

Going the Distance

A Regional Analysis of Food Accessibility in the Detroit Tri-County Area

Elias Schewel and Eric Seymour

INTRODUCTION

Recent studies on the relationship between health and the built environment have focused on the existence and extent of food deserts, which are generally defined as lower-income areas characterized by a dearth of affordable and healthy food options.¹ This project uses GIS to compare neighborhood accessibility to food destinations by travel mode in metropolitan Detroit, specifically the tri-county area consisting of Macomb, Oakland, and Wayne Counties. This analysis confirms, but also complicates, the commonly held perception of Detroit as a food desert. The results of this project contribute to a clearer understanding of the relationship between geography and opportunity in the Detroit area, which is critical given the city's current efforts to reconfigure residential patterns to mitigate inefficiencies in service delivery.

PROBLEM STATEMENT

Far from being homogeneously distributed across metropolitan space, recent studies have shown that the location of such critical resources as food retailers constitutes a highly uneven "geography of opportunity," the contours of which place low-income and minority households living in the central city at a particular disadvantage.² In the absence of accessible, affordable, and healthy food options, inhabitants of food deserts are left with little choice but to consume unhealthy food items from "fringe food" venues such as fast-food restaurants and convenience stores.³ In turn, poor dietary habits can contribute to diabetes, heart disease, obesity and other adverse health conditions. This is a major concern in the United States, as 4 of the country's 10 leading causes of death are diseases for which diet is a risk factor.⁴ Residence in a food desert poses not only dietary, but also financial problems. For example,

health complications stemming from dietary habits can lead to increased medical expenses. Additionally, central-city food retailers charge more, on average, than their suburban counterparts, placing a larger financial burden on consumers.⁵ Further, those using public transportation to access distant food destinations often face time-consuming and inconvenient trips.

Low-income and minority residents, who are the least able to overcome the difficulties posed by residence in a food desert and the most adversely impacted by them, are also disproportionately likely to have insufficient access to healthy food options. Research has shown that the type of food destination available to neighborhood residents varies according to income and race.⁶ Supermarkets, which offer affordable and healthy food options, have been found to be more accessible in higher-income areas. On the other hand, convenience stores, which offer more expensive and less-nutritious options, are found to be more accessible in lower-income neighborhoods. In addition, low-income neighborhoods have been found to be less likely to have fruit and vegetable stands, bakeries, and natural food stores, but more likely to have liquor stores than more affluent neighborhoods.⁷ Reflecting the relationship between neighborhood racial characteristics and access to healthy food destinations, a study of supermarket accessibility in metropolitan Detroit found that predominantly black neighborhoods with high levels of poverty were, on average, 1.1 miles farther from supermarkets than were low-income white neighborhoods.⁸

In light of this pressing problem, this project investigates the contours of the food environment in the Detroit tri-county area along several dimensions. Specifically, this project identifies differences in the accessibility and type of food

1 Short et al., 2007; Warm et al., 2003
2 Briggs 2005; Galster and Killen 1995
3 Cheadle et al. 1991; Marie Gallagher Consulting Group 2008
4 Centers for Disease Control and Prevention 2009

5 MacDonald and Nelson 1991
6 Helling and Sawicki 2010; Moore and Roux 2006.
7 Moore and Roux 2006
8 Zenk et al. 2005

Table 1. Food destination classification, Detroit tri-county area

Food Destination	SIC Codes	Definition	Example
Supermarket	541101: 01, 04 - 06 (All SICs)	Grocery stores and food markets with more than 50 employees	Kroger
Grocery	5411: 01, 04 - 06 (Primary SIC)	All other grocers and food markets	Aldi
Convenience	5411: 03 (Primary SIC)	Convenience stores	7-Eleven
Meat and Fish	5421: 01, 04 - 19 (Primary SIC)	Seafood, butchers, poultry	Eastern Market Seafood Company
Fruit and Vegetable	5431: 01 - 05 (Primary SIC)	Farmer's markets, vegetable markets	Kim's Produce
Specialty	5499: 10, 12, 14, 16 - 23, 26, 27, 28, 30, 37 (Primary SIC)	Ethnic food stores, kosher food stores, health food stores, and other specialty stores	E&L Supermercado

Note: SIC = Standard Industrial Classification

destinations available to neighborhoods based on location and whether or not they are predominantly black, low-income, and transit-dependent. Further, it examines these differences across travel mode. The results of this analysis could inform current plans for altering Detroit's urban form to better accommodate its remaining residents.

