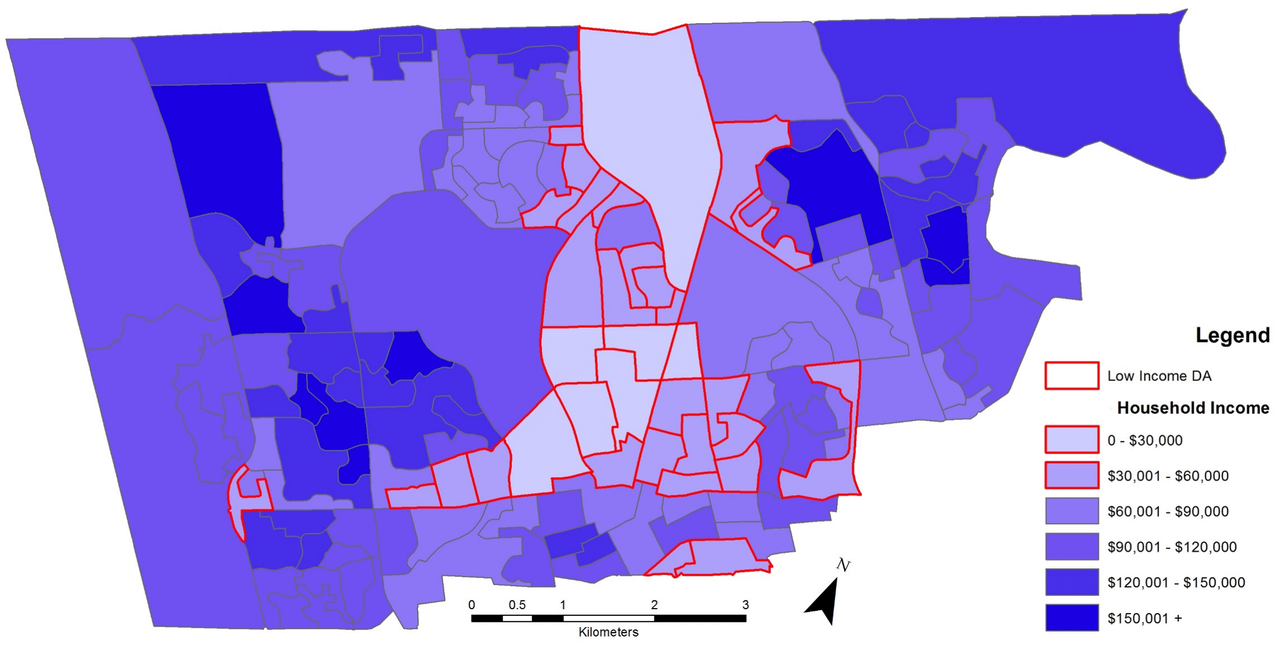
Could the Luxury Effect Apply to Publicly Owned Vegetation? A Study of Street Tree and Income Distribution in Waterloo, ON

Claire Barker-Sharp



Median Household Income by DA Waterloo, ON

INTRODUCTION

WHAT IS THE LUXURY EFFECT?

The *luxury effect* is a hypothesis explaining the relationship between household income and urban ecology. Studies of it indicate that urban biodiversity, specifically plant diversity, is correlated positively to community wealth. Commonly, affluent residential neighbourhoods have greater canopy cover, vegetation cover, and plant diversity (Schell et al, 2020). At the lot level, the luxury effect is evident through the abundance and variety of plantings; wealthier properties may have a higher expendable income open to buy more and wider varieties of plants, including native species, increasing functional diversity (Schell et al, 2020).

IMPACTS ON PLANNING & HEALTH

Research on urban forests and street trees indicate that their presence promotes:

- Physical activity by providing space for recreation and creating an attractive outdoor environment (Mytton, Townsend, Rutter, & Foster, 2012).
- Mental well-being and the reduction of heart rate, blood pressure, and stress (Kardan et al., 2015), as well as obesity, asthma, and diabetes (Ulmer et al., 2016).
- Habitat for migratory and native species to thrive (Schell et al, 2020).

