Environmental Racism in the Tacoma Area, 2018

Pollution and Demographic Factors Compared in Context of Block Groups, Parks, and Schools

Analysis and Layout by Liam Fisher

Purpose

This analysis was motivated by humanitarian intentions, in order to pursue equal environmental protections and wellbeing for all people regardless of their demography. A central part of the perspective which motivated this project is the expectation that people generally will not choose exposure to pollution where alternatives exist. Based on this, whichever groups are disproportionately exposed to pollution will face such exposure primarily as a result of imposed environmental racism—whether due to a lack of societal capital or financial capital, they have been deprived of the ability to protect their environments from pollution, or choose unpolluted environments. As such, external support is necessary to help any such groups escape from their unreasonable living conditions.

Objectives

The intended form of support is the generation of data useful to planners and advocacy groups pursuing the creation of fairer conditions and the redress of existing environmental racism in Pierce County, Washington. To that end, four core questions were set, with the goal of identifying environmental racism as it is experienced at home and in locations where children congregate. The first question was “For the areas in Pierce County which are exposed to substantial pollution, what is the typical socioeconomic status of the local population? “, the second was “For the areas in Pierce County which are exposed to substantial pollution, what is the ethnic makeup of the local population? “, the third was “Regarding schools and parks in areas which are exposed to substantial pollution, what is the typical socioeconomic status of the population expected to make use of the facilities?”, and the fourth was “Regarding schools and parks in areas which are exposed to substantial pollution, what is the ethnic makeup of the population expected to make use of the facilities?”. Furthermore, it was hypothesized that low socioeconomic status would be correlated with more pollution.

Methods

The analysis detailed here proceeded in four significant stages.

In stage 1, the majority of operations were join operations and field calculations on census data. The primary function of the step was to prepare all collected data for later usage—park entrances were digitized and converted to multipoints, socioeconomic and racial tabular data were combined based on common block groups, and travel times were added based on walking and driving travel modes. X/Y formatted EPA toxic release data were also converted into points at this stage, and their relative threat was coded based on simple qualitative data provided by the EPA.

Stage 2 involved the preparation of the block group level indices which the project was subsequently based on. A pollution index was generated by using kernel density analysis to generate a pollution raster from the toxic release points, using zonal statistics and an attribute join to assign each block group a mean point source pollution index value, while an automotive pollution index value was calculated based on the total length of arterial roads within each block group. An overall pollution index was then classified based on the sum of these values. Each block group was likewise assigned a socioeconomic status index value based on average education levels, average income, and the industries of employment for its residents. Finally, the racial proportions of each block group were assessed.

Stage 3 centered around the transferal of pollution and demographic information to K-12 schools and parks and their indexing. All demographic data were exported from the block groups as rasters, while schools in general as well as elementary and middle schools in particular inherited pollution values from the locations of their centroids, and parks received the average pollution value of the locations of their entrances. Service area analyses (driving for schools, walking for parks) were then performed for parks and K-12 public schools to allow zonal statistics to assign the schools demographic values based on the demographic rasters, while the official catchment areas were used for the elementary and middle schools in place of service areas.

Stage 4 consisted of generating additional visuals and correlation coefficients from the completed indices and racial data. To generate correlation coefficients, the data tables of all enumeration units were exported into Microsoft Excel and processed with the correlation coefficient function. Special visuals, meanwhile, were generated using the Optimized Outlier Analysis tool in ArcMap for each individual variable produced.

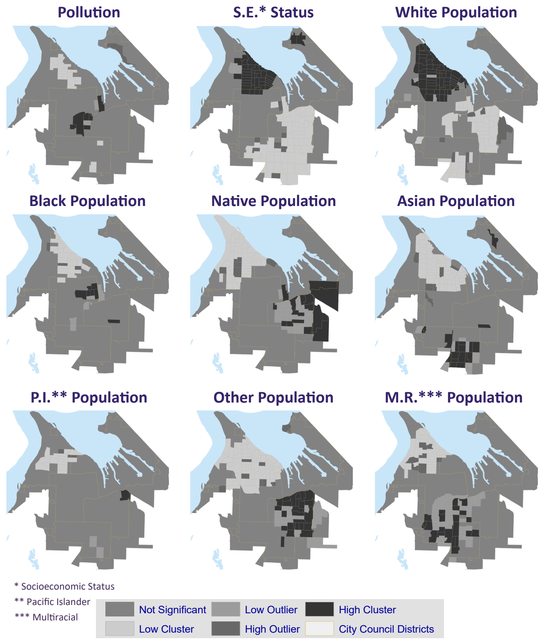
Results

An early conclusion drawn was that it is not possible or desirable to analyze the entirety of Pierce County—almost all toxic-release sites were in or around Tacoma, and speed limit data from outside the area were unusable. As such, only block groups in or adjacent to Tacoma were analyzed.