METHOD

The study area for this project is the Detroit tri-county area. The unit of analysis for this project is the Census Block Group (CBG); those with no reported population in the 2000 Census are excluded from our analysis.⁹ CBGs are frequently used as a proxy for neighborhoods in similar analyses and they allow for a finer-grained analysis than Census Tracts do.¹⁰ Demographic data for this project was obtained from the 2000 Census (SF1 and SF3), shapefiles for census geographies were retrieved from ESRI's portal for Census TIGER/Line shapefiles, and the road shapefile and network dataset used for the network analysis were derived from ESRI's Streetmap Premium. Information on food destinations was retrieved from Reference USA, a commercial database of individual businesses. Care was taken to remove duplicate and errant entries. This data includes Standard Industrial Classification codes (SICs) and number of employees for each establishment; these variables were used for classifying food destinations in our analysis. Table 1 presents the food destinations we selected for this project, their corresponding SIC codes

and employee counts, as well as an example of each type. Records for businesses included their latitude and longitude coordinates, which were used for geocoding. Finally, the road shapefile and network dataset used for the network analysis were derived from ESRI's Streetmap Premium.

To determine differential levels of accessibility to food destinations based on travel mode, we used the Network Analyst extension in ArcMap to produce five-minute service areas for walking, biking, and driving from the center of each CBG. Although five minutes is a short interval, it is a conventional benchmark used in accessibility studies. In preparing the different network datasets used for each mode, we established a time-based cost attribute for each dataset using speed limits for motorists, a constant speed of 10 miles per hour for cyclists, and a constant speed of three miles per hour for pedestrians. Highways and limited-access roadways were excluded from the network for biking and walking analyses. We then determined the number of food destinations located within the service area for each CBG for each mode of transportation. In order to provide a different measure of accessibility to compare against our primary method, we also calculated the average distance from the center of each CBG to the nearest food destination by store type.

Limitations of this study include the fact that the data on the number and type of food destinations is neither entirely current nor reliably categorized. Businesses classified as convenience stores are often liquor or party stores, which

9 This project was completed prior to the availability of 2010 Census data.

10 Raja et al. 2008

are disamenities and not likely to be viable food destinations from a public health perspective. We also assumed that all pedestrians and cyclists move at the same speed, which is certainly not the case. Furthermore, the results are based on the assumption of a five-minute travel time for each mode – a relatively short travel span that will overstate accessibility in denser, street-grid locations such as the inner city compared to suburban locations.

FINDINGS AND DISCUSSION

Table 2 presents the number of food destinations in the entire tri-county area and in Detroit alone, both as a raw count and as number per 10,000 residents. Grocery stores are far and away the most numerous type of food destination (representing 37% of the tri-county food stores), followed by convenience stores (23%) and bakeries (16%). This is hardly surprising given that they are generally much smaller than supermarkets, the vast majority of which are more than 40,000 square feet, as compared to 2,500 to 10,000 for grocery stores. Table 2 also shows that the percentages for type of food destination are similar for both Detroit and the tri-county area, with the exception of supermarkets and grocery stores. Although supermarkets constitute

8% of the entire inventory of food destinations in the tri-county area, they constitute only 2% in Detroit. This pattern is even more pronounced when examined on a per capita basis: the tri-county area has 0.38 supermarkets per 10,000 residents, while Detroit has only 0.08. However, Detroit has more grocery stores and meat and fish destinations than the tri-county region as both a share of the total number of destinations and per capita.

Figure 1 and Table 3 illustrate the auto-dependent character of the food environment in the tri-county area. Table 3 shows that, on average, there is not a single food destination available within a five-minute walk of any neighborhood. When the range of accessibility is broadened by assuming travel by bike, only grocery stores may be reached within a five-minute travel time. Not surprisingly, numerous food destinations are accessible within five minutes by automobile. In fact, this is the only mode by which it is typically possible to reach a supermarket within five minutes. These accessibility levels, however, differ between the tri-county area as a whole and Detroit alone.

