eurocentric worldview, which means that I have been trained to view humans and nature as distinct entities and use a reductionist approach.

Urban landscapes are a complex combination of natural, physical, social, and built elements (Pickett et al. 2017). The addition of the social and built elements, and their integration with natural and physical elements is what make cities unique ecosystems. Natural and physical elements are what we would traditionally expect from an ecosystem, they include include flora, fauna, and structures such as rivers and lakes. Built elements are created by humans, e.g.buildings and roads, and are often referred to as “grey” infrastructure. Humans and our interactions make up the social elements of cities. All four types of elements can benefit urban dwellers. City populations continue to increase due to the nature of their centralized design which allows urban residents to fulfill many basic needs and access better services (United Nations, Department of Economic and Social Affairs, and Population Division 2019). For example, living in a city allows you to live, work, and shop in a small geographic area while accessing services that may not have been previously available to you such as waste management and higher quality education. In addition to the benefits of urban built and social elements, the natural and physical elements of the city provide many benefits to urban dwellers. Most people experience nature through the lens of the urban landscape and contact with urban nature results in greater overall well-being, more happiness, reduced mortality, and other mental and physical health benefits (Frumkin et al. 2017). All nature provides specific gifts and benefits to humans that we cannot receive from built elements. However, urban nature differs from non-urban nature in an important way, management.

Everything in our cities is managed by humans, including urban nature. For example, the composition of the urban forest is determined by a variety of stakeholders (Aronson et al. 2017). Urban planners, residents, and developers all make decisions regarding the density and species of trees that make up the urban forest. Often, urban nature is being managed in a way that maximizes benefits to urban dwellers. Maximizing human benefit can look very different depending on the interested party (Salmond et al. 2016). For example, municipal planners want to have low levels of maintenance and are often guided by ecologically determined “best practices” for planting, whereas residents may be trying to maximize benefits such as food production or aesthetic beauty. All management goals are valid and important, and managing urban nature to maximize benefits to all parties involved is an especially critical and “wicked” problem (Gaston, Avila-Jim Enez, and Edmondson 2013).

Cities in the Global North are not currently being designed or managed to maximize benefits to all stakeholders. Currently, we build and manage our cities under capitalist and settler-colonial systems. The prioritization of maximizing financial benefit to private businesses and individuals in combination with the legacy of settler-colonial ideals, most notably racism, has led to a deeply skewed and inequitable distribution of urban benefits (Ernstson 2013). Despite the hard and relentless work of many municipal government employees, activists, and NGOs to address the long-standing inequities of urban nature’s benefits, there are still extremely harmful disparities in how the distribution, production, and delivery of urban nature’s benefits occurs (Schell et al. 2020). For example, the “luxury effect” is a well-proven theory in urban ecology where a large amount of variation in urban nature quantity and quality can be explained by the socioeconomic status of the neighbourhoods in question (Gerrish and Watkins 2018; Wu 2014). Further, urban parks provide many benefits to residents, including alleviating public health issues, and park area is negatively correlated with the proportion of BIPOC residents in the census tract in the United Stats (Hoover and Lim 2020). To maximize urban nature’s benefits to the entire urban population, we need to critically engage with the prioritization of economic benefits and make our decisions based on other critera, such as equity, compassion, and justice.

Managing urban nature to maximize benefits to all urban dwellers is a daunting task, however, an “ecosystem services” framework may allow us to attempt it (Bennett 2017). Nature bestows many benefits and gifts on humans that interact with it, consciously or unconsciously. Often, the gifts that nature gives to humans are defined as “nature’s contributions to people” or ecosystem services (Millennium Ecosystem Assessment 2005; Díaz et al. 2015). However, nature’s impacts are not always beneficial (Roman et al. 2020; Salmond et al. 2016). For example, urban greening can provide services such as air pollution and heat mitigation but it can also cause gentrification and resident displacement, ultimately acting as a disservice to the community (Roman et al. 2020). The negative impacts of nature on human lives are often referred to as ecosystem disservices. The urban landscape is a complex and dynamic system that is made up of many ecosystem services and disservices.

Ecosystem services improve human’s quality of life. Depending on the particular service, humans often rely on ecosystem services for our survival (Millennium Ecosystem Assessment 2005). For example, the crop production is an ecosystem service that most humans rely on as our source of food. Ecosystem services can also enhance our lives, by providing benefits that we don’t need to survive, but are still important to our health and allow us to thrive. For example, in China, living in a community with access to clean water can improve elderly individuals’ mental health and aid in stress recovery (Chen and Yuan 2020). Thus, managing urban nature for the production and delivery of ecosystem services is a common municipal goal.

Ecosystem services are often categorized into four main groups, all of which provide humans with services that improve their quality of life. Based on the Millennium Ecosystem Assessment (2005), the four categories of ecosystem services include provisioning services, regulating services, supporting services, and cultural services. In reality, many ecosystem services cross the boundaries of each group and can provide benefits in multiple categories. Provisioning services are defined as benefits that provide products from ecosystems, for example food provided through agriculture. Regulating services are defined as benefits that are obtained through the regulation of ecosystems, such as climate regulation from tree canopies. Supporting services are defined as services that are needed for overall ecosystem functioning, such as nutrient cycling. Finally, cultural services are defined as benefits obtained from ecosystems that are non-material in nature, for example, a sense of belonging. All four groups of ecosystem services provide different benefits to humans and all are required to improve quality of life.