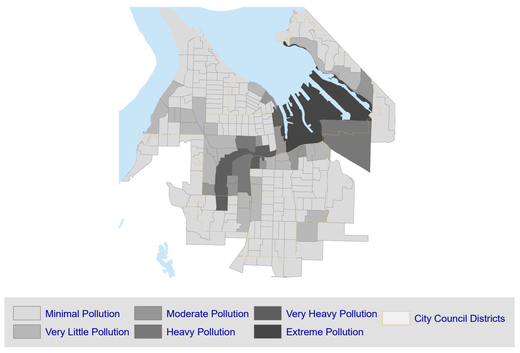
Keeping that in mind, a number of trends are visible. In all cases save for block groups of residence, an enumeration unit’s black population percentage is the strongest indicator of exposure to pollution. Regarding block groups, Native Americans, being mostly concentrated around the highly polluted port area, experience the worst pollution in their block groups of residence. Barring socioeconomic status (SES) in general K-12 public schools, socioeconomic status and white population proportions are negatively correlated to pollution, as are unidentified monoracial populations (‘other’) and mixed race populations in most cases. This broadly aligns with the visuals showing that the area of lowest pollution overlaps with the areas of highest SES and white populations, while other groups are most heavily concentrated in areas near either the high relative pollution cluster or isolated zones of elevated absolute pollution.

It is worth noting that all generated correlation coefficients, save for that between black populations and middle school pollution, are very weak, even if one does not expect the absolute 1:1 positive or negative relationship of a 1 or –1 correlation coefficient. This is most likely because most of Tacoma is not meaningfully polluted by ongoing toxic releases, and thus most people are exposed to near zero pollution, race and status notwithstanding, which would dilute the statistics regarding who is or is not exposed more often.

Statistical Cluster Comparison



Indexed Pollution in the Tacoma Area



Correlation With Pollution (By Spatial Unit)

Statistic	Block Group	School SA	Park SA	E.S. Catchment	M.S. Catchment
SES Index Score	*-0.101*	0.028	-0.084	-0.027	-0.227
White Population	-0.093	-0.011	*-0.097*	-0.041	*-0.290*
Black Population	0.063	**0.184**	**0.196**	**0.226**	**0.530**
Native Population	**0.185**	-0.075	-0.034	0.031	-0.069
Asian Population	0.110	0.097	0.154	-0.027	0.238
Pacific Islander Population	0.019	-0.032	0.063	-0.091	-0.225
Other Population	-0.034	*-0.166*	-0.090	-0.010	0.058
Multiracial Population	-0.020	-0.030	-0.043	*-0.077*	0.295

Citations

This project could not have been completed to the standard it has without Dr. Kelley’s provision of school catchment zone polygons and the suggestion of using cluster analysis (Optimized Outlier Analysis in ArcMap) to generate visuals for this poster. Without his guidance, the results would neither be as rich nor as clear; the most extreme correlation coefficients would be absent, and there would have been no visuals due to the non-spatial nature of correlation coefficients.

Key Literature:

Ichiki, A., Ido, F., & Minami, T. (2008). Runoff characteristics of highway pollutants based on a long-term survey through a year. Water Science and Technology, 57(11), 1769-1776. https://doi.org/10.2166/wst.2008.268.

This piece was necessary for the calculation of appropriate pollution weights for arterial roadways. Without it, it would not have been possible to include non-point source pollution factors in this analysis, resulting in less authentic pollution indices.

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Cartographic Details
Projection: Lambert Conformal Conic
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Prepared For: TGIS 415
Instructor: Dr. Matthew Kelley
Institution: University of Washington, Tacoma

Contact Liam Fisher
Email: fishel2@uw.edu
Home Phone: 253-853-5053
Cell Phone: 253-650-0647

UNIVERSITY of WASHINGTON