Table 4 shows that Detroit neighborhoods have higher

Table 2. Available food destinations, Detroit tri-county area, 2000

Food Destination	Tri-County Count	% of Total	Number per 10,000: Tri-County	Detroit Count	% of Detroit	Number per 10,000: Detroit
Grocery	695	37	1.72	236	50	2.48
Convenience	436	23	1.08	100	21	1.05
Bakery	307	16	0.76	57	12	0.60
Meat and Fish	167	9	0.41	52	11	0.55
Supermarket	153	8	0.38	8	2	0.08
Fruit and Vegetable	84	4	0.21	14	3	0.15
Specialty	51	3	0.13	9	2	0.09
Total	1,893	100	4.68	476	100	5.01

average accessibility to some food destinations than those in the region taken as a whole, though supermarkets are, on average, inaccessible without a car. Access to grocery stores within a five-minute travel time by bike from neighborhoods in Detroit is, on average, 1.89 times greater than the average for the entire study area. However, neighborhoods in Detroit have, on average, only 0.78 times the number of supermarkets accessible to them along the same measure of access. Within a five-minute drive, Detroit neighborhoods have more than twice the regional level of accessibility to meat and fish stores, and 1.39 times the tri-county average accessibility level to fruit and vegetable stores. This table also shows that Detroit neighborhoods, in comparison to the tri-county area as a whole, have better access to meat and fish and fruit and vegetable destinations, illustrating that Detroit is better served not only by convenience and grocery stores, but also by smaller fresh-food retailers.

Our examination of access to food destinations for disadvantaged and vulnerable communities presents a picture that, while certainly less than satisfactory, is somewhat more variegated than commonly believed. For instance, Table 5 shows that, on average, transit-dependent neighborhoods, defined as CBGs in which the share of households without access to private vehicles exceeds 50%, have very poor access to all types of food destinations. The average number of supermarkets available by private vehicle, the mode for which access is greatest, is only 0.38 within a five-minute travel time, which is only 0.23 times the regional average. This general finding is true for each of the three travel modes. However, these results also show that grocery stores are located within a five-minute bike ride of transit-dependent neighborhoods. With the exception of supermarkets, transit-dependent neighborhoods have better than average access to food destinations within a five-minute travel time for both biking and driving. Unfortunately,

Figure 1:

AVAILABLE FOOD DESTINATIONS WITHIN FIVE-MINUTE TRAVEL TIME OF A NEIGHBORHOOD
by Block Group, Detroit Tri-County Area, 2011

