UPDATED ANALYSES FOR ASSESSING PROTECTED GREENSPACE ACCESS IN UNDERSERVED COMMUNITIES ON VANCOUVER ISLAND

Prepared by: Jenny Munoz
Canadian Wildlife Service, Environment and Climate Change Canada
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INTRODUCTION

Greenspaces, including protected areas such as regional, provincial, and national parks, are crucial for providing a range of environmental and societal benefits [1]. They are essential for supporting biodiversity, protecting water resources, improving air quality, and regulating local climates [2]. The importance of greenspaces extends beyond their ecological functions; they also provide vital benefits for human health, including physical and mental well-being [3]. Greenspaces offer opportunities for physical activity, strengthen community connections, and support mental health through stress reduction.

Despite their benefits, greenspaces are not equitably distributed [4]. Underserved communities—such as immigrants, low-income individuals, racialized populations, people with disabilities, women, and Indigenous peoples—frequently have limited access to greenspaces and their benefits [4-6]. These communities often live in areas with fewer trees, smaller parks, and must travel greater distances to access greenspaces [7-8]. The lack of greenspace access negatively impacts the well-being and health of underserved communities, which is recognized as a public health concern [9]

Identifying areas with restricted access to protected greenspaces and examining their distribution in relation to underserved communities can provide crucial insights for policymakers. This can help reduce inequalities in greenspace access among populations and enhance the well-being of underserved communities. This report focuses on identifying Dissemination Areas on East Vancouver Island that have restricted access to protected greenspaces and face increased socioeconomic and demographic barriers to accessing these areas and their benefits.

Here we present an updated analysis for assessing greenspace access within underserved communities on the east side of Vancouver Island. Building upon previous assessments by Rivas [10] the revised approach aims to enhance the accuracy and relevance of our findings, addressing identified gaps and incorporating new data sources (such as gender and activities of daily living). By refining our methods, we seek to better understand and address the challenges faced by underserved communities in accessing protected greenspaces.

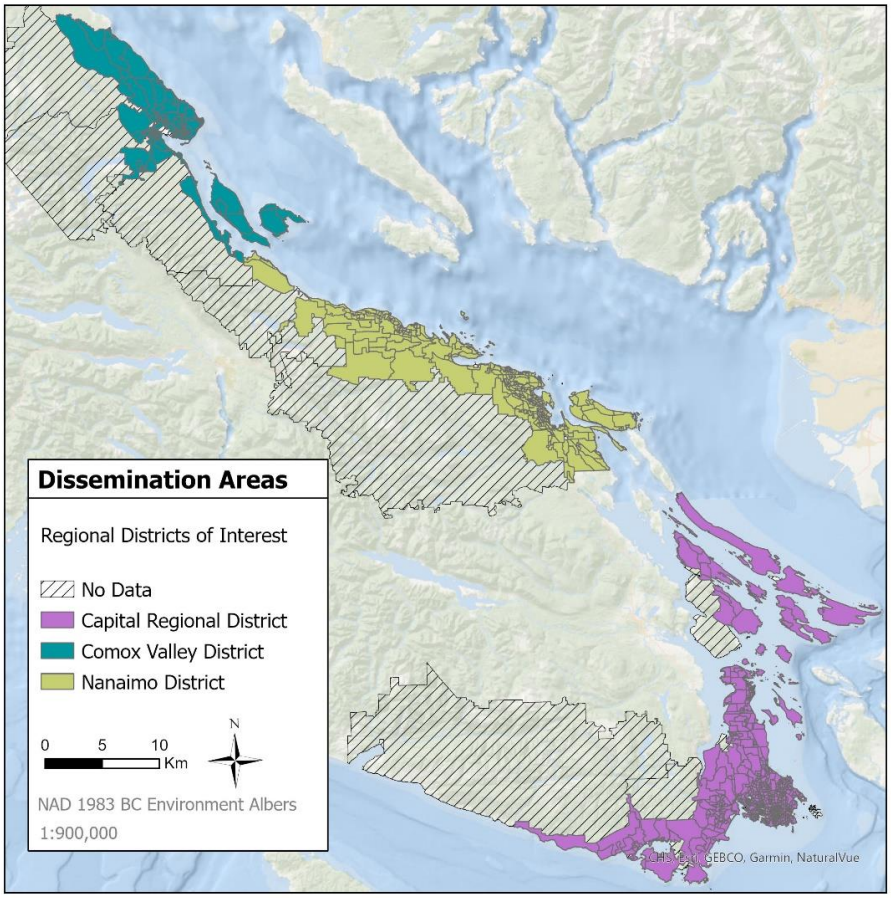
METHODS

Study area

Vancouver Island, located in the province of British Columbia (BC) in western Canada, is a large island with a population of approximately 0.86 million people. The island is divided into 13 Regional Districts. This study focuses on three Regional Districts in the eastern part of Vancouver Island: Capital Regional, Comox Valley, and Nanaimo.

