

Race and Superfund Sites in North and South Carolina: A Geospatial Analysis of Environmental Injustice

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ABSTRACT

The current definition of Environmental Injustice identifies that minority individuals are often faced with disproportionate environmental risk burdens. This concept can be seen in North and South Carolina with Environmental Protection Agency (EPA) Superfund site locations. By geospatial mapping of Black and African American populations in North and South Carolina and their proximities to EPA-designated Superfund sites, it is revealed that a higher population of these individuals surrounds many Superfund sites. This concept was mapped on ArcGIS Pro by creating a bivariate map using census data of the Black/African American populations and comparing it with the EPA geodatabase information regarding Superfund sites. The results reveal a high concentration of the Black/African American population surrounding the EPA-designated Superfund sites throughout both states. This research highlights the vulnerable population faced with severe environmental injustice and can help inform future risk assessments and public policy from an equity perspective.

INTRODUCTION & STUDY AREA

An EPA-designated Superfund Site is contaminated land caused by hazardous waste being dumped, left out in the open, or improperly managed. In 1980, Congress established the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This act allows the EPA to clean up these contaminated sites and also forces responsible parties to clean up the contamination or to reimburse the government for the cleanup process (EPA 2023).

The EJ movement began in Warren County, NC, where minority populations were disproportionately exposed to toxic waste from a landfill containing Polychlorinated biphenyl (PCB). Today, areas of North and South Carolina continue to suffer from environmental injustice from exposure to toxic releases. Due to this historical and continual threat, these two Southeastern states were chosen as the case study area for this investigation.



Jerome Friar Collection, UNC Chapel Hill (1982)

METHODS: MAPPING THIS CONCEPT

The analysis was executed using ArcGIS Pro, ArcGIS Online, and SPSS using two primary data sources. The EPA's (2024) geodatabase of Superfund sites was uploaded to ArcGIS Pro and clipped to North and South Carolina. Census tract data from ArcGIS Hub (2023) USA 2020 Census Race and Ethnic Characteristics – Place Geographies was also clipped to the study area. This data showed information on all levels, such as nation, state, county, etc., including the number of Black/African American (AA) persons per census tract.

Using this data, the census tracts within five (5) and ten (10) miles of a Superfund site were identified using the *Spatial Selection* tool. If any part of the census tract were within this radius, the entirety of the tract would be counted as within the radius as well. Tracts were then ranked and coded as low, medium, or high risk based on these proximities. This new attribute allows the map to be converted into a comparative visualization easily using ArcGIS Online. By changing the style of the map to "relationship," it was converted into a bivariate map, comparing two properties (Black/AA & Proximity to Superfund sites).

Finally, a difference of means test (Independent Samples *t* Test) was run on the number of Black/AA persons in census tracts that are 10 or fewer miles from a Superfund site and more than 10 miles from a site. Results were tested for significance using a p-value of 0.05 using SPSS. The test identifies if tracts within 10 miles of a Superfund site have a significantly higher average number of Black/AA individuals.

RESULTS

Distance from Superfund Site	Risk Ranking	Number of Tracts (n = 4,037)
5 or Fewer Miles	High (Code = 2)	1,012
10 or Fewer Miles	Medium (Code = 1)	1,782 (770 between 5 & 10)
More than 10 Miles	Low (Code = 0)	2, 255

The final bivariate map reveals concentrations of the two variables, on which blue represents the Black/AA population and orange represents the proximity to a Superfund site. The darkest shade of blue represents higher levels of Black/AA populations, and the darkest shade of orange represents communities within 5 miles of a Superfund site. Higher Black/AA populations surround many Superfund sites, which are shown in the darkest shade (mix of orange and blue).

The average number of Black/AA persons per tract was 841. Tracts within 10 or fewer miles of a Superfund site average 873 Black/AA persons, while tracts more than 10 miles from a Superfund site averaged 816 Black/AA. The difference of means test found a significantly* ($p=0.029$) higher average number of Black/AA persons in tracts within 10 or fewer miles of a Superfund site.