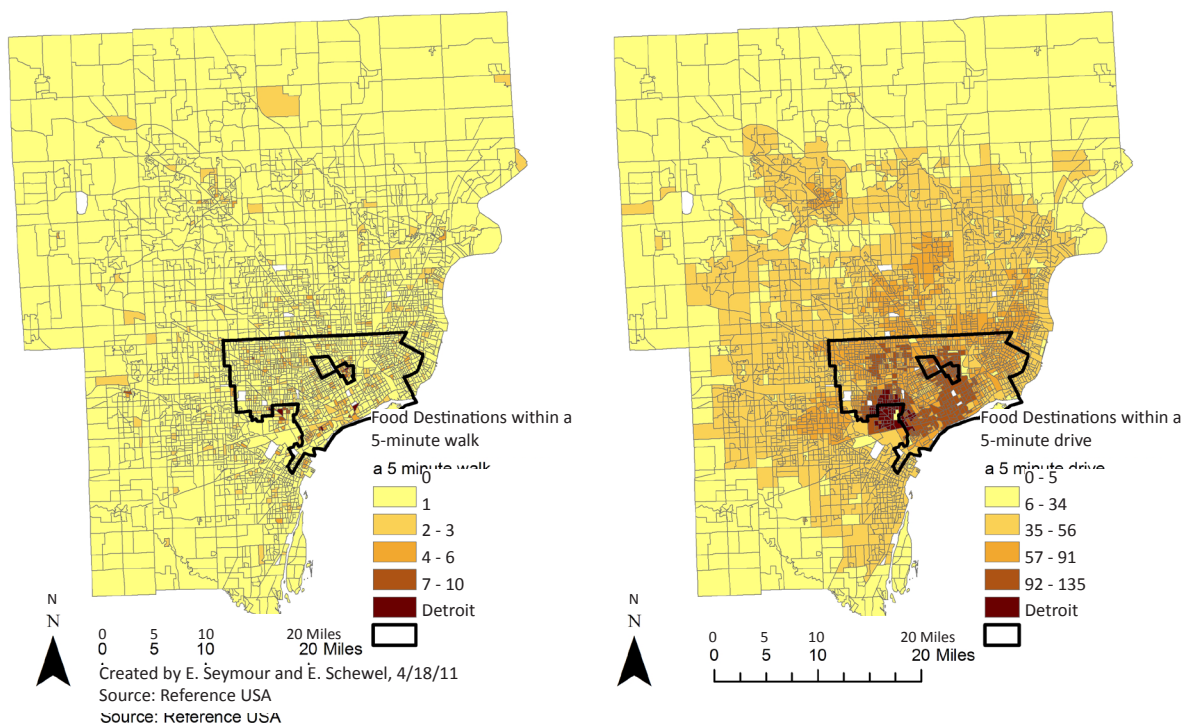


Table 3. Average number of food destinations accessible within a five-minute travel time, Detroit tri-county area

Type of food Destination	Average Number of Food Destinations Within...		
	a five-minute walk from the centroid of a CBG	a five-minute bike from the centroid of a CBG	a five-minute drive from the centroid of a CBG
Supermarket	0.004	0.12	1.64
Grocery	0.082	1.30	12.28
Convenience	0.034	0.66	6.78
Meat and Fish	0.017	0.30	3.18
Fruit and Veg	0.006	0.11	1.17
Specialty	0.003	0.06	0.58

Table 4. Average number of food destinations accessible within a five-minute travel time to neighborhoods in Detroit by travel mode

Type of food Destination	Walking		Biking		Driving	
	Average	Index	Average	Index	Average	Index
Supermarket	0.000	0.00	0.04	0.29	0.38	0.23
Grocery	0.179	2.18	2.39	1.84	26.21	2.14
Convenience	0.107	3.12	1.20	1.80	11.29	1.66
Meat and Fish	0.000	0.00	0.77	2.55	7.02	2.21
Fruit and Vegetable	0.018	2.78	0.27	2.39	2.48	2.13
Specialty	0.018	5.82	0.20	3.45	1.70	2.92

Note: Index value is the quotient of the average number of food destinations in Detroit and the entire study area. Transit-dependent neighborhoods are defined as those in which more than 50 percent of households are without access to private vehicles.

residents of transit-dependent neighborhoods would be expected to have significant difficulties in taking advantage of these better-than-average levels of driving accessibility to food destinations.

Table 6 depicts similar results from the analysis of accessibility levels for high-poverty neighborhoods (those in which more than 40% of households are in poverty). Alarming, these results show that high-poverty neighborhoods have only 0.18 times the tri-county area average number of supermarkets available to them within a five-minute bike ride and less than half the area average number of supermarkets available by driving (still less than one store). Table 7 shows that predominantly black neighborhoods (those in which more than 60% of households described themselves as black alone on the 2000 census) face accessibility levels similar to those in high-poverty and transit-dependent neighborhoods. The similarities between these groups are hardly surprising given that they are all highly correlated.

Our measure of the average distance to the nearest food destination produces a somewhat crude, but certainly

useful measure of proximity to the nearest food destination from each neighborhood of interest. Given that many food destinations were entirely inaccessible within a five-minute travel time for walking and biking, we wanted to find out just how far away the nearest food destination was actually located. Table 8 shows that, on average, the nearest supermarket is nearly two miles away from any given Detroit neighborhood, and nearly three miles from transit-dependent neighborhoods. This is a considerable distance to overcome for transit-dependent individuals, particularly considering the poor coverage and performance of the Detroit transit system. The average distance to the nearest food destination, regardless of type, falls beyond the 0.25-mile threshold commonly used to indicate a convenient walking distance. However, grocery stores, on average, are located within the 0.5 mile threshold for a convenient biking distance.