RESEARCH QUESTION

Many aspects of the *luxury effect* revolve around lot-level ecology; a feature usually dictated by a parcel owner's ability to fund plantings. **This raises the question: are street trees, a feature controlled and maintained by a municipality, also subject to the luxury effect?** To explore this, the following study will consider distributions and nativity of street trees as functions of median household income across the City of Waterloo, Ontario.

METHODS

DATA SOURCES

- 2016 Census Dissemination Areas (DAs) with Income Data, Statistics Canada
- Street Tree Inventory, City of Waterloo

CATEGORIZATION OF SPECIES

A categorization field for species was created to draw general observations of common tree types throughout the City. A total of 28 general tree type categories were created in which the 60 species within the inventory were sorted under. A secondary field defining whether the inventory species were native or non-native to the region was added, using information provided by the Government of Ontario's Tree Atlas for the Southwest Region.

DEFINING LOW-INCOME

Low-income is defined by the Government of Canada as dependent on the size of the family unit, with the minimum necessary income ranging from $25,921 for 1 person to $68,598 for 7 persons (Government of Canada, 2020). To highlight this, DAs with a median income between $0 to $60,000 were considered *low-income*. Median values were used over average values to reduce skewness.

ANALYSIS

Using Esri's ArcMap, the *Optimized Hot Spot Analysis* tool was applied to the Street Tree Inventory dataset with the DAs being set as the data aggregation method. Given incident points, this tool creates a map of statistically significant spatial clusters of hot and cold spots using the *Getis-Ord GI** statistic (Esri, 2021).

RESULTS

STREET TREES

The results for all street trees showcases multiple hot spots of high confidence within areas of greenfield expansion on outskirts of the City, while a cold spot is present within the urbanized core. Native street trees feature a significant hot spot across more greenfield, and a highly significant cold spot within the downtown core. The size of this cold spot indicates an extensive lack of native street tree species throughout the built-up area of the City. Non-native street trees feature less significant hot and cold spots, likely indicating that non-native species are more common throughout all dissemination areas in the City.

INCOME

In comparing the results of the Hot Spot Analysis against the median household income in Waterloo, it is evident that cold spots for *all*, *native* and *non-native* street trees intersect within dissemination areas of low-income. Moreover, street tree hot spots consistently matched with dissemination areas of median incomes ranging from $90,000 to over $150,000 – well above the *low-income* classification.

CONCLUSION

The results of this study indicate that areas within the City of Waterloo that lack street trees, specifically, those that lack species native to the region, tend to coincide with areas of low household income – a finding that supports the luxury effect hypothesis. Note, however, that in addition to income distribution, the quantity and type of street tree within an area can be influenced by land use, percentage of built-up area, population, and levels of pollutants.