The geographic unit of analysis for this study is the Dissemination Area (DA), which is a standard geographic area used for disseminating census data in Canada. Each DA consists of one or more dissemination blocks and has a uniform population of approximately 400 to 700 individuals. DAs for the Capital Regional, Comox Valley, and Nanaimo Regional Districts were obtained from Statistics Canada (statcan.gc.ca) and were used to define the study boundaries. A total of 950 DAs were included in the analysis. Some DAs were excluded due to unavailable data, and 9 DAs with areas larger than 70 hectares were omitted due to their unsuitability for the study methodology.

Figure 1. Map of the Regional Districts of interest of Vancouver Island. Dissemination Areas boundaries are displayed.



ANALYSES

Our analyses were conducted in three phases. The first phase focused on estimating greenspace access (Restricted Greenspace Index). The second phase involved assessing the distribution of underserved communities/equity-deserving groups across the districts by utilizing indicators from the 2021 census data (Underserved Community Index). The third phase analyzed the spatial association between greenspace and underserved communities in the three districts of interest. The methods used in each phase are described in detail below, in the following order: Greenspace Index, Underserved Community Assessment, and Hotspot mapping. All analyses were completed using R 4.0.2 [11] and ArcGIS Pro 3.2.2 [12].

Protected greenspaces and Restricted Greenspace Index estimates

To identify protected greenspace areas in the three districts we used the 2021 BC NGO Conservation Areas Database provided by the Canadian Wildlife Service. Protected greenspaces included lands owned by non-governmental organizations, provincial and national protected areas, and local government protected areas.

To estimate the Restricted Greenspace Access Index for each Dissemination Area (DA), we used two metrics: Distance to Protected Greenspace and Greenspace Area. We calculated the Distance to protected greenspace by averaging the linear distance from the centroid of each DA to the two nearest greenspaces, utilizing the "near" tool in ArcGIS Pro. The Greenspace Area was determined by measuring the area of protected greenspace within a 700-meter radius buffer around the centroid of each DA, using the "buffer" and "pairwise intercept" tools in ArcGIS Pro. This buffer standardized the calculations across DAs of varying sizes. Next, we estimated the non-greenspace area for each DA by subtracting the Greenspace Area from the buffer area (1.54 km^2).

The Restricted Greenspace Index was then calculated by summing the normalized scores of both the Distance to Greenspace and the Non-greenspace Area per DA and dividing this sum by the maximum value. This resulted in an index ranging from 0 to 1, where a higher score indicates reduced access to protected greenspaces for the population in that area. Finally, the index was normalized for further analysis.

Sociodemographic factors and Underserved community Index

To describe the population socioeconomic and demographics characteristics for each DAs at the three districts we used the 2021 Canadian Census data obtained from Statistics Canada (statcan.gc.ca). We used eight relevant socioeconomic and demographic variables known to influence access to greenspaces: first language not official, minority identity, median income, unfamiliarity with the official language, Indigenous identity, new immigrants, reported disability, and gender women+ (Table 1). The variables varied in completeness of sampled population, data was available in its entirety for Language related variables and Income statistics subjects, while a sample of 25% was available for the other variables. For each variable we extracted the raw counts and calculated the proportion of the counts from the total count of responses. Each variable was

min-max normalized to a range of 0 to 1 (R package scale::rescale). The "median income" variable was inverted (multiplied by -1) to reflect that lower income individuals are more underserved.

To Estimate the Underserved Community Index, we summed the min-max normalized values of these eight factors and divided them by the maximum value, resulting in scores ranging from 0 to 1. A higher score indicates greater social vulnerability in the area.

Table 1. Socioeconomic and demographic variables used to estimate the Underserved Community Index.