In order to focus on areas where we perceived food deserts to be located, we isolated CBGs exceeding our transit-dependency and poverty thresholds from which no supermarkets or grocery stores may be reached in a five-

Table 5. Average number of food destinations accessible within a five-minute travel time to transit-dependent neighborhoods, Detroit tri-county area

Type of food Destination	Walking		Biking		Driving	
	Average	Index	Average	Index	Average	Index
Supermarket	0.000	0.00	0.04	0.29	0.38	0.23
Grocery	0.179	2.18	2.39	1.84	26.21	2.14
Convenience	0.107	3.12	1.20	1.80	11.29	1.66
Meat and Fish	0.000	0.00	0.77	2.55	7.02	2.21
Fruit and Vegetable	0.018	2.78	0.27	2.39	2.48	2.13
Specialty	0.018	5.82	0.20	3.45	1.70	2.92

Note: Index value is the quotient of the average number of food destinations in Detroit and the entire study area. Transit-dependent neighborhoods are defined as those in which more than 50 percent of households are without access to private vehicles.

Table 6. Average number of food destinations accessible within a five-minute travel time to high-poverty neighborhoods, Detroit tri-county area

Type of food Destination	Walking		Biking		Driving	
	Average	Index	Average	Index	Average	Index
Supermarket	0.004	1.15	0.02	0.18	0.76	0.46
Grocery	0.184	2.25	2.54	1.95	25.09	2.04
Convenience	0.076	2.22	0.96	1.44	10.00	1.47
Meat and Fish	0.022	1.34	0.58	1.93	6.56	2.06
Fruit and Vegetable	0.013	2.10	0.21	1.84	2.17	1.86
Specialty	0.004	1.46	0.10	1.81	1.12	1.92

Note: Index value is the quotient of the average number of food destinations in Detroit and the entire study area. High-poverty neighborhoods are defined as those in which more than 40 percent of households are categorized by the 200 Census as being in poverty.

minute walk. Table 9 shows that nearly 20,000 people were living in food deserts across the tri-county area in 2000. We define food deserts as CBGs that meet the following criteria: the share of transit-dependent persons exceeds 50%, the share of persons in poverty exceeds 40%, and there are no supermarkets or grocery stores available within a five-minute walk. In Detroit alone, the number of persons living in a food desert CBG in 2000 was 13,749. The dataFigure 2 shows that food deserts are predominantly concentrated in Detroit's east side, but that there are also pockets of inaccessibility in other areas, including Pontiac, to the northeast of Detroit.

CONCLUSIONS

This analysis confirms what other research has clearly established: there are significant inequalities in access to affordable and healthy food options in the Detroit metropolitan region. In particular, transit-dependent neighborhoods are severely disadvantaged in their access to food destinations. This has implications for viewing public transportation as an important piece of the food access puzzle in the Detroit region. Expanding transit opportunities between food destinations and transit-dependent neighborhoods should be considered in any plan to address food deserts. However, this study also shows how the overwhelming emphasis placed on accessibility to supermarkets leads to some oversimplified characterizations of the food environment. Numerous smaller grocery stores located in the central city are accessible to many neighborhoods, including those that are disadvantaged. Any future plan for reconfiguring patterns of residence and destinations should be predicated on such a nuanced understanding in order not to disrupt functioning food networks in Detroit based on the belief that none exist.

Table 7. Average number of food destinations accessible within a five-minute travel time to predominantly-black neighborhoods, Detroit tri-county area

Type of food Destination	Walking		Biking		Driving	
	Average	Index	Average	Index	Average	Index
Supermarket	0.002	0.49	0.08	0.63	1.05	0.64
Grocery	0.128	1.56	2.01	1.54	21.62	1.76
Convenience	0.053	1.56	1.03	1.55	10.33	1.52
Meat and Fish	0.022	1.31	0.52	1.72	5.96	1.87
Fruit and Vegetable	0.005	0.74	0.09	0.79	1.35	1.16
Specialty	0.002	0.62	0.04	0.69	0.53	0.92

Note: Index value is the quotient of the average number of food destinations in Detroit and the entire study area. Predominantly-black neighborhoods are defined as those in which more than 60 percent of households identified themselves as Black on the 2000 Census.