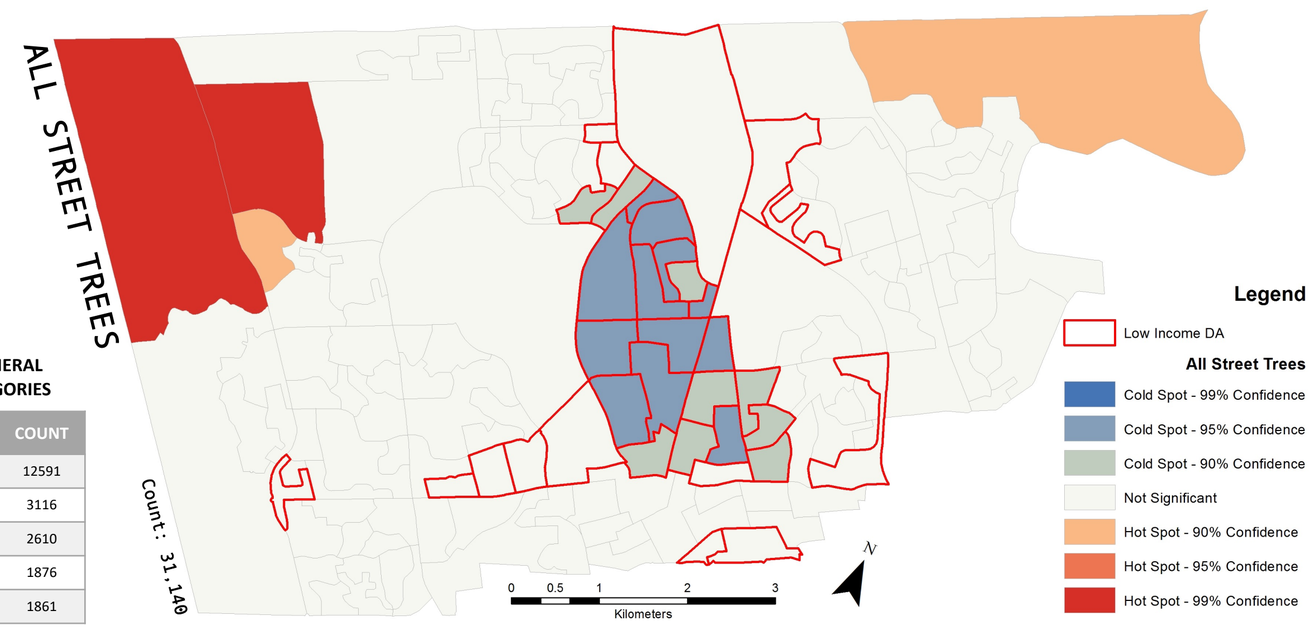
FUTURE RESEARCH

The role of urban greenery in improving environmental, physical and mental wellbeing is evident throughout numerous studies, but has been amplified through the COVID-19 pandemic. This study utilized income data from the 2016 Census; future research may utilize the 2021 Census to comparatively assess the impacts of the pandemic on income and street tree distribution.

Further investigation on this topic may consider temporal changes to an environment that impact the ability for street trees to be planted and sustained. Such topics may include the effects of gentrification, urban intensification, or the establishment of invasive species or diseases. Such research may help identify neighbourhoods at risk of reduced urban greenery, and will allow urban planners, policy-makers, and neighbourhood associations to implement proactive approaches regarding the location and type of species to be planted.