Variable	Definition	2021 Canadian Census grouping variable
First language not official	The percentage of residents whereby their First language / Mother tongue is not an official language in Canada and was learned at home in childhood and still understood by the person at the time the data was collected.	Total - Mother tongue for the total population excluding institutional residents. (100% data)
Racialized population /Minority identity	The percentage of residents who self-declare as a minority. The Employment Equity Act defines visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in color."	Total - Visible minority for the population in private households. (25% - sample data)
Median income	Median total income of economic family in 2020 ($)	Total - Income statistics for economic families in private households (100% data)
Unfamiliar with official language	The percentage of residents with no knowledge of official languages. Refers to whether the person can conduct a conversation in English only, French only, in both or in neither language.	Total - Knowledge of official languages for the total population excluding institutional residents. (100% data)
Indigenous Identity	The percentage of residents who identify as First Nations (North American Indian), Métis and/or Inuk (Inuit) and/or those who report being Registered or Treaty Indians (that is, registered under the Indian Act of Canada), and/or those who report having membership in a First Nation or Indian band .	Total - Indigenous identity for the population in private households (25% - sample data)
Difficulties on the activities of daily living/ Reported Disabilities	The percentage of individuals that reported disabilities. Refers to difficulties a person may have doing certain activities as a result of physical, cognitive, mental, or other health-related conditions or problems. including those who may have a long-term physical, cognitive, mental or other health condition. This information is used as a first step in identifying people who are likely to have a disability but cannot be used on its own as an estimate of the population with a disability.	Total – Activities of daily living (25% - sample data)
Gender Women +	Gender refers to an individual's personal and social identity as a woman or non-binary person (a person who is not exclusively a man or a woman). Given that the non-binary population is small, data aggregation to a two-category gender variable is sometimes necessary to protect the confidentiality of responses provided. In these cases, individuals in the category “non-binary persons” are distributed into the other two gender categories and are denoted by the “+” symbol.	Gender Women+ (25% - sample data)

Hotspot mapping

For hotspot mapping, we plotted the Restricted Greenspace Index against the Underserved Community Index to generate bivariate maps. These maps highlight areas where restricted greenspace access intersects with high levels of social vulnerability. In this study, hotspots are defined as areas with high scores for both Restricted Greenspace and Underserved Community indices. For the maps we used the NAD 1983 BC Environment Albers projection (Code 3005. Scope: Province-wide spatial data management, Area: Canada - British Columbia, Projection method name: Albers Equal Area). Map visualization was performed using ArcGIS Pro [12]

Hotspot mapping highlighted DAs in the Capital Regional, Comox Valley, and Nanaimo that exhibit both a higher Restricted Greenspace Index and a higher Underserved Communities Index. These areas might be considered priorities for increasing protected greenspaces to improve access for underserved communities.

RESULTS

Hotspot mapping highlighted DAs in the Capital Regional, Comox Valley, and Nanaimo that exhibit both a higher Restricted Greenspace Index and a higher Underserved Communities Index. These areas might be considered priorities for increasing protected greenspaces to improve access for underserved communities (See attached Maps and Appendix).

REFERENCES

1.Chang J, Qu Z, Xu R, Pan K, Xu B, Min Y, Ren Y, Yang G, Ge Y. 2017 Assessing the ecosystem services provided by urban green spaces along urban center-edge gradients. Sci Rep 7, 11226. (doi:10.1038/s41598-017-11559-5)

2.Gunawardena KR, Wells MJ, Kershaw T. 2017 Utilizing green and bluespace to mitigate urban heat island intensity. Science of The Total Environment 584–585, 1040–1055. (doi:10.1016/j.scitotenv.2017.01.158)

3. World Health organization. 2016 Urban green spaces and health. A review of evidence.

4.Schwarz K et al. 2015 Trees Grow on Money: Urban Tree Canopy Cover and Environmental Justice. PLoS ONE 10, e0122051. (doi:10.1371/journal.pone.0122051)

5.Nesbitt L, Meitner MJ, Girling C, Sheppard SRJ, Lu Y. 2019 Who has access to urban vegetation? A spatial analysis of distributional green equity in 10 US cities. Landscape and Urban Planning 181, 51–79. (doi:10.1016/j.landurbplan.2018.08.007)

6.Landry SM, Chakraborty J. 2009 Street Trees and Equity: Evaluating the Spatial Distribution of an Urban Amenity. Environ Plan A 41, 2651–2670. (doi:10.1068/a41236)

7. Watkins SL, Gerrish E. 2018 The relationship between urban forests and race: A meta-analysis. Journal of Environmental Management 209, 152–168. (doi:10.1016/j.jenvman.2017.12.021)

8. Rigolon A. 2016 A complex landscape of inequity in access to urban parks: A literature review. Landscape and Urban Planning 153, 160–169.

9.WHO. 2010. Urban HEART: Urban Health Equity Assessment and Response Tool. https://apps.who.int/iris/bitstream/handle/10665/79060/9789241500142_eng.pdf?sequence=1&isAllowed=y

10. Rivas C. 2023. Exploratory report: Assessment of Access to Protected Green Spaces in East Vancouver Island. Canadian Wildlife Service and the Pacific Birds Habitat Joint Venture.

11. R Core Team. (2020). R: A language and environment for statistical computing (Version 4.0.2) [Software]. R Foundation for Statistical Computing. https://www.R-project.org/

12.ESRI Inc. (2023). *ArcGIS Pro* (Version 3.2.2) [Software]. Environmental Systems Research Institute. https://www.esri.com/en-us/arcgis/products/arcgis-pro/overview