Table 8. Average straight-line distance to the nearest food destination (in miles)

Type of food Destination	All	Detroit	Suburbs	Transit-Dependent	High-Poverty	All
Supermarket	1.61	1.91	1.49	2.95	2.37	1.61
Grocery	0.77	0.38	0.93	0.36	0.38	0.77
Convenience	0.88	0.56	1.01	0.53	0.57	0.88
Meat and Fish	1.64	0.91	1.95	0.95	0.91	1.64
Fruit and Vegetable	2.08	1.78	2.21	1.41	1.58	2.08
Specialty	3.13	2.89	3.23	1.88	2.45	3.13

Note: Index value is the quotient of the average number of food destinations in Detroit and the entire study area

Table 9. Comparative statistics for food desert CBGs, Detroit tri-county area, 2000

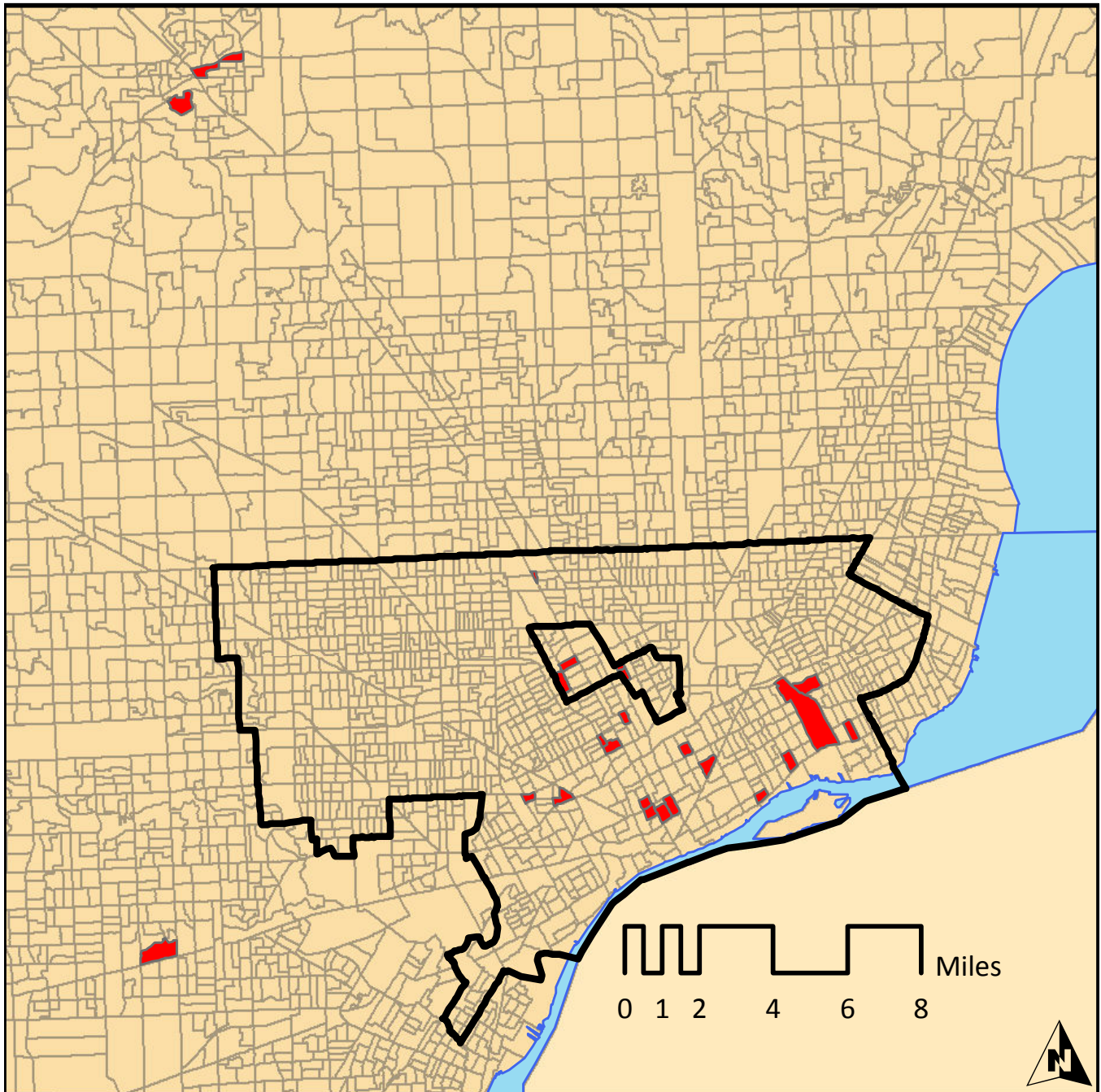
	Tri-County	Detroit	Food Deserts
Population	4,043,467	950,514	19,411
Average median income	\$49,978.54	\$30,803.48	\$11,786.23
Average share poverty	12.74	26.67	55.17
Average share black	30.35	83.24	86.89
Average share transit-dependent	10.83	21.86	60.58
Average nearest supermarket	1.61	1.90	2.98
Average nearest grocery store	0.77	0.38	0.38