Distance from Superfund Site	Number of Tracts	Average Number of Black/AA Persons
10 or Fewer Miles	1,782	873*
More than 10 Miles	2,255	816

CONCLUSION

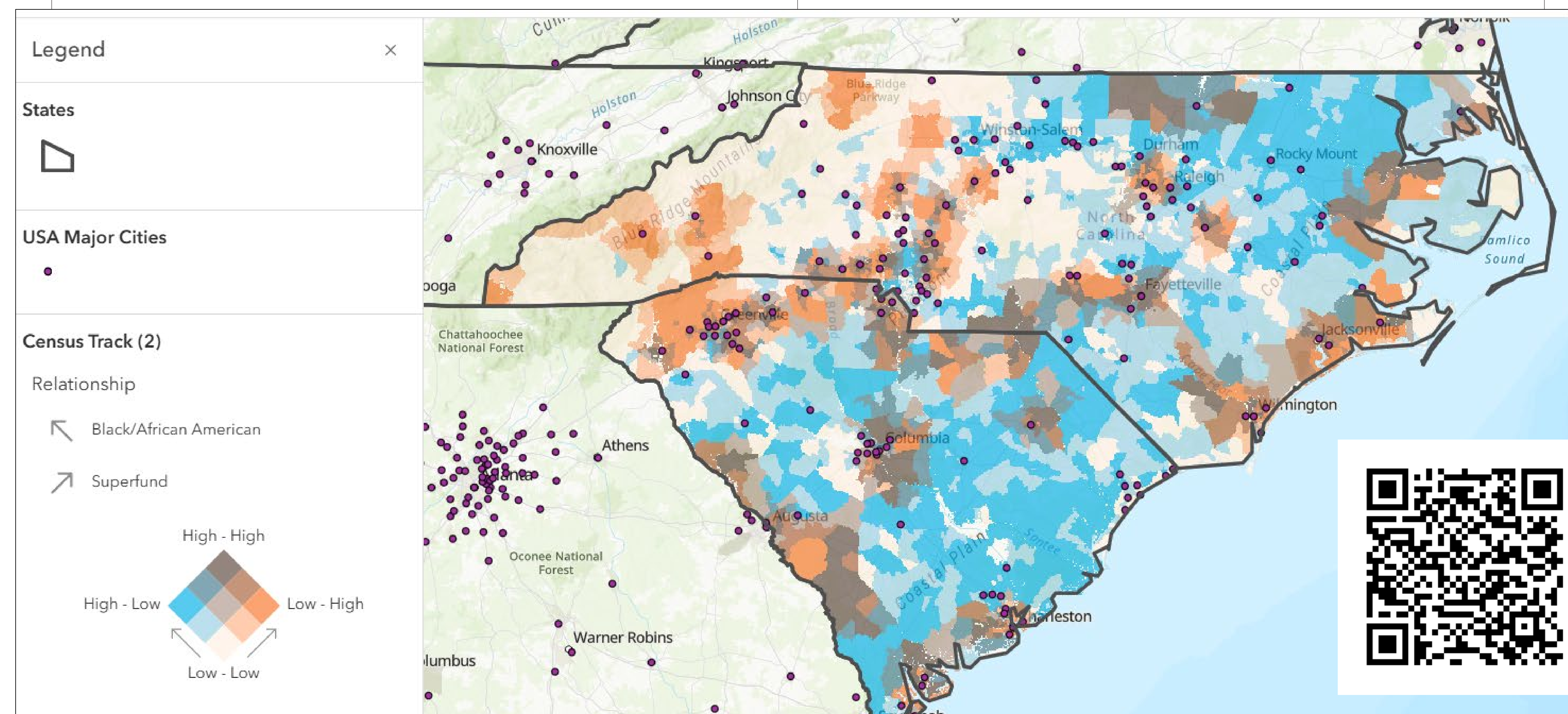
Throughout North and South Carolina, there is a significant relationship between Superfund Sites and minority populations. This data shows that the minority population in these areas faces significant risks to their general well-being. Black/AA populations in census tracts 10 or fewer miles from an EPA-designated Superfund site have a significantly higher average population than those in areas greater than 10 miles from these sites.

Understanding these vulnerable populations and locations is vital for emergency management. These minority populations face higher risks than those who live further away. For example, exposure to hazardous substances released from these sites can cause infant mortality, reproductive issues, cancer, etc.

Vulnerable populations, such as the areas highlighted in this study, will require additional consideration in future risk assessments and public policy development. In case of an emergency, vulnerable groups would require extra assistance. Moving forward, these results can inform targeted policy and practical strategies for achieving equity relating to toxic exposures in the U.S.



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Please use the QR code to explore the StoryMap!