ALL STREET TREES

Count: 31,140

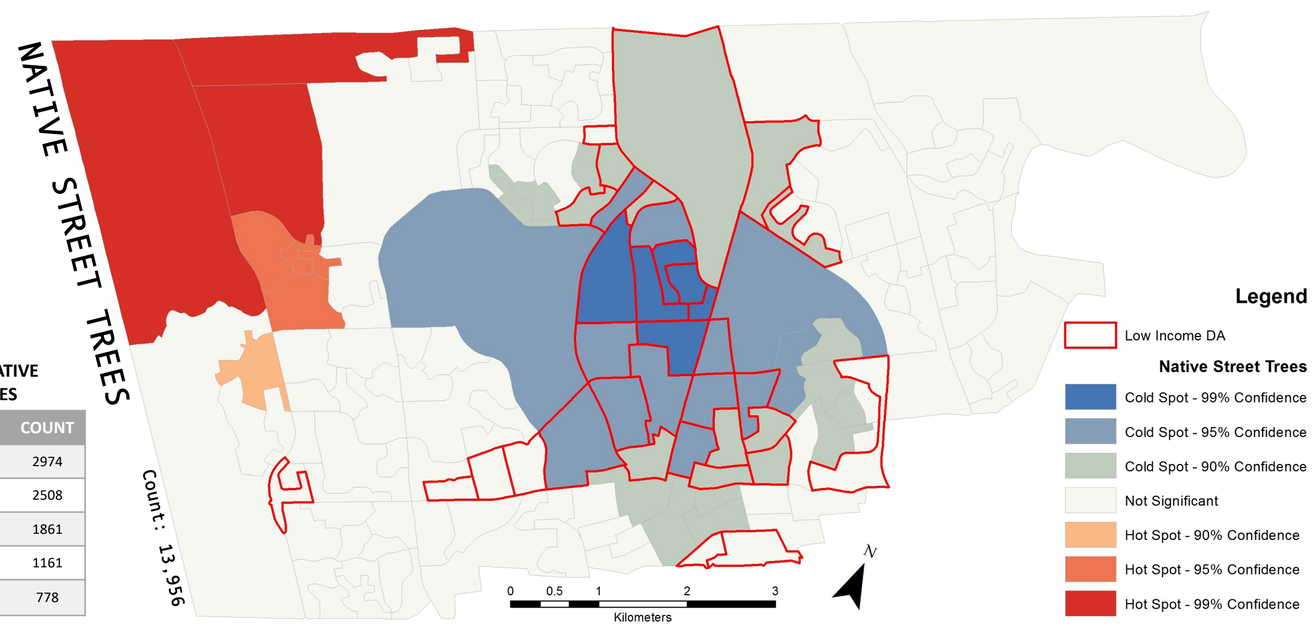


TOP 5 GENERAL TREE CATEGORIES

BROAD SPECIES TYPE	COUNT
Maple	12591
Locust	3116
Ash	2610
Berry	1876
Basswood	1861

NATIVE STREET TREES

Count: 13,956

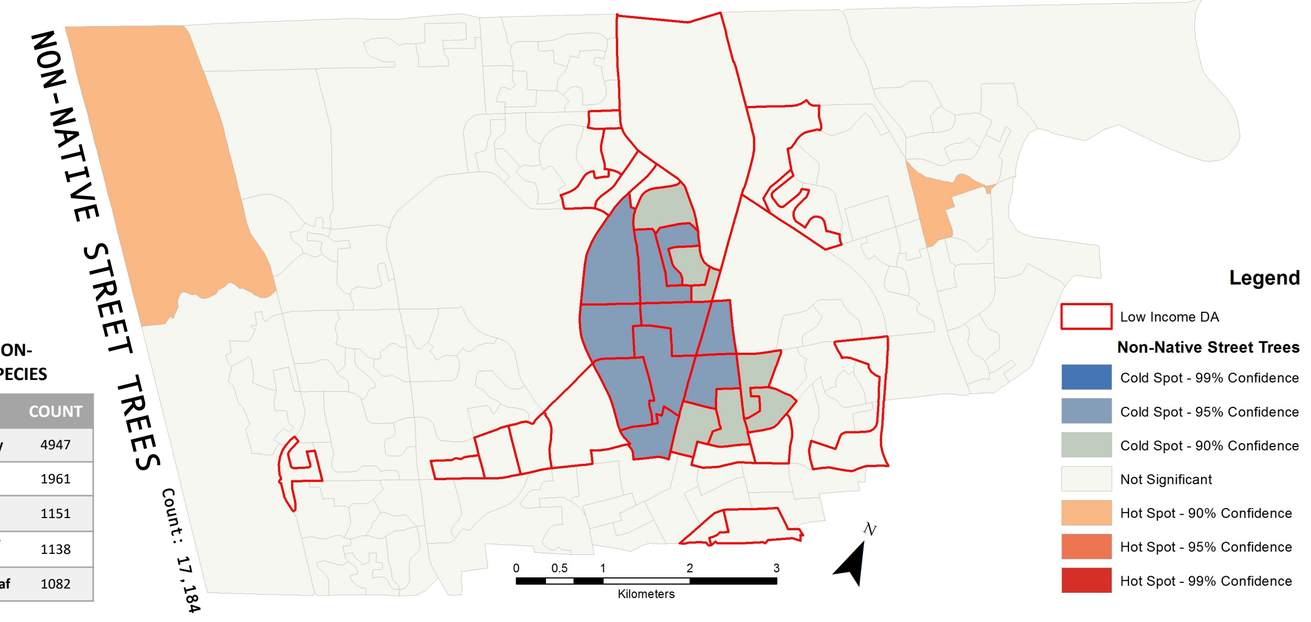


TOP 5 NATIVE SPECIES

SPECIES	COUNT
Maple, Sugar	2974
Maple, Red	2508
Basswood	1861
Serviceberry	1161
Elm, American (Resistant)	778

NON-NATIVE STREET TREES

Count: 17,184



TOP 5 NON-NATIVE SPECIES

SPECIES	COUNT
Maple, Norway	4947
Locust, Honey	1961
Honeylocust, Sunburst	1151
Lilac, Japanese "Ivory Silk"	1138
Linden, Little Leaf	1082

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