Regulating ecosystem services are particularly critical when managing cities (Villamagna, Angermeier, and Bennett 2013). The ecological footprint of a city often extends far beyond its borders, with many of the supplies and services required by the high population being provided from elsewhere (Gaston, Avila-Jim Enez, and Edmondson 2013). Provisioning, supporting, and cultural ecosystem services can be outsourced beyond the bounds of the city limits. For example, many of the provisioning ecosystem services that urban residents need and enjoy are outsourced to surrounding agricultural areas. Similarly, cultural ecosystem services can be provided by nature found outside the city limits, such as National Parks. However, regulating services must be produced *in situ* (Sutherland et al. 2018). The cooling benefits provided by tree canopies cannot be imported, nor can the clean water provided by the city’s watershed. The nature of regulating services requires them to be built into the city’s landscape. Thus, designing and managing urban nature to provide regulating ecosystem services is a key part of having a just and equitable city.

Managing ecosystem services to provide their benefits equitably is a complex task. Ecosystem service management includes four different processes, capacity, pressure, demand, and flow (Villamagna, Angermeier, and Bennett 2013). Ecosystem service capacity is the ecosystem’s ability to produce a service. Capacity is the easiest to quantify ecologically, and is often focused on by urban ecology studies. For example, stocking a river with fish will increase the population and improve that ecosystem’s capacity for fishing yields. However, the provision of ecosystem services is not only dependent on the capacity of the ecosystem. We also must consider pressures, which include biophysical influences that change the ability of the ecosystem to provide the service. Pressures can change the capacity of an ecosystem to provide services. For example, overfishing is a pressure that can reduce population levels to a level where stable reproduction levels are no longer possible, thus changing the capacity of the river’s provisioning services. Demand is the level of service that is required by society, and is notoriously difficult to quantify ecologically (Haase et al. 2014). Demand can increase due to increased population, for example, higher population density in turn requires more food. However, demand also changes with individual values and culture. For example, if two neighbourhoods have the same population density but the culture of one values and requires fish as part of their more than the other, then the demand can differ even when the population density doesn’t. Finally, flow is the amount of ecosystem services actually received by people. Flow is an integration of capacity, pressures, and demand. To truly deliver ecosystem services in a meaningful way in cities, we must take into account each process related to management.

Cities are highly dynamic and heterogeneous (Knapp et al. 2020; Ziter and Turner 2018). The urban landscape varies on a uniquely fine-scale, both temporally and spatially. The heterogeneity of cities lends another level of complexity to managing ecosystem services. Capacity, pressure, demand, and flow of ecosystem services changes across space, time, and scale (Pickett et al. 2017). For example, the capacity of the urban forest to deliver ecosystem services is highly spatially heterogeneous. Urban forest ecosystem service capacity is partially dependent on the species of trees planted. However, different stakeholders will plant different species, which can occur on a small scale, e.g. different homeowners planting different species in their yards. Spatial heterogeneity can also occur on larger scales, e.g. variation in species composition across different neighbourhoods (Ossola et al. 2019) or cities (Lin et al. 2019). The differences in species composition change the capacity of the urban forest at different spatial scales. **Temporal variation also occurs on multiple scales. WRITE STUFF ABOUT TEMPORAL VARIATION**

The urban forest is a critical part of our urban landscapes. The urban forest is composed of all the trees found in a city and provides ecosystem services to residents from all four categories defined by the Millennium Ecosystem Assessment. Importantly, the urban forest provides critical regulating services in cities that improve quality of life and health of urban residents. One of the most recognized examples of the urban forest’s contribution to regulating the urban ecosystem is the ability of urban trees to cool our cities during hot days. The shade provided by urban trees can reduce temperatures by several degrees, potentially reducing air temperatures from dangerous heat-wave levels. Temperature regulation is just one example of the critical regulating services the urban forest provides. The urban forest can also reduce air pollution, sequester carbon, flood control, and noise reduction (Andersson et al. 2015). The ecosystem services provided by the urban forest is dependent on its composition, structure, and management.

As part of a city, the urban forest is dynamic and heterogeneous. There are many factors that impact the current ecosystem services delivered by urban trees. Legacy effects of past management and planning decisions continue to influence the urban forest. In addition, planting trends and opinions change, resulting in differences in forest composition across time. Different spatial locations have different relationships with the urban forest and thus may choose to plant different trees. The mandate of racism and classism determined under capitalism continues to determine the flow of ecosystem services through our urban neighbourhoods. We need to understand how and why ecosystem services vary across space and time **(BIG GAP - FILL OUT)** if we want to be able to maximize the quality of life of all urban residents.

My research… LOL who knows.

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