Note: Food deserts are defined as CBGs that meet all the following conditions: the share of transit-dependent persons exceeds 50 percent, the share of persons in poverty exceeds 40 percent, and there are no supermarkets or grocery stores available within a five-minute walk.

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Food Deserts



Food deserts are here defined as Census Block Groups where more than 40% of households are in poverty and more than 50% of households do not have access to a private vehicle.




-  Detroit
-  Food deserts
-  Census block groups

Figure 2

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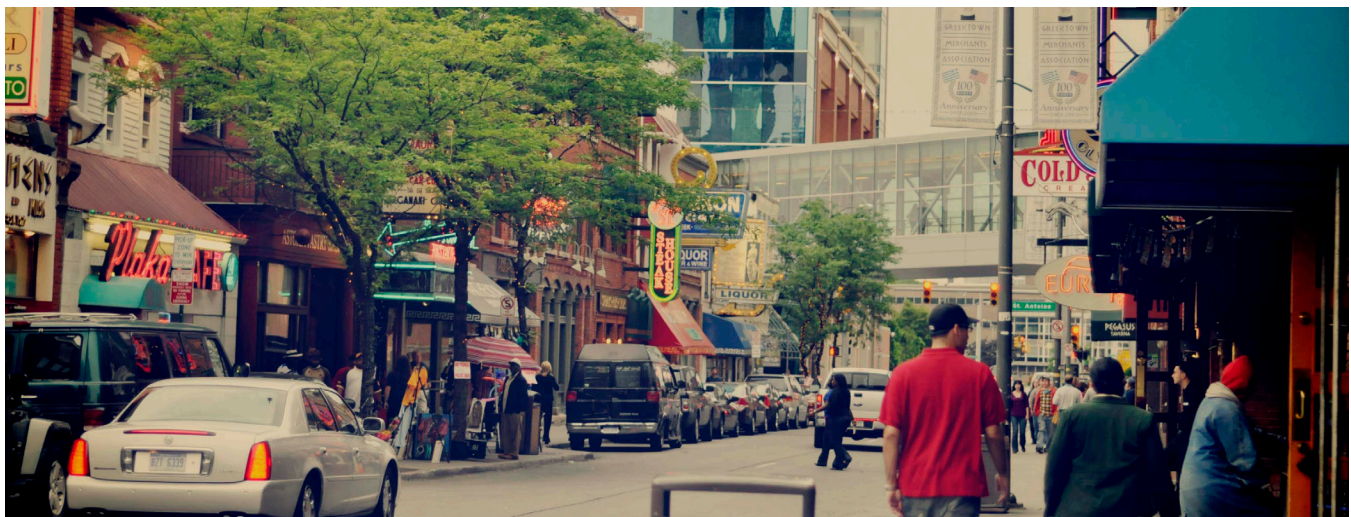
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Greektown, Detroit, MI 2009 (Photo credit: Oleksandra Topolnytska)